IS IT TIME FOR A **59-SECOND MINUTE?** P16

WHY THESE **CRAFT-BEER CANS ARE EXPLODING** P26

A TACTICAL CHAIR THAT'S **BUILT TO SURVIVE TORPEDOES** P48

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POPULAR MECHANICS

CONTENTS

Who doesn't love a piece of furniture that not only looks good, but is also built to last? On **page 48** we tell you about the world's first tactical chair, a near-indestructible item originally made in the 1940s for US Navy vessels, to withstand torpedo blasts. It's now an interior-design icon, found the world over.

04 **From the Editor:** Work that matters.

09 **Readers' letters:** Email us about your DIY projects, your thoughts on articles we've shared, or on anything that interests you; include photos. (You might win a great prize.)

12 **Calendar:** Historic events in May and June.

14 **Time machine:** Fascinating stories from the PM archives.

16 **How your world works:**
• When Earth spins faster, can minutes be shortened? • Black Knight conspiracy: debris or alien satellite? • Laser weapons for old fighter jets. • The risks of human–chatbot resurrections. • There've been more extinction events than we realised. • How to prevent craft beers from exploding.

28 **Book review:** *Power Play* by Tim Higgins.

30 **US Ed's column:** Who should buy an electric car?

32 **Gear and gadgets:** Products, devices, and tools that we love.

40 **Cover story:** How the US's new fighter jet will outclass its competition.

48 **The world's first tactical chair:** It's waterproof, fire-resistant, and able to withstand a torpedo blast.

54 **Innovation:** A biomimetic shape-altering wing that could revolutionise wind-power generation.

60 **This changed everything:** Is this the most important light bulb since Edison's?

63 **What are you building?:** Impressive projects from the *PM* community, and how to replicate them.

74 **Power-tool safety:** A guide to safer angle grinding.

78 **Woodworking:** Learn how to make the classic dovetail joint.

86 **Rust removal:** Two of the best products to revive metal.

90 **How to be good at what you do:** Skateboards meet sustainable craftsmanship.

94 **PM Garage:** Our opinions on three vehicles we've cruised in, swerved, braked and parked.

98 **Do it your way:** Submit your tips and you could win.

COVER: RODRIGO AVELLA (ILLUSTRATION); THIS PAGE: SCOTT SUCHMAN

WORK THAT MATTERS

IF, WHEN I WAS A BOY, someone had told me that I would be a magazine editor when I was grown up, I would've probably given them a strange, confused look. While English was definitely one of my favourite subjects, I never considered a career in media or working on magazines. I was obsessed with sport, and I think all I really wanted to do was play county cricket in England, and then represent South Africa playing for the Proteas.

I also loved animals, so a plan B was to maybe become a vet, or perhaps a game ranger… Which young person in South Africa doesn't dream of one day being a game ranger?

I didn't quite make it to the top level of cricket, I didn't have the heart, stomach, or grades to become a vet, and I quickly realised that being nice to tourists all the time wasn't one of my character strengths, so game ranging was out of the question. My trajectory into the world of magazines was unexpected and a little unintentional, but I soon realised how much I enjoyed the work, and how it suited my personality. And here I am, almost 18 years later, having enjoyed a career that's taken me along many of the back routes of Southern Africa, on several overseas trips, exposed me to the most interesting people, and given me the opportunity to drive hundreds of new cars, and try out countless clever gadgets, devices, power tools and inventions.

Another thing my job as editor of POPULAR MECHANICS has shown me is there are more professions out there than I could ever have imagined. I look at my younger friends today and marvel at the types of work they do – their occupations most definitely never occurred to me when I was younger.

This issue's short feature on 'How to be good at what you do' focuses on the owner of a skateboard-making company. His work resonated with me, because it also entails creating something tangible, that brings joy to others. If my work has taught me anything, it's that I value being a part of something that's worthwhile, that brings enjoyment to others. I realise that's arbitrary, and that 'worthwhile' is subjective, but that doesn't really matter, because that's how I view it. Oh, I also thrive on the meticulous side of my work, ensuring a story reads well, and is highly accurate and grammatically correct.

If you think you do something that's a little different, or you simply want to share the ins and outs of your career with others, please drop me a note at *popularmechanics@ramsaymedia.co.za*. I'd love to hear from you.

Mark

MARK SAMUEL
Editor

PHOTOGRAPHY: MARK SAMUEL

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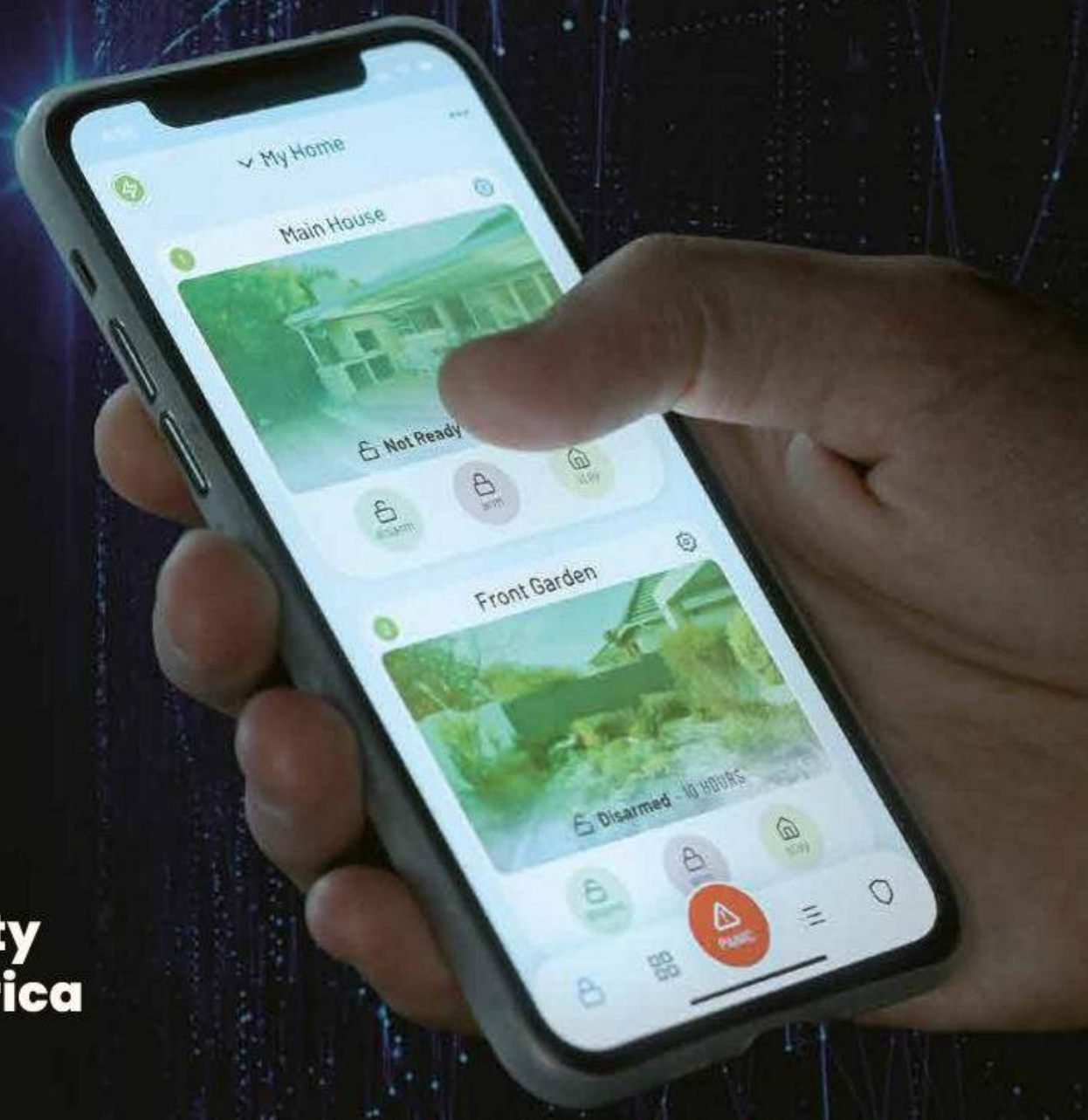

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↓ WHAT'S ON YOUR MIND?

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WINNING LETTER

Stand together

I really enjoy reading Popular Mechanics, particularly the DIY articles.

My daughter is a music teacher, and we jointly make gifts for her students each year. She also runs two extramural music groups – ukulele and marimba. In the recent Eisteddfod, her TVC Ukulele Society achieved an A++ grading as well as Best in Category, so we decided to make them some gifts for their achievement.

We decided on stands for the ukuleles that could be easily dismantled to be stored flat in the ukulele bags. Hinges would've made the folded stands thicker, so we decided to go with a slotted fit-together approach. We looked at various ideas on YouTube and the closest suitable concept was from cardboard. No details were given, so we adapted that to be done in thin plywood.

We made a prototype, to work out the dimensions and angles to ensure the ukulele would be stable on the stand. It turned out to be fine-tuned at a 9° slope and 15° for each matching attachment slot for width.

Three millimetre pine plywood (actually 2.7 mm) was cut into 200 × 250 mm rectangles (using Kreg Rip-Cut and Accu-Cut guides). Two 8 mm holes were then drilled in the corner of each L-shape, made identical by a fence and stop-block clamped to the drill-press base. This meant that the bandsaw blade could be turned and the straight cuts stopped at the holes; these were made at the 9° angle, maintaining 90° between the base rest and the upright. A block was clamped on the bandsaw mitre gauge turned to 9° off 90°, and the very rough shape cut-out as straight cuts, turning the blade at the pre-drilled 8 mm holes.

Then, while there were still plenty of straight and square reference edges available, the matching slots to fit the two parts together were cut with the bandsaw table tilted 15° (again tested using the prototype). The bandsaw rip fence was put in place halfway up the height of the stand, on the lower side of the tilted table. The cuts for the slots were made from the front and back of the respective parts, spaced by the thickness of the plywood, then thinned slightly by sanding, so the fit was snug. This was the point where the two parts of each stand became different, and concentration was crucial.

The length of the slots was cut to just short of halfway across the estimated final width of the uprights, also for final fitting later. The waste in the slot was nibbled out freehand using the bandsaw.

While I don't have photos of the final shaping steps, this is how I went about it. The final shape of the two identical halves of the stand was drawn on to a piece of 9 mm MDF, cut out on the bandsaw close to the line, and then sanded smooth on to the line with a spindle sander. This then served as the master template for all the parts. The template shape was drawn on to each 'L' half (the outer shapes are identical, but matching pairs were kept together as the slots had already been roughly matched), and cut out close to the line using the bandsaw. Spray adhesive (repositionable type) was then used to hold each 'L' on to the template, while they were trimmed to final shape on the router table with a template-following bit.

The parts were all sanded, each slot fitted to width and depth (they were marked as matched pairs by then), and my daughter did the hand-pyrography of the logos (adapted for purpose by my artistic middle daughter) and each member's name. One member is a cajon percussionist, so two of the rectangular plywood cut-outs were used by my daughter to make a mini-shaker cut in the shape of a ukulele body on the bandsaw and smoothed on the spindle sander, again with member name and logos pyrographically applied.

We then applied the finish and used a super-glue with activator to fit the strips of thin 'crazy foam' as feet and padding to the stands for the instruments to rest on. We made ten custom stands and the shaker for the members and three extra stands (one was the prototype) for the classroom. All in all it was quite a production line!

↓ WHAT'S ON YOUR MIND?

To round off the project, my wife made draw-string bags for the stands and shaker, so the stands and ukuleles didn't damage each other inside the ukulele bags. My wife also made masks for the members, which were machine embroidered for the Eisteddfod performance; they have the same logos as the stands. This project was certainly a multidisciplinary team effort!

This design could be adapted and scaled for other instruments.

RUSSELL DIXON-PAVER

What a truly extraordinary project (and set of gifts), Russell. I would love to have seen the looks on the faces of the musicians who received them. Congratulations to you and your family – I hope you enjoy the prize that you've won for your incredible efforts.
– Mark, Editor

EARTH'S EPICENTRE?

While reading the article in the March/April issue, about the mysterious phenomenon of Earth pulsating every 26 seconds, and that it originates in the Bight of Bonny, I remembered that São Tomé and Príncipe nearby is virtually on the equator, and that it's almost exactly at 0° East!

So, just maybe, the pulsating emanates from 0°0'0"N 0°0'0"E, or the 'belly button' of Mother Earth! Anyway, that's my theory – the Bonny Bay Belly Button.

MIKE SIMPSON

Your theory certainly made me smile, Mike. And, who knows… You might just be right!
– 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 Slammer Cordless Drill (*worxtools.co.za, vermontsales.co.za*) valued at R6 085.

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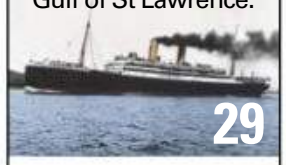
MAY 2022

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
Workers' Day **1**	Public holiday **2**	1952: One of the world's most famous horse races, the Kentucky Derby, is televised for the first time. **3**	**4**	2007: Kenya Airways Flight 507 crashes shortly after take-off in Cameroon, killing all 114 people on board. **5**	**6**	1915: A German submarine sinks the RMS *Lusitania*.  **7**
8 1930: Ellen Church, a trained nurse and pilot, becomes the first female flight attendant. **15**	1860: Novelist and playwright JM Barrie, best known for creating the character Peter Pan, is born in Kirriemuir in Scotland. **9**	**10** 2004: The first legal same-sex marriages in the United States take place, in the state of Massachusetts. **17**	868: A copy of the *Diamond Sutra* is printed, in China.  **11**	**12** 1925: African-American Muslim leader and human-rights activist Malcolm X is born in Omaha, Nebraska, USA. **19**	1989: Aggrieved members of the town of Welkom in the Free State tar and feather the mayor, Mr Gus Gouws. **13**	**14** 1996: 16 year-old Otto III is crowned Holy Roman Emperor.  **21**
22 1914: RMS *Empress of Ireland* sinks in the Gulf of St Lawrence.  **29**	**16** 1981: Built on the old market square and covering more than 72 000 m², the South African State Theatre opens in Pretoria. **23**	**24** 2013: A record-breaking 4 km-wide tornado hits El Reno in Oklahoma, causing eight deaths and more than 150 injuries. **31**	2011: The final episode of the *Oprah Winfrey Show* airs, ending its 25-year run. **25**	**26**	1967: The US aircraft carrier USS *John F Kennedy* is launched by Jacqueline Kennedy and her daughter Caroline. **27**	**28**
	30					

JUNE 2022

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
1975: Closed since the Six-Day War in 1967, Egyptian president Anwar Sadat reopens the Suez Canal. **5**	**6** 2002: The US withdraws from the Anti-Ballistic Missile Treaty.  **13**	1951: Pixley ka Isaka Seme, lawyer, political activist, and co-founder of the ANC, dies aged 69. **7**	1962: Former SS commander and member of the Nazi party Adolf Eichmann is executed after being found guilty of war crimes. **1**	**2** 1973: Also known as Big Red, race horse Secretariat wins the US Triple Crown, one of the most prestigious achievements in racing. **9**	1935: 1 000 Canadians begin the On-to-Ottawa Trek.  **3**	**4** 1770: James Cook's ship *Endeavour* runs aground on the Great Barrier Reef. Repairs delay the voyage by almost seven weeks. **11**
12 1867: The only emperor of Mexico, Maximilian I, is executed by firing squad. **19**	**20** 1976: Air France Flight 139 is hijacked while en route to Paris and is redirected to Entebbe, Uganda. **27**	**14** 2006: Pluto's newly discovered moons are officially named Nix and Hydra. **21**	**8** 1877: Henry Ossian Flipper becomes the first African American to graduate from the US Military Academy at West Point. **15**	Youth Day **16** 2013: Nik Wallenda becomes the first person to high-wire walk across the span of the Grand Canyon. **23**	**10** 1987: The dusky seaside sparrow becomes extinct, with the death of the last remaining individual of the species. **17**	**18** 1997: *Progress* collides with the Russian Space Station Mir.  **25**
26		**28**	**22** 2012: A weather event known as a derecho sweeps across the US, causing multiple deaths and leaving thousands without power. **29**	**30**	**24**	

TEXT: MARK SAMUEL; PHOTOGRAPHY: NASA, PUBLIC DOMAIN

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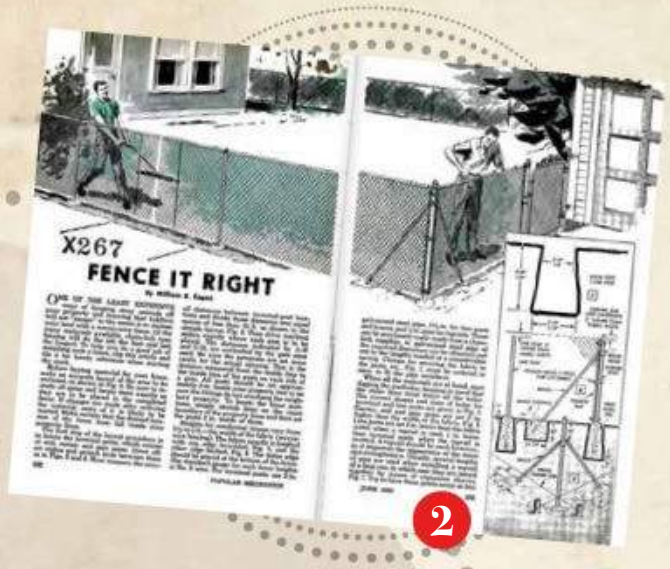

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3

1 MAY 1953

▸ They Call It Spin Fishing

The photo-realistic illustration on the cover of this issue depicted 'the great sport of spin fishing'. The accompanying story explained how this new style of fishing was taking the United States by storm, mentioning that 'within 10 years Americans will be a nation of spin fishermen, bar a few die-hards who refuse to try anything new'. We're not sure if that happened, but the full-colour illustrations of 70 spin-fishing lures, the photos of rod and reel variations and the detailed explanations certainly shed light on this emerging sport.

5

4

2 JUNE 1959

▸ Fence It Right

Ever considered erecting a fence around your property yourself? The idea of the project might sound daunting, but this article, filled with detailed instructions, broke it down into manageable steps. It included clear diagrams and illustrations, some with measurements, as well as recommendations on how to install gates. It even explained how to take up the tension.

3 MAY 1965

▸ Inside Our Fabulous Pivot-Wing Plane

At the time, the F-111 was considered one of the most versatile aircraft ever designed, with its retracting-wing system. It was built to manage jungle take-offs, catapult from the decks of aircraft carriers, hover at minimum speeds, or cruise supersonically through the skies. It could even evade radar- and missile-defence systems.

4 JUNE 1976

▸ Amazing Search For Life On Mars

A tantalising double-page illustration depicted the unmanned *Viking* lander touching down on the surface of Mars, an event that was due to happen the following month, on 4 July. This article described what scientists were hoping to discover on the red planet, including – hopefully – signs of extraterrestrial life.

5 MAY 1980

▸ First Power, Then Glory

Imagine receiving an 86-foot luxury powerboat as a gift… This short feature described the royal yacht that Crown Prince Fahd of Saudi Arabia had built for King Carlos of Spain, as a present. Named *Fortuna*, the craft had 'ample accommodations for family cruising', and two diesel engines, enabling a speed of more than 60 mph (100 km/h). **PM**

TEXT: MARK SAMUEL; PHOTOGRAPHY: POPULAR MECHANICS ARCHIVES

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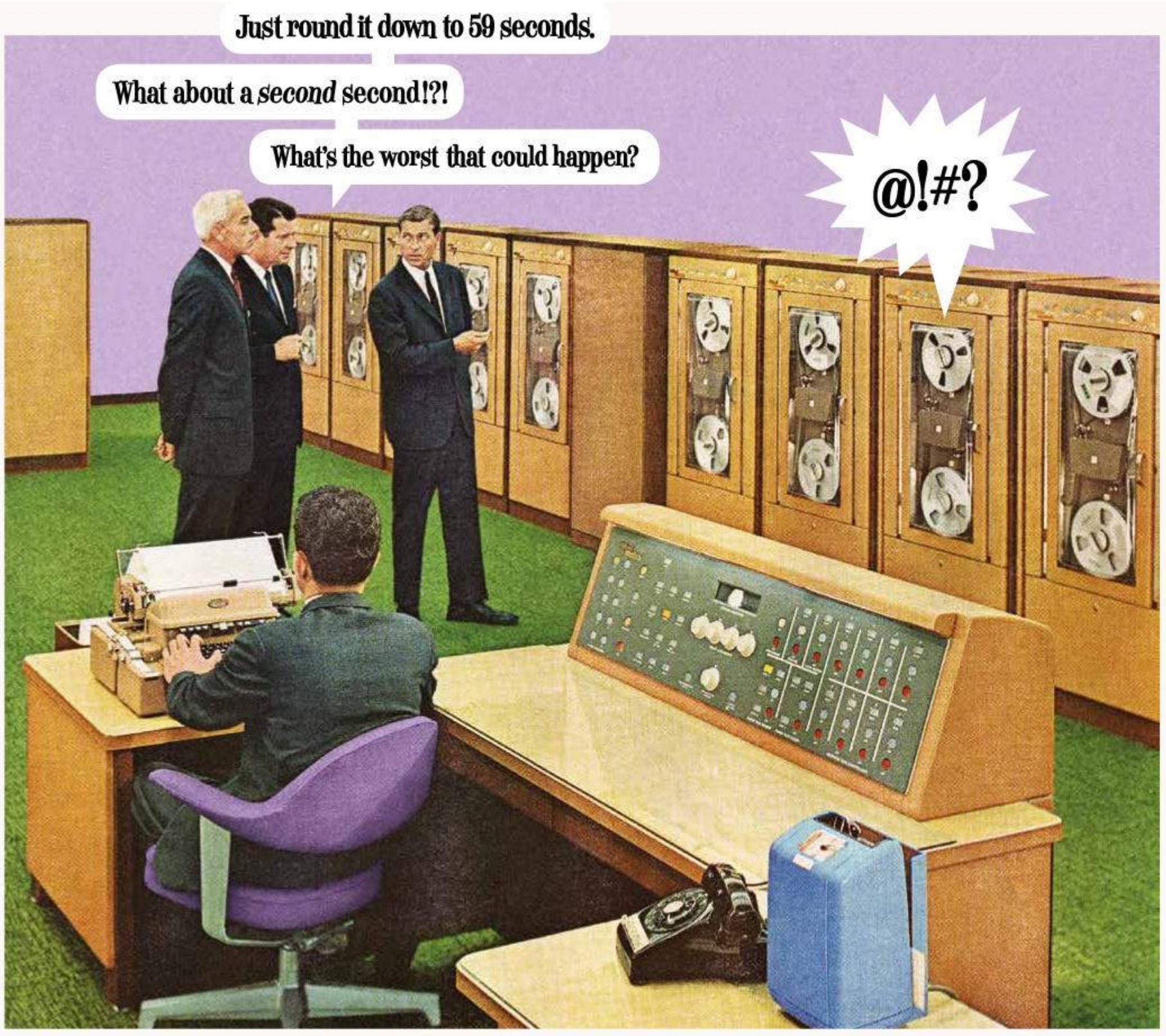
/ BY CAROLINE DELBERT & DAISY HERNANDEZ /



The case for the 59-second minute and why it could wreck us

A DAY IS 86 400 SECONDS LONG, EXCEPT that it never really quite is, not exactly. That number is an excellent average, but the Earth's rate of rotation is in constant flux. After 2020 clocked some of the fastest days on record since 1960, scientists are considering subtracting a second from an upcoming calendar with a 59-second minute, or negative leap second, to align our UTC (the Coordinated Universal Time, used to set clocks around the world) with the time set by the rotation of the Earth (UT1).

In 1971, the International Telecommunications Union (ITU) set a standard that the UTC would never be more than 0.9 seconds ahead or behind UT1, says Demetrios Matsakis, chief scientist at Masterclock, a precision timing

system company, and former chief scientist for time services at the US Naval Observatory.

'Since we can't change the rotation of the Earth, we change what time it is by adding leap seconds,' says James L Davis, PhD, a geodesist (someone who monitors the Earth's position) and Lamont research professor at the Lamont-Doherty Earth Observatory of Columbia University.

The ITU has added 27 leap seconds since 1972 to account for years when the Earth's rotational speed slowed overall. But 2020's increased rate of rotation produced a faster year – clocking 28 seconds faster than the previous fastest year ever recorded. With the trend appearing to continue into the near future, some scientists are considering introducing a negative leap second.

This could have unintended consequences, however, disrupting servers and operating systems like a mini Y2K. Most programming languages use very rudimentary timekeeping based on primitive clock hardware inside the computers themselves. To keep track of 'real time', computers must ping global timekeeping servers for tiny corrections instead of entire seconds.

Regular leap seconds already create headaches, says Matsakis, as many computer programmers are unable to program around the extra second.

'Instead of going to zero when it's 11:59:59 pm, a clock, in military time, goes to 11:60,' says Davis. And for some programs, that extra second wreaks havoc. A negative leap second brings the additional challenge of convincing a computer that it's 12:00:00 for a *second* second in a row.

Consider GPS signals, which measure location and time, and move at the speed of light. 'An error of a nanosecond translates to a foot of error. So if you're off by a second when you're analysing GPS, you'll be way off target,' says Davis.

Variations in Earth's rotational speed are affected by internal friction arising from tidal forces from the Moon and Sun and changes to the shape of Earth. According to NASA, Earth's climate, including winds and atmospheric pressure systems, may also affect the rate of rotation. Post-glacial rebound – which, since the end of the last ice age, has slowly given birth to land masses due to a change in the distribution of ice mass and sea levels across the globe – also changes the Earth's shape.

'This is the ice skater analogue,' Davis says. 'As an ice skater is spinning, they can fling their arms out and they'll spin more slowly. Inversely, if the skater has their arms out and tucks them towards their body, they'll spin faster.' In this instance, think of post-glacial rebound as the tucked arms of the skating Earth.

PHOTOGRAPHY: GETTY IMAGES. PHOTO ILLUSTRATION: COLIN MCSHERRY

> *"AN ERROR OF A NANOSECOND TRANSLATES TO A FOOT OF ERROR. SO IF YOU'RE OFF BY A SECOND WHEN YOU'RE ANALYSING GPS, YOU'LL BE WAY OFF TARGET.*

Across shorter, daily-to-decadal time scales, wind is one of the biggest natural factors to affect rotation, Davis says. 'When winds move, they exchange momentum with the solid Earth. They trade off energy and produce a lot of friction.' This, coupled with the Earth's oceans and their currents, the atmosphere, tides, and even human movement, also has an impact on rotation.

To counter these intersecting forces, some scientists offer the negative leap second as a solution to maintain alignment between UTC and UT1. Ultimately, though, the decision will be up to the International Earth Rotation and Reference Systems Service (IERS), which maintains global time standards. **PM**

HOW WE GOT THE LEAP YEAR

Without 29 February, the changing of the seasons would drift across the calendar year, thanks to our lap around the Sun clocking 365.24 days. Because of that 0.24 days – or five hours 48 minutes and 46 seconds – a leap year must be skipped once every three out of four centuries. Though the years 1600 and 2000 were leap years, 1700, 1800, and 1900 were not, and 2100 won't be one, either.

The first leap year occurred in 45 BCE, at the behest of Julius Caesar and his establishment of the 12-month Julian calendar with a quadrennial leap day repeating 23 February. Caesar's calendar was still off by 11 minutes, which centuries later presented a problem for the Catholic Church as it threw off their Easter schedule. To fix this, the Gregorian calendar – our modern calendar – named after Pope Gregory XIII, was created, which updated the Julian calendar.

– Daisy Hernandez

/ BY CAROLINE DELBERT AND COURTNEY LINDER /

The truth about the Black Knight conspiracy theory

NASA captured this image during the STS-88 Space Shuttle mission while 396 km above the coast of Namibia and looking north.

TAKE A GOOD LOOK AT THE PHOTOGRAPH on this page. NASA captured this image of a mysterious black object orbiting the Earth in 1998, during the first Space Shuttle mission to the International Space Station (ISS).

The space agency refers to the strange entity as item STS088-724-66 in its catalogue of space junk floating in low-Earth orbit (within 2 000 km). Jerry Ross, an astronaut who took part in that mission, says that the object is a wayward thermal blanket that broke loose while his team tried to attach an American module to a Russian module on the ISS.

But for a small, devoted following, it's a 13 000-year-old, artificially made satellite known as the Black Knight. So, could this peculiar object really have come from ancient aliens? Or is it just an innocuous piece of space debris?

The facts surrounding the Black Knight are cobbled together from a number of tales. It begins with Nikola Tesla, who said that he had received radio signals from space during his 1899 radio experiments in Colorado Springs. Martians, he believed, were attempting to communicate with humans through numbers, since they're a universal language.

In a February 1901 *Collier's Weekly* article, Tesla recounted his experience: 'The changes I noted were taking place periodically and with such a clear suggestion of number and order that they were not traceable to any cause then known to me… The feeling is constantly growing on me that I had been the first to hear the greeting of one planet to another.'

Black Knight truthers cite this as the first sign of their satellite, which sent the radio pulses. Scientists have since determined that those radio pulses were most likely naturally occurring signals that space objects emit while in orbit. The prevailing theory, while still unlikely, is that Tesla heard a pulsar, or a faraway celestial body that emits regular pulses of radio waves. Sure, the Black Knight could have emitted such pulses, but that still doesn't make it alien in nature.

Still, the theory that aliens were communicating with Earth through radio pulses propagated even further in 1927 when civil engineer and ham radio operator Jørgen Hals stumbled upon an unusual quality to his radio signals. As he transmitted from his home in Oslo, the signals would unexpectedly return to him moments later. Hals perceived this as an alien phenomenon.

Nearly 50 years later, an article in *Analog Science Fiction and Fact* tried to make sense of Hals's radio echoes. The

author, Duncan Lunan, posited that a 13 000-year-old object orbiting the Moon could have led to the long-delayed echoes (the 13 000 figure having to do with the positioning of the North Pole star, Polaris). 'I tried plotting the delay times against the order in which the echoes were received … and at only the second attempt I found what looked like a star map,' Lunan said in 1998. However, we now recognise those signals as 'long-delayed echoes' that you can hear about 2.7 seconds or more after a radio transmission. And Lunan has since distanced himself from the Black Knight theory.

One more bit of disjointed speculation: In 1960, *TIME* published a story noting that the US Navy had detected an unidentified satellite that may have been a piece of Soviet spy technology. It turned out to be a broken-off piece of the *Discoverer 5* – an early US photo reconnaissance (spy) satellite – but believers still point to this as definitive proof.

Like any good conspiracy theory, the Black Knight has a few fun hooks, plus some high-profile boosts that add a sheen of credibility to the story. In 1963, for instance, Project Mercury astronaut Gordon Cooper supposedly reported seeing a UFO during his 15th orbit while aboard the *Faith 7* spacecraft, according to the UK's Armagh Observatory and Planetarium. Never mind that Cooper has since produced transcripts to the contrary, stating that he never saw an alien spacecraft during that particular mission – Black Knight devotees still include this history in the conspiracy theory origin story.

But the Black Knight is almost certainly the series of discrete events that explain it away: Tesla hearing pulsars or some other natural signal, Hals receiving an echo, *TIME* reporting on a secret US government satellite in good faith, and the astronauts of the ISS seeing a lost blanket in orbit.

From a psychological perspective, it makes sense that people want to believe in the Black Knight, says Alice Gorman, PhD, an associate professor at Flinders University in Adelaide, Australia, who studies space archaeology.

'It's astonishing that there aren't more conspiracy theories about stuff in space,' she says. 'It's really difficult to see details on stuff in Earth's orbit, even through really high-powered telescopes. So when you can't see it, then you can imagine anything about it.'

While NASA and other space organisations keep catalogues of the space debris that they encounter, these lists are still incomplete and dependent on nations sharing sometimes sensitive data.

'There's stuff that might have a catalogue number, but we don't actually know what it is,' she says. 'That makes it a bit easier to say, "Well, here's this mysterious object that comes from somewhere else."'

As for the photo that supposedly depicts the Black Knight? Gorman says that because the image shows a large cross-section of the thermal blanket in orbit, it looks to the human eye like a large, solid object. That means the image could be nothing more than an optical illusion, which isn't too shocking when you consider that people also commonly mistake birds and aeroplanes for UFOs, she says.

And there's still this glaring hole in the Black Knight conspiracy theory: How exactly does an object stay in orbit for 13 000 years? 'You have to use fuel and have rocket engines and stuff to just stay up there… Is this some amazing new propulsion system that we don't know anything about yet on Earth?' Gorman wonders. **PM**

How the Black Knight could exist

Let's pretend for a moment that the Black Knight really does exist. How could it slip by unnoticed for 13 000 years? Gorman has a few ideas.

The first: mimic one of the small pieces of space junk that are no larger than 10 cm in size – space organisations exercise more scrutiny over larger objects. 'We're going to assume that aliens have much more advanced technology than us, so something [that size] could be just as advanced as something the size of a house.' To avoid collisions with other scraps of space junk, aliens could develop miniaturised force-field technology to keep their probe from getting hit, Gorman says.

And thinking long-term, there's the possibility that Earth could eventually have its own ring system – made up entirely of space junk in the 'graveyard orbit', about 300 km above most working satellites. If and when that day comes, the Black Knight will have a decision to make, Gorman says: 'Will it join this ring and risk detection, or run away and hide?'

– Courtney Linder

PHOTO ILLUSTRATION: ALYSE MERKEL USING NASA PHOTO

/ BY KYLE MIZOKAMI /

Laser systems will take up a station on a jet normally reserved for bombs and missiles.

The US Air Force is putting death rays on fighter jets. Yes, death rays

HOW CAN OLDER FIGHTER JETS STAY ALIVE while flying the deadly skies? With a little help from lasers. The US Air Force is working with Lockheed Martin on a defence system called Self-Protect High Energy Laser Demonstrator (SHiELD), a pod-mounted laser that will protect fighters from incoming air-to-air and surface-to-air missiles. The system, which the air force wants to place on planes by the mid-2020s, will likely initially protect older fighters that can't take advantage of stealth to hide from the enemy. Lockheed is also working on a separate weapon, Tactical Airborne Laser Weapon System (TALWS), that will use program data from SHiELD.

Today's fighters are largely limited to passive defences against incoming missiles. Pilots can try to take evasive action by flying outside an incoming missile's sensor arc, launching flares to distract an infrared missile seeker, or

spreading strips of aluminium foil, known as 'chaff', to confuse a missile guided by radar. A laser would be the first real 'active' anti-missile defence in the world of air combat, actively trying to shoot down a missile.

As pod-mounted systems, SHiELD and TALWS will take up a station on a fighter jet typically reserved for bombs, missiles, or sensor pods. That makes them a bad fit for stealthy aircraft such as the F-22 Raptor or F-35 Joint Strike Fighter, as the pods will break up the planes' carefully minimised radar signatures. Instead, lasers will likely go on non-stealthy fighters such as the US Air Force's F-15E, F-15C, and F-15EX Eagle fighters, F-16 Fighting Falcons, and perhaps even A-10C Warthog attack jets. Trading the ability to carry one more missile or bomb for a laser that could shoot down many incoming missiles is a no-brainer. An R2-D2-type artificial intelligence could someday control a laser weapon, paired with existing chaff and flare defences, to defend warplanes from missile attack.

Lasers will make aerial warfare quicker and deadlier than ever. The aeroplane's engine can power the laser, removing the need for an on-board gun magazine and providing a theoretically unlimited number of shots. Laser energy travels at the speed of light, removing ballistics from the targeting equation and making it impossible to dodge.

However, lasers do have a few downsides. The further a laser beam travels, the weaker it becomes. And atmospheric effects, particularly water vapour and smoke particles, quickly dilute a beam's strength. Plus, a laser must be focused on a fast-moving target long enough to have an effect. Unlike missiles, whose high-explosive warheads deliver lots of energy in a single devastating explosion, a laser projects a steady stream of concentrated light that heats the target until something fails or explodes. A missile travelling at ultra-fast speeds could prove a difficult target upon which to focus a beam.

A laser defence system must pack the ability to detect, track, and shoot down incoming missiles into a single pod-mounted package. The laser has to be powerful enough to fry an incoming missile's electronics or cause damage to the skin or control systems, inducing aerodynamic failure. We don't yet know the power level of the TALWS laser, but a *Defense News* report says it's in the 'tens of kilowatts'. That's not enough power to make the missile explode like in the movies, but it can disable the seeker or burn off the guidance fin of a missile, leaving it incapable of steering to the target.

Eventually, laser weapons will go on almost all warplanes, from bombers to aerial tankers, giving them some form of active protection. As these systems become more powerful, they'll become increasingly capable of engaging larger, more complex targets – like enemy aircraft. Lasers will also engage ground targets and, some experts predict, shoot down ballistic missiles shortly after launch.

While it's important not to sell the airborne laser as the ultimate do-it-all weapon, it does have a wide array of theoretical uses. How much of that is actually practical – and affordable? We'll find out soon. **PM**

PHOTOGRAPHY: US AIR FORCE PHOTO (STAFF SGT TREVOR T MCBRIDE), GETTY IMAGES; PHOTO ILLUSTRATION: ELENI DIMOU

A BRIEF TIMELINE OF MILITARY LASER HISTORY

1972: THE DESTRUCTION OF THE DRAGON'S JAW

During the Vietnam War, the US spent years trying to destroy the 'Dragon's Jaw' bridge, expending hundreds of tons of bombs and losing 11 jets to anti-aircraft fire. Finally, in May 1972, 14 US Air Force F-4Cs put the bridge out of action with Paveway bombs, which homed in on laser energy that another aircraft pointed at the bridge.

1991: OPERATION DESERT STORM

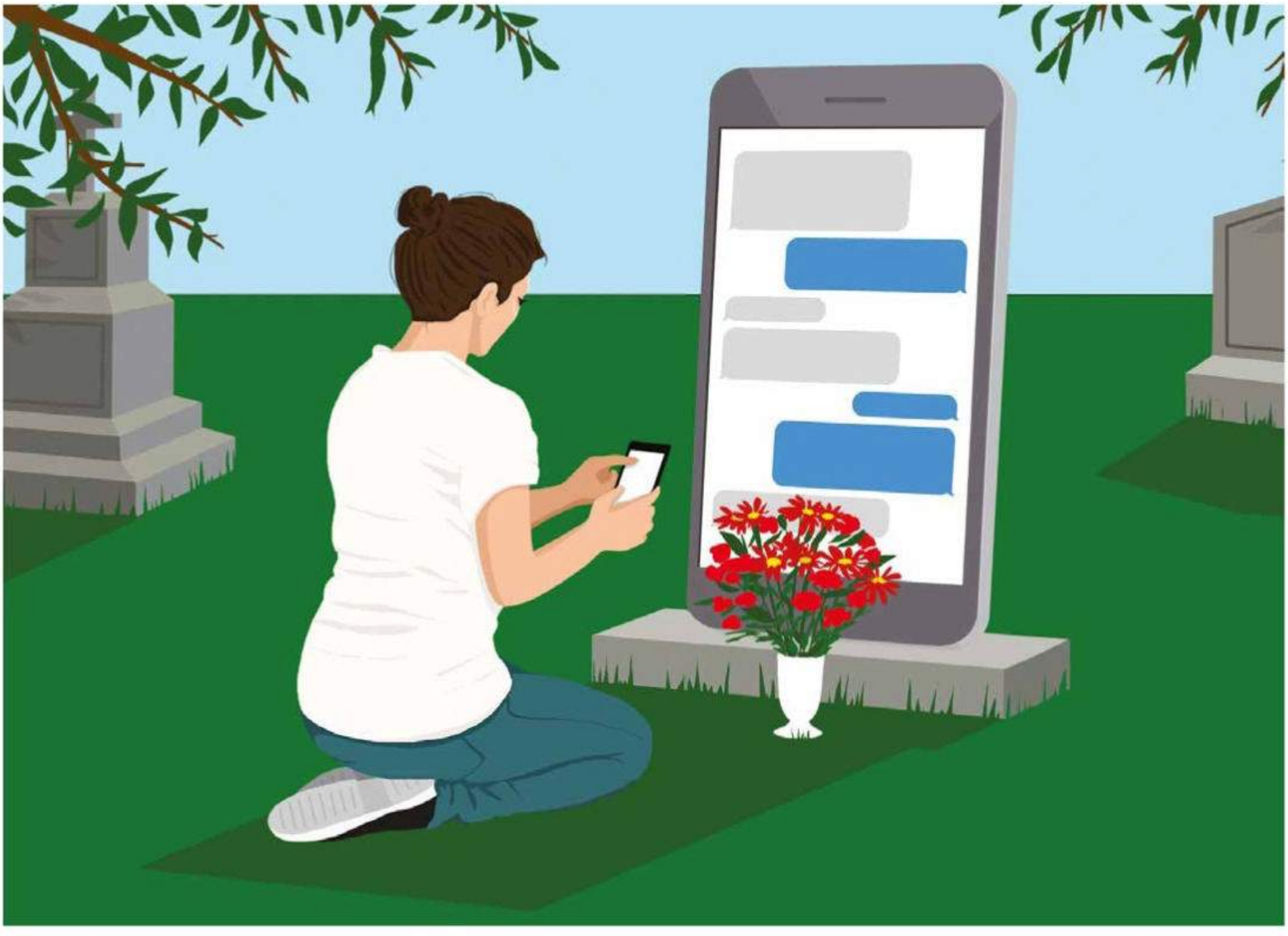
The US used its next-gen Paveway III laser-guided bombs to attack the Iraqi military from low level and hit a target within three metres of the laser-aiming point. The F-117A stealth fighter destroyed targets in Baghdad with Paveways, while F-15E, F-111, and A-6 bombers smashed airfields, bunkers, tanks, and other Iraqi targets.

2014: THE FIRST LASER WEAPON GOES TO SEA

Lasers only 'painted' targets for bombs from miles away until the Pentagon fitted the *USS Ponce* with the AN/SEQ-3 Laser Weapon System (LaWS). In low-power mode, the 30 kW weapon disrupted a target's optical sensors. At high power, it destroyed sensors, sliced fins off drones, and detonated a drone's explosive payload.

/ BY COURTNEY LINDER /

After you die, you could be resurrected as a chatbot. That's a problem



NO ONE KNOWS WHERE WE GO WHEN we die. Or for that matter, what happens to our most intimate thoughts, dreams, and desires when the nerve cells in our brains fire for the very last time. But it looks as though Microsoft may have some ideas.

In December 2020, the US Patent and Trademark Office (USPTO) granted a patent to Microsoft that outlines a process to create a conversational chatbot of a specific person using their social data. Specifically, Microsoft could use images, voice data, social media posts, text messages, and written letters to 'create or modify a special index in the theme of the specific person's personality'.

That sounds pretty benign, but in an eerie twist, the patent states that the chatbot could potentially be inspired by friends or family members who are already dead. And the system could even generate a 2D or 3D simulacrum of the person.

Naturally, this opens a whole can of worms, explains Irina Raicu, the director of the internet ethics programme at Santa Clara University's Markkula Center for Applied Ethics. 'If you try to create a very good chatbot for someone who died … you could put words into people's mouths that they never said,' she notes.

Taking a person's tweets and Facebook posts, then creating an index – or a sort of catalogue for the data to help a computer search for the right answers to a query – does not always lead to organic or honest responses.

'If this becomes accepted, I think this could have a chilling effect on human communications,' Raicu says. 'If I'm worried that anything I'm going to say could be used in a weird avatar of myself, I'll have to second-guess everything.' Using sarcasm on the internet, for instance? You might not want to anymore, for fear that your comments could be taken in earnest and built into a chatbot dialogue, potentially harming your reputation post-mortem.

This isn't the first time an intelligent chatbot has been created as a way to bring back the dead.

In 2015, technologist Eugenia Kuyda's friend, Roman, died in a sudden and tragic car accident in Moscow. She gathered text message conversations between Roman and many of his friends and assembled a chatbot that could serve as a sort of analogue for him. In 2017, she used that experience to launch Replika, an AI chatbot service that allows anyone to make their own virtual friend.

Regardless of any positive effects, it raises an issue: While these chatbots may be beneficial to the person who is grieving, they may also be exploiting the dead, Raicu says.

In the case of the Microsoft patent, Raicu says that an individual has a constitutional right to privacy, so this sort of chatbot is already a violation of a deceased person's autonomy – they have no say in which bits of their social data go into the final chatbot, for instance. And creating a chatbot modelled on a person who has never consented in the first place feels unfair, because they aren't a part of the decision-making process.

On the one hand, Raicu says, much of this brand of innovation is driven by people who do feel genuine empathy and want to help others through the loss of a loved one, perhaps. But at the same time, these technologists must be astute in their designs, considering the negative implications.

It may seem dystopian, and perhaps a bit paranoid, but the only sure-fire way to protect your humanity from these kinds of programs would be to set up a section in your living will regarding your personal data, says Alexander Hauptmann, a research professor at Carnegie Mellon University's Language Technologies Institute.

'You could imagine that people might be able to put stuff in their will about how their archive of data should be used or disposed of,' he says. 'But then the other question is, who is actually going to sue [the person who built the chatbot]? Maybe some other family member who knows what the will said and objects to it.'

For what it's worth, we asked Microsoft about the patent. While they didn't tell us much, they did direct us to a January 2021 tweet from Tim O'Brien, general manager of AI Programs at Microsoft, in which he confirmed that there are no active plans at the company to use this chatbot patent.

'But if I ever get a job writing for *Black Mirror*, I'll know to go to the USPTO website for story ideas,' he tweeted. Touché. **PM**

PHOTOGRAPHY: WARNER BROS; ILLUSTRATION: KEIRSTEN ESSENPREIS

STRANGER THAN (SCIENCE) FICTION

Black Mirror, a popular sci-fi anthology on Netflix, seemingly prophesied this technology back in 2013 with an episode titled 'Be Right Back'. In it, a woman signs up for a chat service that lets her communicate with an AI version of her late partner, who'd died in a car crash. We won't spoil it for you, but suffice to say, things get weird.

And then there's the 2013 film *Her*, wherein Joaquin Phoenix stars as a lonely writer who dates Samantha, an intelligent operating system voiced by Scarlett Johansson, with troubling results. While Samantha is not a chatbot per se, the film still illustrates the psychological trauma that can befall those who lean too heavily on technology.

/ BY CAROLINE DELBERT /

Uh-oh... New research on extinctions shows life doesn't always find a way

The Late Cretaceous's grand finale: an asteroid, a 1 500 m tsunami, and global wildfires.

FIVE MASS EXTINCTION EVENTS ARE generally credited with the state of life on Earth today, but new scientific evidence suggests Earth's history may be marked by additional extinction events, as well as seemingly incidental population explosions.

Jennifer Hoyal Cuthill, PhD, a data scientist at the University of Essex in England, and her colleagues used a machine-learning algorithm to chart shifts in the diversity of life over time and found that life doesn't always rebound after extinction. This new research 'goes against some of the traditional stories about evolution, which focus on mass extinctions and what happens immediately after them,' she says.

Scientists often assert that mass extinction events make way for mass adaptive radiation events, periods when surviving species evolve and flourish. When the dinosaurs went extinct roughly 66 million years ago, for instance, the rest of life on Earth had broader access to food and other resources. Those species thrived, and eventually gave rise to humans. The logic follows, but the new research says mass extinction events are not the sole cause of adaptive radiation events, if they contribute to those occurrences at all.

To study the ebb and flow of biodiversity through time, an international team of researchers first selected more than a million data points representing the occurrence of 171 231 prehistoric species from the Paleobiology Database. This publicly available database is a hub of fossil records – including everything from big-ticket, famous finds plucked from the Burgess Shale to minor, individual T-Rex fossils – spanning the 540 million-year period from the Cambrian explosion to the present day.

The researchers then fed this data, which altogether illustrates a timeline of life on Earth, into a machine-learning algorithm that charted when and where these organisms appeared along that timeline. In other words, the scientists could attach spikes and dips in population diversity to specific moments in history.

The algorithm concluded that while the 'big five' mass extinctions are in the 95th percentile of most disruptive population change events, so are 'seven additional mass extinctions, two combined mass extinction–radiation events, and 15 mass radiations,' the researchers write in the journal *Nature*. The 'big five' should really be the 'big 29'.

Only one of the 'big five' extinction events – the Permian-Triassic extinction, that wiped out about 96 per cent of marine species and around three-quarters of all land-dwelling species 250 million years ago – is followed by a mass radiation event. 'There are many other examples [of mass radiations], such as the Cambrian explosion, that don't seem to have been triggered by an extinction,' Hoyal Cuthill says. In these scenarios, instead of an extinction event replacing one dominant species with another – dinosaurs making way for small mammals, and ultimately, humans – species evolve and thrive via new ecological niches.

The Cambrian explosion, which is responsible for almost all animal life on the planet today, saw species move into new ecosystems and develop new traits such as burrowing and predation. Around 180 million years later, at the start of the Carboniferous period, life once again blossomed without the influence of a preceding extinction event. That time, some organisms emerged from the oceans and began to conquer land to find new sources of food.

A mass extinction doesn't appear to guarantee a subsequent mass radiation, and what's more, it seems a big enough radiation event can, in some cases, hinder growth and induce other extinctions. A viral, invasive species – such as the wild hogs of the southern United States or the lionfish found in Florida – can harm their environment's ecological diversity so much as to oppress some species and possibly wipe out others. The environment's biological carrying capacity, if you will, breaks under the population's resource demand.

By questioning the idea that extinctions and radiations must be causally linked, these researchers have introduced a new series of questions that others can continue to study – say, for instance, how scientists can tackle the extinction crisis Earth is currently grappling with. **PM**

PHOTOGRAPHY: GETTY IMAGES

EXTINCTION 101

How the 'big five' extinctions shaped the trajectory of life on Earth

1

ORDOVICIAN-SILURIAN EXTINCTION: ~ 440 MILLION YEARS AGO

Roughly 85 per cent of all animal species on Earth die, thanks to an ice age that deprived the oceans of oxygen and flooded them with toxic metals.

2

DEVONIAN EXTINCTION: ~ 370 MILLION YEARS AGO

Low-oxygen oceanic 'dead zones', volcanic eruptions, and a possible meteorite impact are thought to drive up to 80 per cent of life on Earth to extinction.

3

PERMIAN-TRIASSIC EXTINCTION: ~ 250 MILLION YEARS AGO

Earth's 'Great Dying' kills nearly 96 per cent of marine life and 75 per cent of land animals, courtesy of volcanic eruptions and global warming.

4

TRIASSIC-JURASSIC EXTINCTION: ~ 210 MILLION YEARS AGO

Volcanic eruptions across Pangaea fill the atmosphere with CO_2, triggering a global warming that wipes out almost 80 per cent of life on Earth.

5

CRETACEOUS-PALEOGENE EXTINCTION: ~ 66 MILLION YEARS AGO

A 10 km-wide asteroid slams into Mexico's Yucatán Peninsula, and the resulting climate crisis kills up to 80 per cent of all species on Earth.

/ BY CLAIRE PORTER /

Some of the trendiest craft beers are exploding. Huh?!

WE ALL KNOW THE SOUND: TSCHHHK followed by a fizzy hiss. It's the sound of cracking open a crisp, cold beer. But there's another, much less inviting sound you might have been unlucky enough to hear: the loud and definitive pop of an exploding beer can. This explosive phenomenon gained notoriety in 2018 when cans of craft beer, often made with fruit, were spontaneously erupting. In February 2021, one US craft operation voluntarily recalled one of its sour ales for the same reason. The good news is breweries go to great lengths to ensure that these bad batches are the exception, not the norm.

Whether it's beer, seltzer, or soda, as carbonated beverages warm up – from cold refrigeration to room temperature and beyond – the carbon dioxide becomes less soluble, leaving the liquid and moving to the air space at the top of the can. Aluminium cans are built to withstand this normally slight increase in pressure, but at excessive carbonation levels, they're likely to burst at the seams.

This becomes a problem with beers that are prone to refermentation, a process in which yeast and microbes continue to process sugars, expelling additional carbon dioxide. It's most common with increasingly popular fruited or flavoured beers because they have both active yeast and fermentable sugars.

'It's a constant balance between safety and flavour,' says Matthew Farber, creator and director of the Brewing Science Certificate Program at Philadelphia's University of the Sciences. When brewers add fruit purees or extracts just before canning, they're feeding active yeast a ticking time bomb.

Lucky for fans of fruit beers, breweries have several tools at their disposal to prevent disaster. Cascade Brewing in Portland, Oregon, is known for its barrel-aged sour ales. 'Our sour beer programme is probably about 80 per cent fruited,' says Kevin Martin, Cascade's director of brewery operations. Fruits are added about three-fourths of the way into the ageing process, giving sugars three to six months to ferment. 'You want to give the yeast enough time to do that in the fermenter tank so that all those fermentable sugars are gone by the time you put the beer into a can or a keg,' Farber adds.

Brewers, including home DIYers, have other options to avoid a boom. Right before canning, they can filter out as much yeast as possible using sterile filters or a prolonged cold-conditioning stage, called cold crashing, in which the beer is rapidly chilled and then held cold for a few days or weeks so the yeast settles at the bottom of the tank. Then they can siphon off the beer, or with the proper equipment,

remove the yeast from the bottom of the tank while leaving the beer behind.

For some styles, filtration isn't always an option. Brews such as hefeweizens need yeast for their signature haze. Wild beers and some sours utilise unpredictable yeast that takes longer to ferment. Instead, pasteurisation reduces the risk of refermentation while preserving flavour and sugar content. At Cascade, Martin and his team pasteurise a honey ginger lime sour ale, which incorporates raw honey. Freshly packed cans are submerged in a hot water bath for 20 minutes, killing off active microbes and yeast.

Not every fix demands an extra step, either. Properly filling cans leaves a small headspace where gas can compress and expand more easily than liquid. 'If you have a full liquid volume all the way to the top of your can and that liquid expands, that's when you're going to get rupturing or bowing,' Martin says.

Brewers can test whether their methods were successful in one of two ways. They can send a can off for lab analysis to check for remaining bacteria or yeast. Or for a more lo-fi approach, they can put sample cans in warm storage and see if the tops start bowing or any beer fizzes out after a few days. This technique is also easily replicable for home brewers.

Although Farber and Martin emphasise that brewers are the ones responsible for properly packaging their beer, consumers can take precautions. Refrigeration slows the process of fermentation, so keeping your beer cold reduces the risk of popped tops. This also prevents oxidation, thereby preserving flavour. And, if you're camping, braaiing, or otherwise untethered from a fridge, your standard ice-filled cooler will do just fine.

If you're still concerned, have a conversation with your local brewer. 'Ask the staff if there are fermentable sugars in this product,' Martin says. Practically all beers have residual sugars in them that contribute to taste and mouthfeel, but rarely are those sugars at risk of refermenting. And if you're still not sure, there's an even simpler solution: Enjoy your spoils responsibly soon after you bring them home. 'Your best defence is to drink it,' Martin says. Don't mind if we do. **PM**

WHEN BREWERS ADD FRUIT PUREES OR EXTRACTS JUST BEFORE CANNING, THEY'RE FEEDING ACTIVE YEAST A TICKING TIME BOMB.

PHOTOGRAPHY: TREVOR RAAB

ALL BOTTLED UP

With the proper packaging, highly carbonated beers don't have to be dangerous. Belgian-style bottles that are made with thicker glass and deeper punts (the indent at the bottom of the bottle) can withstand greater pressure than regular bottles and aluminium cans. They're similar to champagne bottles and have corks with metal cages to keep the tops from popping off. These more-durable containers are ideal for fruited or especially active beers, and any styles that brewers want to referment through a method called bottle conditioning.

'In bottle conditioning, the carbonation comes from a controlled refermentation that happens in the bottle,' Cascade Brewing's Kevin Martin says. Brewers measure a beer's sugar level in its finished state and add priming sugar at bottling to prompt refermentation that produces extra bubbles. Once the beer reaches final gravity – the point at which all the fermentable sugars have been turned into carbon dioxide and ethyl alcohol – it's ready for distribution. The amount of sugar and time it takes to hit the sweet spot depends on chemistry. 'If we know a beer has a high microbial load, we might add a little less sugar, anticipating that its levels will drop further than we expected,' Martin says. 'If it has a very low microbial load, we might add more. There's a little bit of art to the science.'

/ BY TIANA CLINE /

Driven

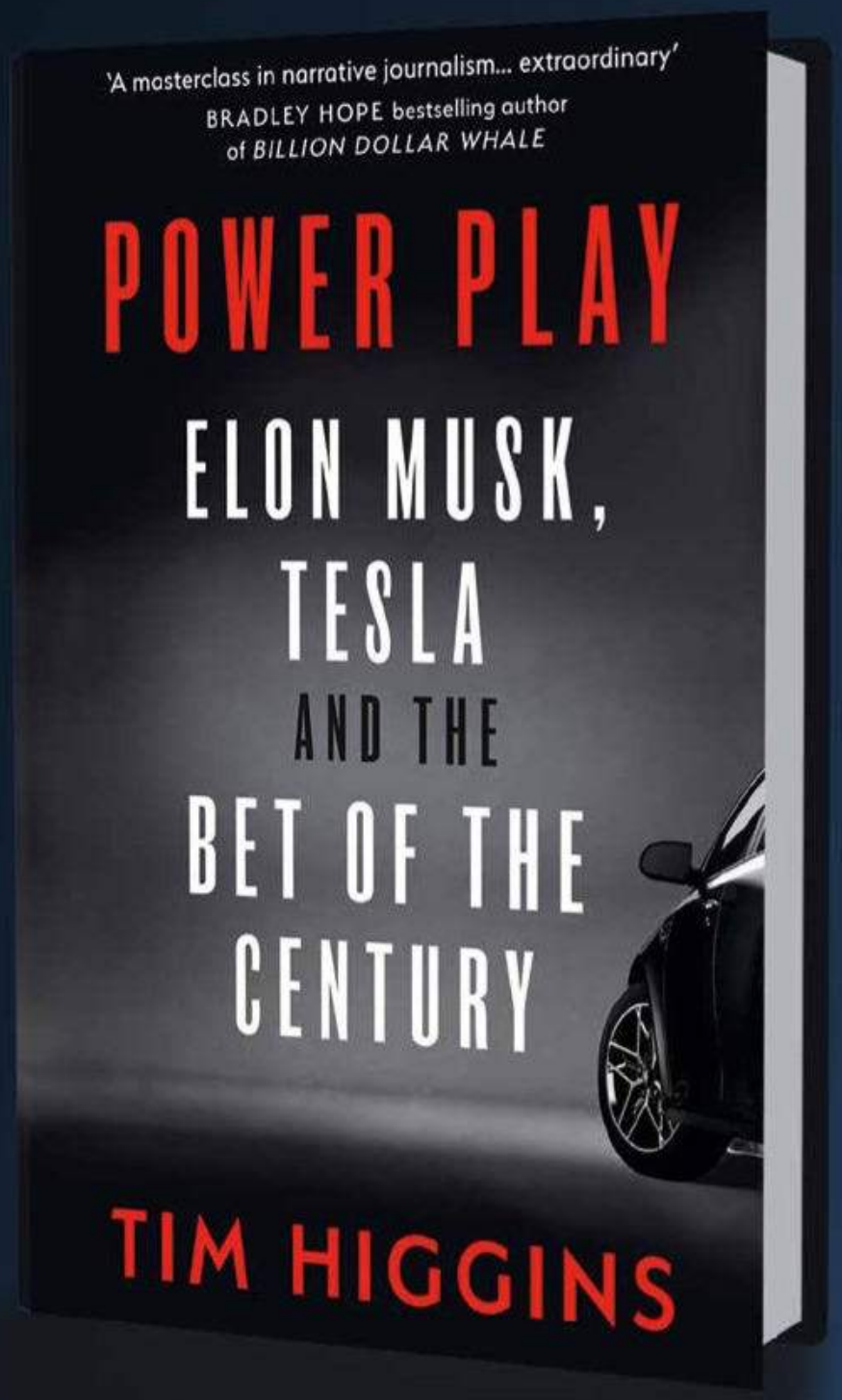
A not-so-brief history of the rise, and rise, of Tesla.

TESLA NEARLY didn't happen. In the early 2000s, the company had a bit of a rocky start. In fact, it wasn't even Elon Musk's idea, although he was open to investing millions in the dream of two Silicon Valley entrepreneurs who wanted to sell a high-end electric sports car – sustainable and sexy.

Power Play is the story of how it all came together, and Tim Higgins, the book's author who also happens to be a reporter for *The Wall Street Journal*, explores exactly what it took to turn the auto industry on its head. While it may feel now that every carmaker today is going the electric or hybrid route, Elon Musk was the person who spearheaded the electric vehicle (EV) market and beat the odds doing so. He took risks, he invested his entire fortune in Tesla, he managed to secure additional funding, again and again, and work around potentially disastrous engineering debacles. It's quite a dramatic tale and Higgins does an exceptional job weaving key players such as JB Straubel, Sterling Anderson and Peter Rawlinson into the book.

Higgins conducted hundreds of interviews with Tesla insiders to get the full picture of a company that, by all accounts, went on a roller-coaster ride – skirting bankruptcy more than once – to get where it is today. It doesn't make a difference if you're a Musk fan or critic, if you think he's a crazy genius or an anti-hero trying to get us all to Mars – this is an extraordinary and riveting (but sometimes appalling) tale for anyone interested in comprehensive and well-documented insights into Tesla's road to success. And who wouldn't be? The company's market value sits at $625 billion today. **PM**

'When something is important enough, you do it even if the odds are not in your favour…'
– Elon Musk



Power Play: Tesla, Elon Musk, and the Bet of the Century by Tim Higgins (Penguin Random House) is available online, and wherever good books are sold.

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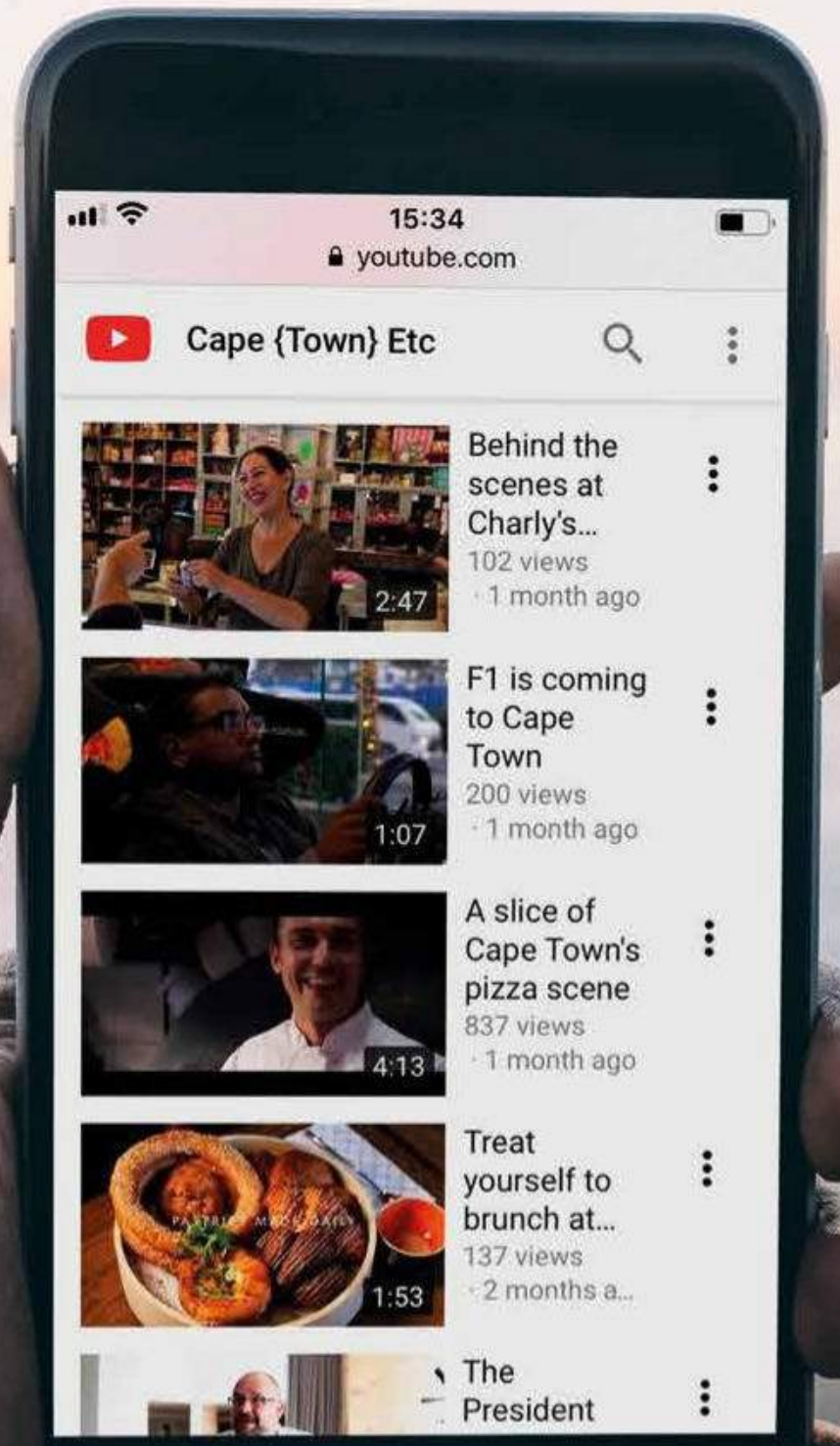

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/ BY ALEXANDER GEORGE, EDITOR, US EDITION /

Who should buy an electric car?

THEY'RE ROLLS-ROYCE QUIET. SOME ARE Lamborghini fast. No oil changes. No exhaust smell to remind you that parts of Miami will be underwater in 30 years. But after testing a bunch of new electric vehicles (EVs) for Pop Mech's Auto Awards last year, I understand why, for the past few years in the US, the number of Ford F-Series pickup customers alone is greater than the number of all new electric-car customers combined: EVs are still a hassle.

Specifically, driving them far is a hassle. Through no fault of the manufacturer, even a $105 150 Porsche Taycan 4S's technical excellence becomes irrelevant when you're nervous about finding power to run it. Three days of testing a Taycan required five apps' worth of downloading, password creation, and email confirmation. And of the public chargers those apps allowed me to pay to use, one was so slow (0.3 km per minute) it served only as a bridge to a faster station (3 km per minute), which was located next to a truck-stop garbage pile, where I sat for an hour. EVs still require planning and patience.

This is where Tesla maintains a big advantage. Its Superchargers are reliably fast (usually 50 kW or better), are abundant in the US, and bill you automatically. But the reality is, even the most practical EVs still only make sense for a really specific customer: someone who has at least $40 000 to spend on a car and owns a garage with a 240 V charger to use between predictable daily commutes.

Hopefully, by the time I achieve those requirements, public chargers will have also become faster and more plentiful. Because with pretty much every EV we tested recently, the actual driving part is an absolute joy.

If that sounds compelling, here are three EVs we drove in the last year or so that justified the inconveniences. **PM**

FORD MACH-E 4

The extended-battery AWD version can go 435 km and do 0 to 100 km/h in under 5 seconds. Plus, there's plenty of headroom in the rear, and the plastic 'frunk' has a drain, so you can use it as a cooler.
– Louis Mazzante

VOLKSWAGEN ID.4

An in-betweener EV: the benefits of electric without overwhelmingly fancy tech. But the dash can be confusing and a pain to operate while driving.
– Will Egensteiner

CAKE KALK&

80 km of range, 80 km/h top speed. E-bicycles are (much) cheaper, but don't have this build quality, stability, and torque.
– Alexander George

PHOTOGRAPHY: FORD (MACH-E), VOLKSWAGEN (ID.4), CAKE (KALK&)

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GEAR & GADGETS

Must-have hardware for humans on the go

MSI
VECTOR GP76 12TH GEN GAMING LAPTOP

MSI'S VECTOR GP76 has landed in South Africa, and prolific gamers, or really anyone who demands exceptional performance from their computer, should take notice. This beast of a machine confirms, rather emphatically, that laptops can indeed deliver blistering speed and high performance.

When it comes to power, few laptops can match this device. Its 12th Gen Intel Core i9 processor executes tasks with lightning-quick efficiency. Compared to the previous model, performance has been improved by a prodigious 45 per cent, a stat that really bodes well for intensive multitasking projects. Powered by Ampere, NVIDIA's second-generation RTC architecture, a NVIDIA GeForce RTX 3070Ti processing unit (GPU) takes care of the graphics – in layman's terms, you're in highly capable hands, as this technology is incorporated into many of the world's fastest laptops, that are typically used by gamers and content creators, who require high-quality hardware.

By maximising the CPU and GPU's performance, MSI's OverBoost technology contributes to the ultimate gaming experience, delivering up to 210 W of power (165 W – with Dynamic Boost – from the GPU, and 45 W from the CPU).

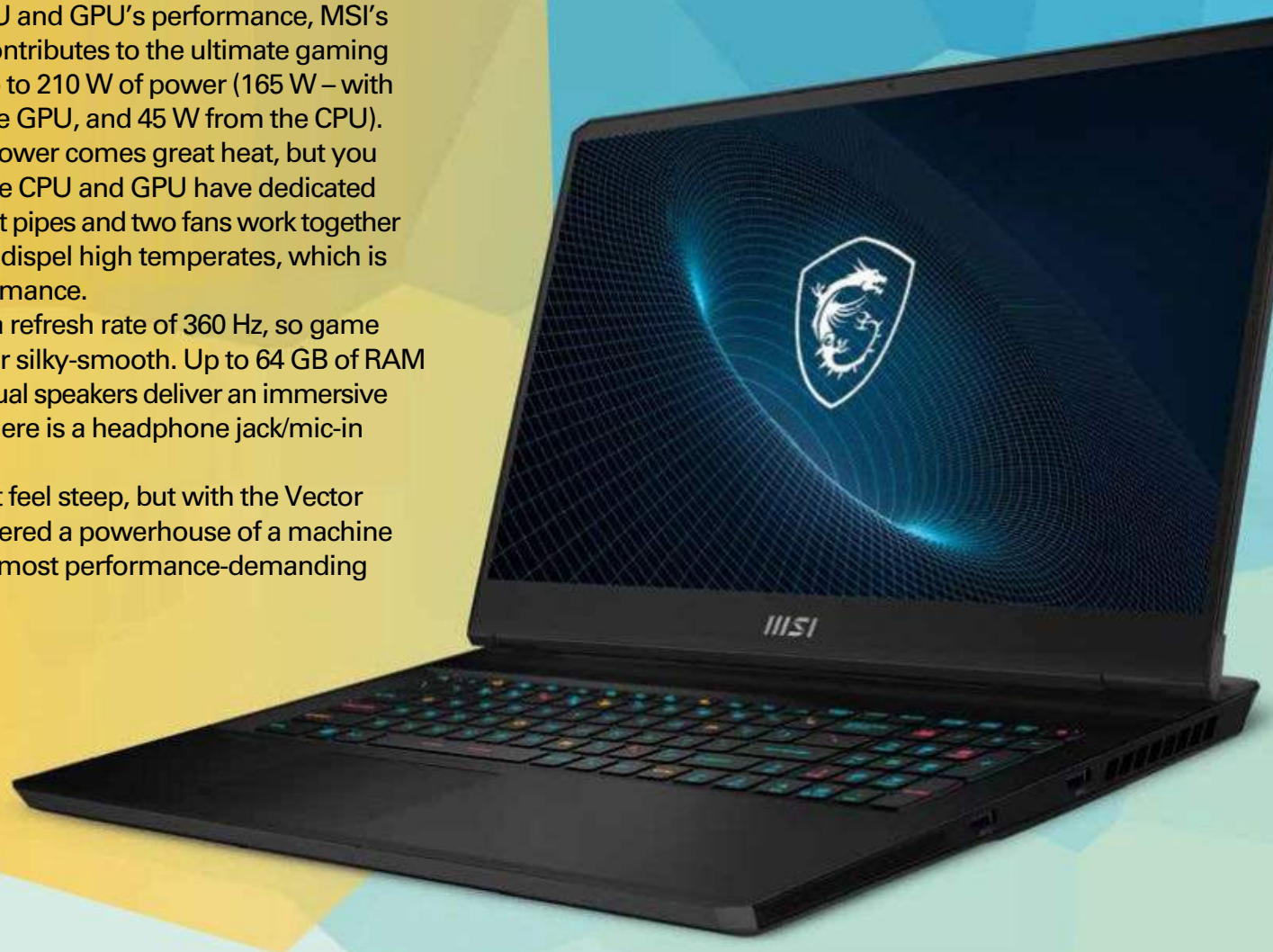
Of course, with great power comes great heat, but you needn't worry, as both the CPU and GPU have dedicated thermal solutions. Six heat pipes and two fans work together to maximise air flow and dispel high temperates, which is integral to smooth performance.

The 17.3" display has a refresh rate of 360 Hz, so game visuals will always appear silky-smooth. Up to 64 GB of RAM can be accommodated, dual speakers deliver an immersive sound experience, and there is a headphone jack/mic-in combo port.

Indeed, the price might feel steep, but with the Vector GP76, MSI has truly delivered a powerhouse of a machine that will handle even the most performance-demanding games and tasks.

RRP R55 999

evetech.co.za



HUAWEI
MATEVIEW GT 34" SOUND EDITION

The MateView GT is Huawei's first gaming monitor. We've been impressed with Huawei's wearables and in-ear headphones so far, so it wasn't much of a surprise that this ultra-wide 165 Hz curved monitor really got us excited (and we're not only referring to the very cool touch-sensitive and programmable RGB light-strip sound bar that's built into the stand).

While the MateView GT takes up a fair bit of desk space, you're going to appreciate the extra screen real estate. It's relatively easy to set up – all you need to do is pop the curved screen on to the stand and you're good to go. All the ports you'll ever need are sneakily hidden away in a panel at the back, and there's a little five-way joystick for adjusting the display settings.

The monitor comes with a selection of cables (we're talking USB-C to USB-C, USB-C to USB-A, DP 1.4), but you'll need to invest in your own HDMI cable if that's how you prefer to connect. However you proceed though, the ultra-wide design is ideal for creators, gamers and anyone else who's seeking a beautiful big screen for their computer set-up, that also features two dual-array microphones. The WQHD 3 440 × 1 440 resolution delivers a good balance between speed and graphic detail, while the 1.07 billion colours will ensure your video and images always look good.

In short, Huawei's MateView GT is a monitor that simply looks as good as its specs, all for a solid price, considering the pricing of its competition.

RRP R13 999

consumer.huawei.com/za

WORX
PEGASUS FOLDING WORK TABLE

We can never have too many solid work surfaces in our workshops or garages. And if space is at a premium and you don't have a permanent work bench, or you find yourself moving from worksite to worksite, you'll definitely require a sturdy portable workstation.

The WORX Pegasus is an excellent solution, for professionals and DIYers alike. It's a lightweight yet extremely sturdy folding work table, that's simple to transport and easy to set up, no matter where you're working. The top surface measures 79 × 64 cm, big enough to accommodate large wood sizes. Configured as a work table, it'll support up to 136 kg; as a sawhorse, it'll hold up to 454 kg.

When collapsed and folded, it has a depth of only 12.7 cm, slim enough to store out of the way, or in the back of your bakkie.

It includes four clamp dogs and two quick clamps, for holding a variety of materials firmly in place, or for stabilising unique shapes, giving you confidence to work freely on your project at hand. It features grooves to support standard timber sizes, a folding built-in shelf for tools, measuring guide, as well as a bracket for power strips and attachable accessories. And of course, being WORX, it's cleverly designed to connect with additional units, to expand your portable work surface. It clocks in at 13.6 kg, so almost anyone will be able to manage it and move it around. If you're a keen DIYer, you definitely need one of these in your arsenal.

RRP R3 679

worxtools.co.za; vermontsales.co.za

EPSON EH-LS500B HOME PROJECTOR

Sometimes bigger can be better, much better, especially when we're talking about TV screen size. Or, more specifically in this case, the display area of Epson's EH-LS500B Android TV Edition home projector.

What's particularly special about this device is that it can be placed very close to the wall on to which it's projecting its image. And that image can be a massive 65 to 130 inches in size, projected in ultra-high-def 4K resolution. When you compare the price of this device to televisions with the same dimensions and resolution, you'll agree that it'll be money well spent.

And, because it's an Android TV, you can stream shows, games, movies, news and sports, effortlessly. It's very simple to set up. Hook up your device to one of three HDMI inputs, enjoy immersive sound from the two 10 W built-in speakers, and control the projector using either its remote, or via the iProjection app on your smartphone. There's even a nifty hidden compartment at the front, where you can secretly stash your streaming device.

It boasts a brightness output of 4 000 lumens, and an incredible contrast ratio of 2 500 000:1 – for viewers this means vivid, clear content, deep blacks, and crisp, well-defined shadows.

You won't require a black screen permanently set up on your wall to use this device. Rather, it's discreet and stylish, and will blend in easily with your home decor. And, if you need more convincing, the laser light source is so durable you could watch content every day for 10 years in Eco mode – that's around 20 000 hours of viewing.

RRP R49 999

epson.co.za

SNAP SHIPS

With interchangeable pieces, and an armada of spacecraft project options, Snap Ships is a modular building system of toy models that will keep young and old alike entertained for hours. Prompting creativity and imagination is what these models are all about – gain added insight and find helpful build instructions by downloading the interactive iOS or Android apps, and learn more about the different ships, and the colourful characters that feature in the collection.

As the name suggests, the components snap together, ultimately forming spacecraft, bombers, drones, robots and more that move, function and deploy projectiles. The included separation tool helps you to break pieces apart, so you can try out different configurations with the same set.

In the words of one of our young reviewers: 'The Snap Ships range of toys is sturdily built and packaged, and well suited to kids six to eight years old. I spent more than an hour trying different arrangements with the parts in my kit, as each model can be built in multiple ways. It's great to be able to build different models using the same kit.'

RRP from R180

toykingdom.co.za/snap-ships

LENOVO
TAB P11 PRO

SOMETIMES WE WANT THE versatility and mobility of a tablet, while at other times a laptop is more convenient, to carry out tasks such as compiling long emails or hashing out work. But who wants to carry around two devices?

Lenovo has the perfect solution, the Tab P11 Pro. With its all-aluminium unibody design, this is one of Lenovo's thinnest and most powerful Android tablets, boasting 6.9 mm bezels around an outstanding 11.5" OLED display. It delivers vivid 2K resolution along with Dolby-enhanced audio, so it's perfect for viewing content, at home or while commuting or travelling.

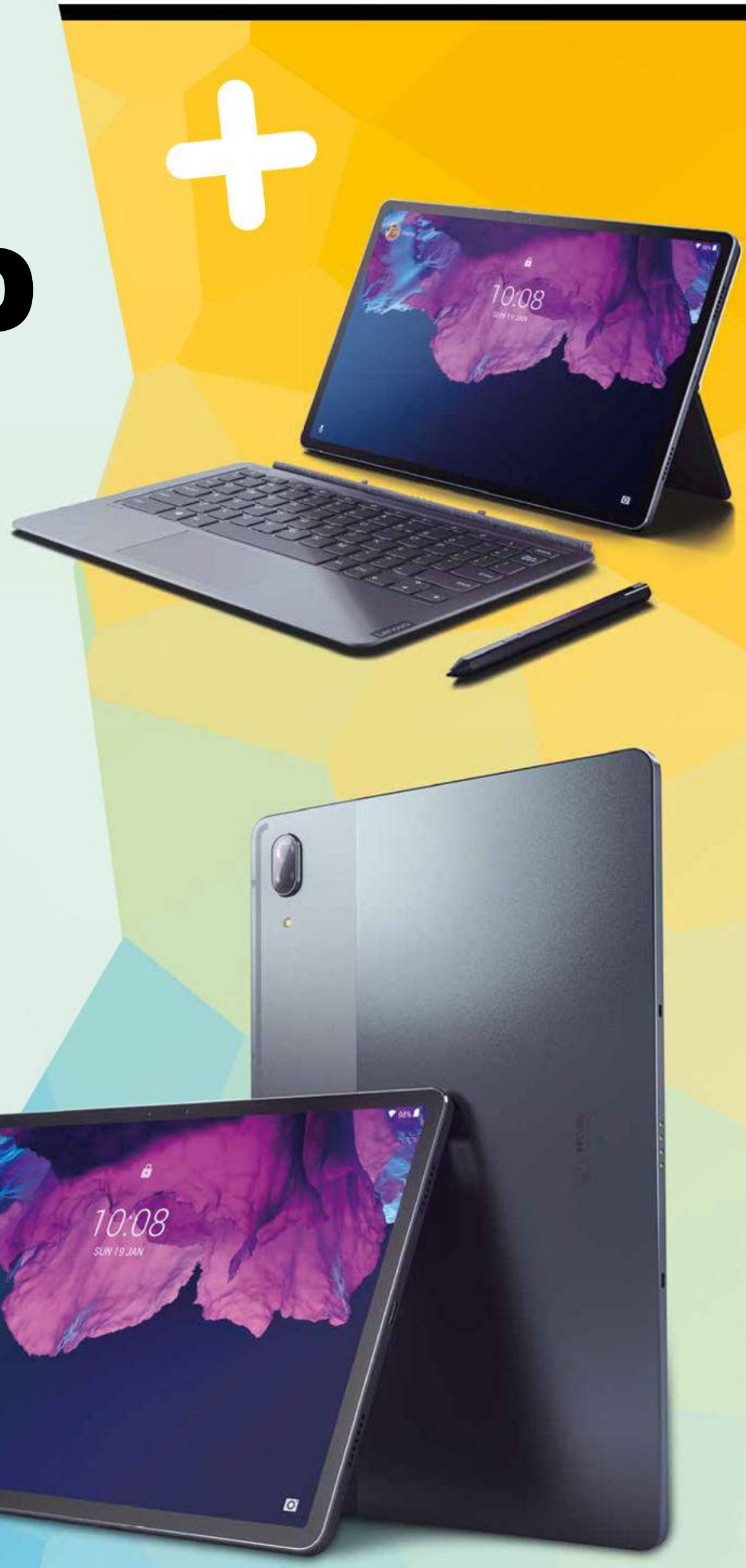
Things get really interesting when you magnetically attach the optional keyboard, that has 18 mm pitch sizes, 3 mm key spaces and 1.3 mm of travel. It transforms the device into a hub of productivity, with the flap-out cover propping the screen up at the desired work-angle.

Then there's the optional Lenovo Precision Pen 2, a well-weighted stylus that ups the ante if you want to sketch, paint, draw diagrams, or even jot down handwritten notes. It delivers exceptional control and accuracy, achieved via its 4 096 levels of pressure and tilt detection.

It's powered by a Qualcomm Snapdragon 730 G octa-core processor, and has up to 6 GB of RAM and 128 GB of storage. You can expect around 8–10 hours of continuous usage from the 8 600 mAh battery. While its cameras aren't its strongest suit, the 13 MP primary and 5 MP secondary lenses on the back, and 8 MP 'selfie' camera on the front, manage most tasks acceptably.

But we'd strongly recommend paying extra for the keyboard and pen – they turn a good device into a highly useful one.

RRP from ±R10 500 (imported)
grooves.land



NOKIA
T20 TABLET

THE NOKIA T20 is a relatively inexpensive Android tablet that feels more premium than its price point might suggest. It's slim, lightweight, the build quality is great and the back cover has a matt finish, which, all in all, makes for one sleek-looking device.

The handsome 10.4-inch IPS LCD can be unlocked using facial recognition. Stereo speakers are hidden on the edges of the tablet, and the sound is decent and clear, though perhaps not as loud as some of the other tablets we've tested. If you intend using it for video calls, you'll appreciate the front-facing 5 MP selfie camera. If you're a gamer, you'll find that the T20 runs smoothly, and isn't prone to overheating.

Perhaps the only slightly frustrating thing about it is the placement of the headphone jack. It sits on the bottom right of the device, where other cables plug in, so we found that its location can interfere with how you hold the tablet. It does have Bluetooth though, so you can choose to connect your audio that way.

The battery is powerful enough to give you seven- to eight hours of solid use, which really makes the Nokia T20 a great tablet option in the more budget-friendly side of the market.

RRP R3 999

cellucity.co.za

LOGITECH
MX ANYWHERE 3 WIRELESS MOUSE

Logitech's MX Anywhere 3 mouse is a slimmed-down and more mobile version of the brand's beloved MX Master 3 mouse. It has a similar design, including the same soft silicone side grips, and a high-tech MagSpeed Electromagnetic scrolling wheel that in addition to being a pleasure to use is ever so precise. And that's probably why it's so often recommended for programmers… But don't let that intimidate you – this mouse is also perfectly suited to standard users too.

A standout feature is its battery life – you can expect it to stay powered for up to 70 days on a single full charge, and, rather amazingly, if it runs flat, a quick one-minute charge using the USB-C port will give you up to three hours of use.

The only negative is that it's a bit on the small side, so if you have large hands it might not be right for you. That said, its compact size does make it well suited to remote working, and carrying it with you when you travel. If you enjoy working at coffee shops or airport lounges but don't enjoy laptop trackpads, the MX Anywhere 3 is the companion for you – it will track on just about any surface, even glass, so you can leave that cumbersome mousepad behind at your desk.

RRP R1 449

computermania.co.za

MULTI-SHARP
DRILL SHARPENER

What do you typically do when your drill bits become blunt? Most of us tend to throw them away, because they no longer serve the purpose for which they were designed. A dull drill bit is not only frustrating to use, it can also be dangerous. But what if you could extend the life of your bits, by sharpening them yourself?

The Multi-Sharp Drill Sharpener lets you do just that, whether it's a bit made for drilling through steel, wood, or masonry, or even if it's a spade bit. The device clamps your bits in such a way that the grinding stones accurately correct the tip angle, and restore the cutting edges. Use it on all of your bits, from 3 mm in diameter right up to 13 mm; it can even handle centre-point wood bits.

The sharpener's jigs are set up with all of the required tip-angle geometry, positioning the bit above the grinding wheels. The unique cam action ensures the right rake and chisel edge is achieved.

The carbide sharpening wheels are made from aluminium oxide and silicon, and are durable enough to restore up to 150 high-speed steel bits (for wood) and 75 slotted driveshaft masonry bits.

It's conveniently designed to fit any power drill, which will drive the grading wheels, and replacement wheels are available when yours eventually wear out. Simply follow the instructions – which advise the correct speed to use for various bits – to make your blunt bits as good as new.

RRP R575

vermonsales.co.za

AMAZON KINDLE OASIS

Time to upgrade your e-reader? We've been rather impressed with the Kindle Oasis. While it's everything you would expect from an electronic book, there are some nice details that make the Oasis a little different to the rest of the Kindle collection. The design, for one, is somewhat unique – it's not a symmetrical slab but rather weighted to one side, which we found makes it much more comfortable to hold while tucking into your favourite novel. The tangible buttons for turning the page were another thing we preferred to earlier models – having that control at the push of a button is so much better than a touchscreen … and they're easy to press with the same hand you're using to hold the device. No matter if you're left- or right-handed, the Oasis is comfortable to use. The screen auto-rotates, adjusting to whichever hand you prefer using.

The seven-inch screen boasts high-def 300 dpi resolution that in true Kindle style is perfectly readable in any light conditions thanks to its anti-reflective display coating. And yes, it does have the option of warm light too, which is a nice touch for late-night reading.

The Oasis comes with either an 8 GB or 32 GB memory – either is more than sufficient to accommodate your on-the-go library. The larger though is ideal for books with graphics or for audiobooks. With a six-week battery life and IPX8 waterproof rating (which is great for poolside or bath-time reading), the Oasis is truly a book-lover's dream device.

RRP from R5 499
macnificent.co.za

WEDGIT HOSE AND CONNECTORS

If you have a garden, you probably own a hosepipe. It's probably also perished, kinks easily, and leaks, if not from the hose itself then definitely around the connection points.

Wedgit is a hose and coupling brand that has been designed by South Africans and manufactured here to cope with our harsh climatic conditions. The African sun is definitely unique, and powerful, and imported brands often simply can't withstand our unrelenting environment.

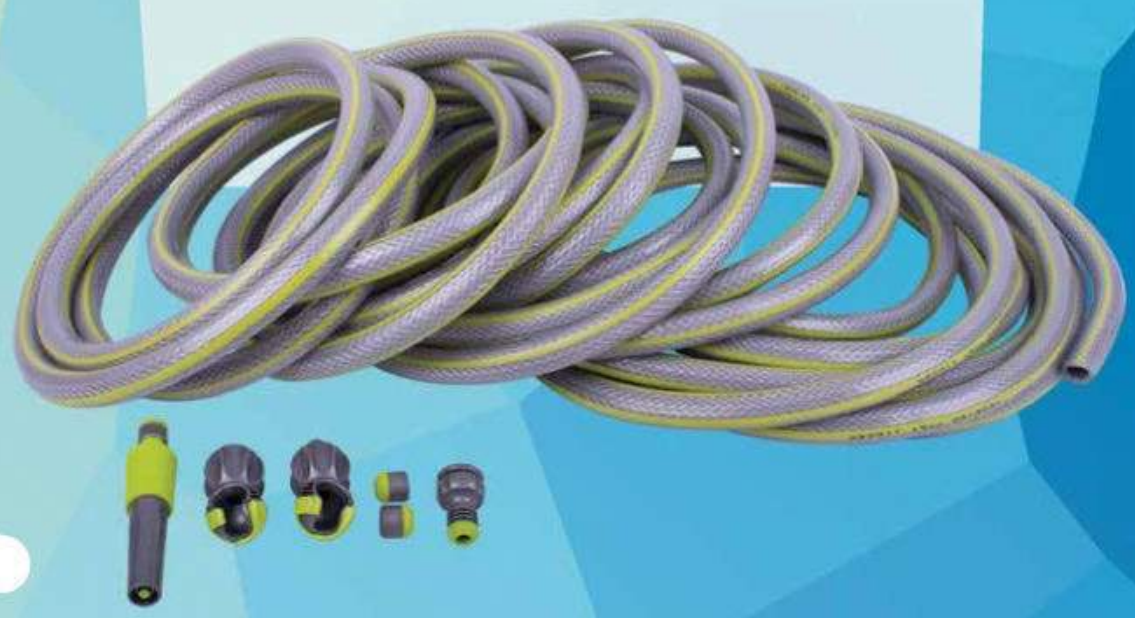
Wedgit hose couplings are tough, made from a higher-grade UV-stabilised polymer than normal. They have fewer moving parts, and they boast superior mechanical strength and rigidity when compared to competitors. While even a young child will have the strength to connect a Wedgit coupling to a tap or accessory, the hose nut has an unrivalled bond to the hose, resulting in no leaks and wasted water.

Tested up to a pressure of 17 bar (three-times that of the municipal water supply), the leak-free Wedgit connectors and couplings are available for both 12 mm (½") and 19 mm (¾") garden-hose diameters, forming a connection that's strong enough to tow a car – yep, that test has been done! And if you use the Wedgit Converter Cap, the coupling technology is compatible with most sprayers and nozzles.

Made from UV-stabilised and heavy-metal-free materials, the nine-sided Wedgit garden hose has a 10-year design life. Available in 12 and 19 mm diameters, these hoses are made to be highly kink-resistant, and withstand pressures of up to 35 and 28 bar respectively.

Start your collection with either a 20 m-long 12 mm hose- or 25 m-long 19 mm hose starter kit, which includes a collection of Wedgit connectors.

RRP R1 125 (20 m, 12 mm hose + starter kit)
RRP R1 592 (25 m, 12 mm hose + starter kit)
vermonsales.co.za



SAMSUNG
GALAXY S22 ULTRA SMARTPHONE

Is this a Note or not? The S22 Ultra is Samsung's flagship smartphone device, as well as the first Galaxy S with a built-in stylus. It takes the best of what Samsung fans loved about the Note and adds powerful cameras, an OLED screen and a LTPO display (which essentially means better refresh rates).

It's a big, boxy phone with a curved display that's packed full of all the frills and fancy features that we've come to expect from Samsung. On the back are four camera lenses – a 12 MP ultra-wide, a 108 MP wide-angle, a 10 MP 3× optical zoom (telephoto camera 1), and a 10 MP 10× optical zoom (telephone camera 2) – and a laser autofocus sensor. The niche photography features are particularly impressive, especially when it comes to portraits or using the night mode, something Samsung now calls 'Nightography'.

While Samsung's S Pen is compatible with a number of the brand's smartphones, the fact that it has a dedicated slot on the S22 Ultra makes it all feel a little more premium. When you pop it out, a menu of stylus-centric options is displayed on the screen. Scribbling notes by hand and watching them morph into (surprisingly) legible fonts is a lot of fun.

The Samsung Galaxy S22 Ultra might be a little different to what we're used to from this tech giant, but that's certainly not a bad thing. Our verdict is that this device is very close to perfect, if you have a budget that stretches that far.

RRP from R27 999

samsung.com.za

PHILIPS
3000 SERIES GARMENT STEAMER

We know what you're thinking: 'I already have an iron; do I really need a steamer too?' After trying it out, we think so! The Phillips 3000 handheld garment steamer is cute and compact, yet impressively powerful. With no complicated buttons to confuse you, this mini-steamer is ready to carry out its duty in 30 seconds flat. Simply fill the 120 ml water tank and in no time you have lovely, hot, fabric-flatting steam at your disposal. When you're done, it folds up quickly and neatly, making for the perfect accessory for trips. (You'll know what we mean if you've ever opened your suitcase to a nest of creased clothes when you're away from home.) The one downside is that you have to plug it in. Fortunately it comes with a 2 m-long cable, which should make most plug sockets accessible.

So why use steam? Treating fabrics this way is an excellent method of killing harmful bacteria, and if the coronavirus has taught us anything, it's that if something can be sanitised, you really ought to. Steaming also removes odours, which reduces the number of times you need to wash a garment. While steam is great for bed linen and curtains, mini-steamers such as the Philips 3000 work particularly well on your more delicate items that you can't iron – and there's no risk of burning through the fine fabric.

RRP R799

yuppiechef.com

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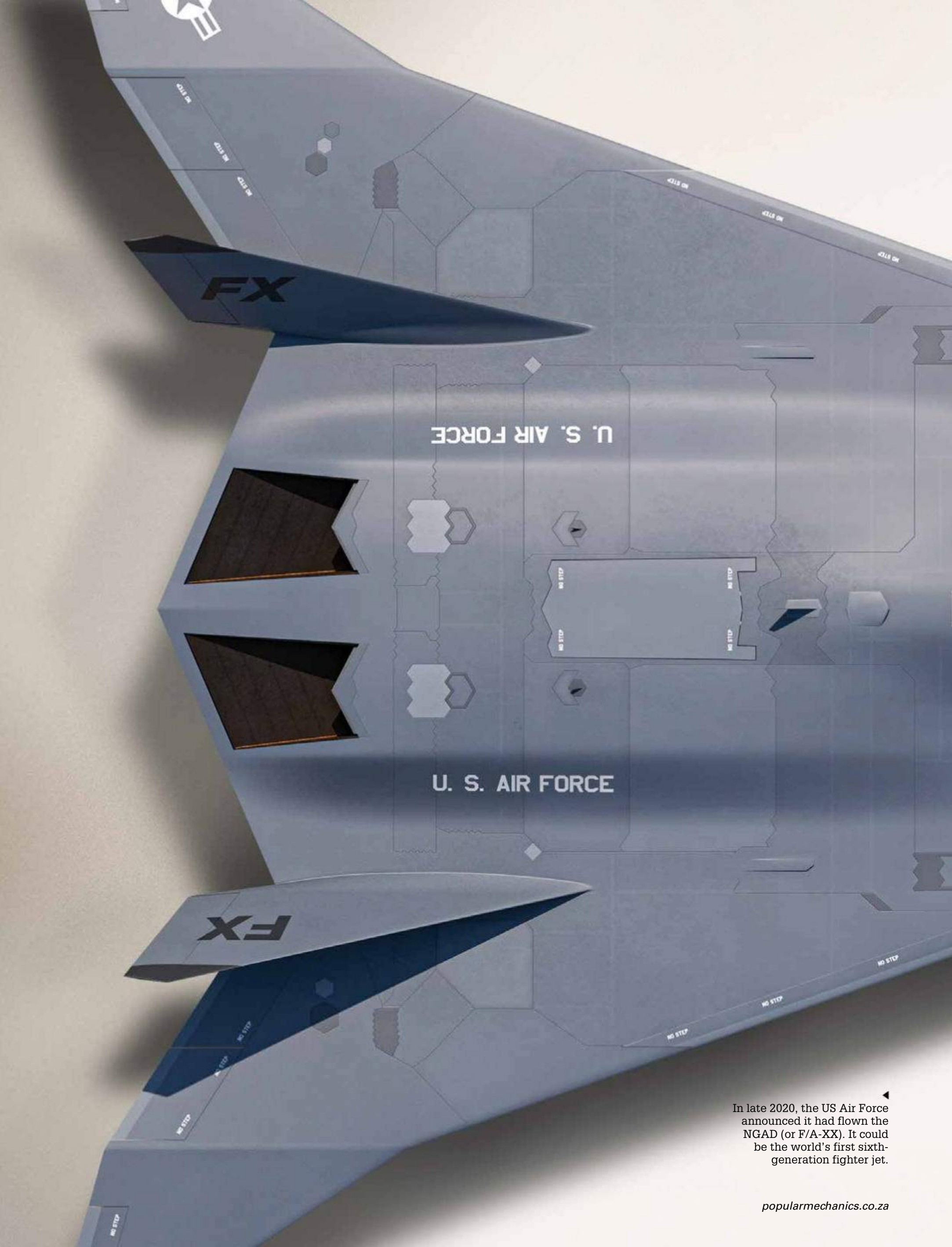


In late 2020, the US Air Force announced it had flown the NGAD (or F/A-XX). It could be the world's first sixth-generation fighter jet.

BY ALEX HOLLINGS

HOW AMERICA'S NEW FIGHTER WILL

OUTCLASS ITS COMPETITION

ILLUSTRATION: RODRIGO AVELLA

As China and Russia inch closer to rivalling America's top fighters, the US Air Force is on the hunt for a new jet. Dubbed the Next-Generation Air Dominance programme (NGAD), this effort is intended to replace America's hobbled fleet of F-22 air superiority fighters. While maintenance records indicate that just 33 F-22s are flight-ready at any given time today, China's fleet of Chengdu J-20 Mighty Dragons is estimated to number around 50 aircraft, and Russia's fleet of Sukhoi Su-57 Felons is growing, expected to reach 76 planes by 2028. America's air supremacy is at risk.

The J-20 and the Su-57 are stealth fighters designed for the contested airspace of a near-peer war. Most modern fighters specialise: America's F-35 Joint Strike Fighter serves a primary ground-attack role, while the F-22 Raptor is considered an air superiority fighter. Details are scarce regarding the sixth-generation NGAD fighter, but it will likely boast awe-inspiring capabilities that improve upon or offset the advancements of the previous generation, including the J-20 and Su-57. Examining the NGAD's competition provides clues as to what the new plane might bring to the table. The US Air Force's next jet can't just compete with these fighters. It has to exceed them.

The Su-57 is the first Russian plane to use stealth technology.

'Russia considers stealth useful ... but they show no interest in winning a stealth competition with the US.'

1 STEALTH

Stealth's series of overlapping technologies, production methods, and combat tactics is about surviving contested airspace, not becoming invisible. While some fourth-generation fighters leveraged topical treatments like radar-absorbent coating to delay detection, the Su-57 and J-20 were designed with stealth in mind from the ground up. The NGAD aircraft will thus have to lean into new technologies to make it harder to detect than any fighter before it.

Su-57 Felon » The Su-57's stealth capabilities fall between the advanced fourth-generation International Roadmap Super Hornet and the fifth-generation J-20, and it's 'closer to the former than the latter,' says Tyler Rogoway, aviation analyst. This calibre platform would offer a reduced radar cross section compared to fourth-generation jets in operation today, and it isn't comparable to America's fifth-generation fighters.

'Russia considers stealth useful in aircraft design, but they show no interest in winning a stealth competition with the US,' says Steve Trimble, defence editor for *Aviation Week*. Yet Trimble concedes that the first-production Su-57s demonstrate an evident improvement in body-panel tolerance over the prototypes.

J-20 Mighty Dragon » Experts can only speculate about the make-up and capability of the radar-absorbent materials coating China's J-20, but a clear influence from stolen design schematics for America's F-22 Raptor indicates stealth at least better than the Su-57's.

Computer modelling suggests the J-20's front canards make it difficult to detect when approaching head-on, but the plane's design has room for improvement. The J-20's fourth-gen engines dump heat out the back of the aircraft, but a rectangular faceted nozzle design in those engines would be more effective at minimising radar returns and reducing infrared detectability, according to a study from Michael J Pelosi, PhD, a professor of Information Technology at the University of Maryland, and Carlo Kopp, PhD, associate fellow of the American Institute of Aeronautics and Astronautics.

NGAD » The NGAD will almost certainly leverage an advanced radar-reflecting design and a full-body coating of radar-absorbent materials. Advanced heat distribution as energy is released from the aircraft, or a reduction in heat from the engines, could further lower the aircraft's infrared signature. On-board electronics that can jam enemy radar and communications, similar to those employed by the EA-18G Growler, could further harden the NGAD for a fight behind enemy lines.

PHOTOGRAPHY: ALAMY

2 AVIONICS

America's F-35 Joint Strike Fighter is often referred to by pilots as a 'quarterback in the sky'. It's a flying supercomputer designed to present vast amounts of data – friendly and enemy aircraft, ground assets, mission objectives, and more – in a single, simple user interface. Russia and China have each emphasised this technology in the Felon and the Mighty Dragon, so the NGAD must access and interpret data from a broader range of sources. Doing so may require artificial intelligence.

Su-57 Felon » The Su-57 exchanges data with nearby aircraft and ground assets, and couples that data with existing intelligence to offer a streamlined understanding of the battle space. These avionics operate on a concept called network centricity, a new architecture for the Russian military that can be improved via software updates to increase automation over time, freeing the pilot to engage opponents.

The Su-57 also pairs side-facing radars with a nose-mounted X-Band N036 Byelka (Squirrel) AESA radar system. These offer the Su-57 a wide field of view, enhancing the pilot's situational awareness.

J-20 Mighty Dragon » The J-20 is believed to leverage a secure data link for advanced communications and data transmission. It boasts a chin-mounted infrared/electro-optical search-and-track sensor that scans the horizon for enemy aircraft, and a passive electro-optical detection system to identify target aircraft at a distance without putting off any electromagnetic energy that might compromise the aircraft's profile.

On-board systems combine radar information with infrared imaging for an integrated view of the battle space via holographic head-up display and LCD touch screens. These systems can determine speed, rate of closure, and even the type of aircraft being targeted. The primary screen in the J-20's cockpit is 24 by 9 inches (60 × 23 cm), with three smaller auxiliary displays.

China's first J-20s reached a top speed of Mach 2.55.

NGAD » Its avionics, sensors, and on-board computers should surpass the F-35's, thanks to an 'open system architecture' approach similar to that of your smartphone. Just as your phone is a collection of multifunction sensors and data processors, upgradable via periodic software downloads, so will NGAD's avionics be open to improvements over the platform's lifetime. 'Today's fighters are not just aeroplanes,' says Major Justin Lee, US Air Force F-35 pilot. 'They are systems of sensors and weapons fused together in an efficient package. And because everything is tied together, one software update can make the entire system significantly better in a matter of minutes.'

PHOTOGRAPHY: GETTY IMAGES

3 ARMAMENT

In order to maintain a stealth profile, fighters carry weapons internally, but some offer external hardpoints for mounting extra firepower. Russia and China maintain large fleets of non-stealth fourth-generation fighters, so their fifth-generation fighters will likely be leveraged in low-profile operations. The NGAD fighter might likewise carry its weapons internally as well, with an internal payload exceeding those of the F-35 and F-22.

Su-57 Felon » The Felon boasts a unique internal weapons bay configuration that can likely support between four and six medium-range air-to-air missiles. Two secondary weapons bays can be found in triangular structures under the fighter's wing roots. These open like clamshells to reveal short-range air-to-air missiles. Six external hardpoints can carry extra munitions.

The Su-57 employs a single 30 mm Gryazev-Shipunov GSh-30-1 autocannon, in Russian service since 1980, for close-range engagements. With a firing rate of 1 800 rounds per minute and incendiary armour-piercing projectiles, this weapon can be deadly at an air-to-air range of 800 metres and an air-to-ground range of more than 1 800 metres.

J-20 Mighty Dragon » The J-20 utilises one large primary bay for a variety of missiles and bombs meant for air-to-surface engagements, as well as two smaller lateral bays used for air-to-air weapons. The lateral bays allow the J-20 to keep its primary weapons bay closed while engaging other fighters, minimising the jet's radar signature even while it engages opponents.

But the J-20 was not designed for close-up dogfighting. As such, it has no cannon, making it the only fifth-generation fighter in the world that forgoes the guns. The J-20 also boasts four additional external hardpoints beneath its wings. In total, it can carry four weapons in its primary internal bay, one in each lateral bay, and four externally.

NGAD » The NGAD will likely come with the ability to operate in a formation of pilot-guided support drones, like those being developed by the air force's Skyborg or Boeing's Loyal Wingman programmes. These networked platforms will be able to extend the NGAD's sensor reach, engage targets on the NGAD's behalf, and serve as nodes between the NGAD and other nearby assets.

A power surplus on the new plane might support future directed energy weapons and defences, including laser-induced plasma filaments that can create infrared holograms to confuse inbound missiles.

The Su-57 has an expected service life of 35 years.

4 MANOEUVRABILITY

While the Su-57 is acrobatic and built for close-up dogfights, the J-20 emphasises avionics and weapon performance to engage at longer distances. The US favours the latter approach, thanks to their weapons with over-the-horizon reach, though the F-22 demonstrated surprising agility for this leaning. That could indicate the NGAD will invest in high manoeuvrability, even if its offensive systems continue the US Air Force's long-range legacy.

Su-57 Felon » The Su-57 is the only stealth fighter on the planet today to utilise 3D thrust vectoring controls. These allow the pilot to direct the outflow of thrust from the engines independent of the direction the aircraft is pointed, so the Su-57 can execute dramatic rolls and loops at low speeds, as well as orient itself in unique positions for attack (for example, pointing the fighter's nose down towards enemy aircraft while the engines' outlets keep the plane travelling in a forward direction).

J-20 Mighty Dragon » The first J-20s did not incorporate thrust vector controls, but China has announced that their latest iteration of the fighter, the J-20B, will include the capability. Some experts think the J-20's length and aerodynamic profile make it poorly suited for the acrobatics of an air superiority fighter, but J-20 test pilots have said the aircraft is comparable in agility to China's fourth-generation fighter, the J-10. Analysis from Chinese aeronautical engineer Song Wencong, PhD, also suggested the jet could be more agile than what many experts predicted, but the plane's acrobatic chops remain in question.

NGAD » The F-22 Raptor offers similar, but inferior, thrust vector controls to those of the Su-57, suggesting the US Air Force prefers a sharpshooter fighter that can maintain the ability to scrap in close quarters. However, recent air force renderings of the NGAD programme depict an aircraft without a vertical tail like those found on the F-35 and F-22. While not without precedent on a stealth fighter, this absence could indicate a stealth-heavy platform that sacrifices greater control surface on the tail, and thus acrobatic performance, for a lower profile.

As depicted by Boeing, the NGAD's engine intakes are shielded from radar below.

NGAD's design can lean into specificity while its competitors are forced to balance disparate capabilities.

PHOTOGRAPHY: ALAMY (J-20), BOEING CONCEPT ART (NGAD)

5 OVERALL PERFORMANCE

The Su-57 and J-20 represent their respective nations' first effort to field a tactical stealth aircraft, and as such, they're meant for broad mission sets with low specialisation. The NGAD might shine via the opposite approach: It will likely be purpose-built for sky combat. NGAD's design can lean into specificity while its competitors are forced to balance disparate capabilities.

Su-57 Felon » Future iterations of the Su-57 are expected to field new Izdeliye 30 engines, but the current Felons' less-powerful AL-41F turbofan engines are capable of speeds in excess of Mach 2, with a service ceiling of 66 000 feet, and a rate of climb of 1 180 feet per second. This power, combined with thrust vector controls, makes the Su-57 a speedy and acrobatic adversary. While exact range figures vary, it is believed the Su-57 has a supersonic range of more than 1 450 km, or 3 000 km at subsonic speeds and carrying external fuel tanks.

The Su-57 also boasts directional infrared countermeasure systems that use laser turrets to blind incoming infrared missiles, and robust landing gear to utilise less-developed airfields. It might not be the best fifth-generation fighter on the block, but the Su-57 appears well balanced and fierce.

J-20 Mighty Dragon » The J-20 jettisoned its Russian-designed AL-31 engines in favour of a modified version of China's Shenyang WS-10 turbofan, which will offer a slight increase in thrust until China's more advanced WS-15 engines – purpose-built for high-performance stealth applications – come online. Chinese officials claim the WS-15 will bring the J-20's overall performance to an even footing with America's F-22 Raptor. Concerns about the J-20's agility and lack of on-board cannons place it behind the Su-57 in terms of close-range dogfighting capabilities, however. But defence experts don't agree on how practical close-range dogfighting is in the 21st century, so it's difficult to say whether these deficiencies will haunt the plane.

NGAD » The US Air Force has taken pains to present the NGAD programme as anything but a traditional fighter development effort. This is not the production of a single platform, but rather a family of systems, and that might be the future plane's greatest strength. Advancements made under NGAD will likely find their way into crewed and drone platforms that work in concert with one another, making the heightened capabilities offered by these aircraft more than the sum of their parts. The stated aim of NGAD is air dominance, and with China's J-20 now a decade-old design, and Russia's Su-57 even older, that goal seems within reach. **PM**

The Emeco 1006 chair is hand-built in Hanover, Pennsylvania, and will last 150 years.

PHOTOGRAPHY BY **SCOTT SUCHMAN**

THE WORLD'S FIRST TACTICAL CHAIR

BY **CORY GRAFF**

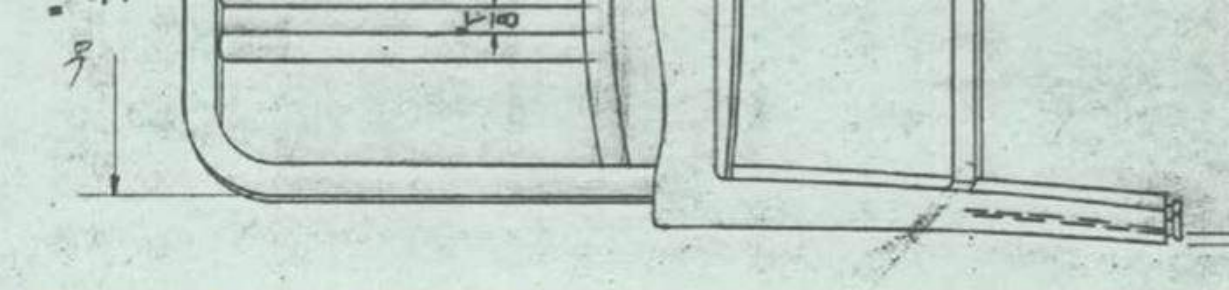
How a chair designed to survive torpedoes became a timeless icon of industrial design.

FIRE KILLS WARSHIPS. IN THE EARLY DAYS OF World War II, the USS *Vincennes* was set ablaze when Japanese shells shattered the heavy cruiser's hangar space. The damage itself was not fatal, but the boat's own paint and inventory – spare aeroplane parts, life jackets, and machine oil – fed the fire, lighting up the night sky to attract more heavy-calibre gunfire. In the early morning hours of 9 August 1942, the *Vincennes* rolled over and sank near Savo Island in the South Pacific.

As similar losses mounted, the US Navy embarked on a campaign to rid its combat ships of almost everything that would ignite. A new ban prohibited cork insulation, linoleum flooring, rugs, and curtains, along with items from sailors' personal belongings, such as excess books, dress uniforms and hair oils. When elimination proved impossible for some necessary items, such as wooden mess benches, the Navy sought non-flammable alternatives.

A proposal seeking submissions for a new shipborne chair caught the attention of a young Baltimore engineer named Wilton Dinges. The chairs had to be waterproof, fire- and corrosion-resistant, and light yet tough enough to endure constant abuse and withstand a torpedo blast. With help from aluminium producer Alcoa, Dinges created the seven-pound (3.1 kg) Model 1006 ('ten oh six').

Due to wartime scarcity, Alcoa could only supply Dinges with the softest zero-temper aluminium, recycled from scrap. But he used this to his advantage, leveraging the malleable state of the metal to craft the chair's gentle back curve and tapered front legs. Dinges then exposed the soft aluminium to a series of heat and acid treatments that achieved a hardness three times that of steel. Later testing showed that a single chair could support 770 kg.



To prove the 1006's strength and resilience to the navy, Dinges held a demonstration from an eighth-storey hotel room in Chicago. With naval officers watching, Dinges dropped his chair from the window. In a silver blur, the 1006 streaked towards the ground, bounced, and clattered to the curb unharmed. Dinges won the contract and established the Electric Machine and Equipment Company (Emeco) to produce it. In 1944, the first chairs equipped US Navy submarines.

Through the end of the war, the chairs survived kamikaze attacks near Okinawa, and weathered two typhoons in the Pacific. When the US military tested two atomic bombs at Bikini Atoll in July of 1946, the chairs adorning the interior of the battleship USS *Nevada* were 'little disturbed' by a nuclear weapon set off just 560 m away.

After the war, Emeco built its current factory in Hanover, Pennsylvania, and kept making chairs for the military while expanding to other institutions – restaurants, schools, and hospitals – in need of aesthetically clean and physically tough furnishings. Practically indestructible, the chairs are built to last 150 years. The first World War II-era 1006s are just hitting the midpoint in their lifespan.

But the chair's popularity and military orders began to fade near the end of the 1970s as new furniture styles and cheap imports became available. The handcrafted pieces made in the US were comparatively expensive – today a single chair costs $595 – and institutions often chose to save a buck by procuring lesser substitutes. Emeco was slowly dying and Dinges sold the company to restaurant design businessman Jay Buchbinder in 1979.

Emeco scraped along until Buchbinder's son, Gregg, acquired the company in 1998 and discovered it was actually on the verge of a boom. 'I heard our customer service employee, Paulina, yelling into the phone, "No, I will not ship your chairs! You send the money first,"' says Gregg Buchbinder. 'I asked her who was on the phone, and she said, "Some guy … Giorgio Armani."'

In a search of Emeco's customer files, Buchbinder found huge names in fashion, architecture, and interior design, including the likes of Terence Conran, Frank Gehry, and Philippe Starck – and he began reaching out to them.

'When I met Gregg,' says Starck, 'it was a revelation. I told myself I had to work with him to participate in this magic.'

As the 1006's popularity grew, interior design adopted the chair as its 'little black dress'. The streamlined profile of subtle curves and rounded corners over polished joints is neutral yet elegant. It went with almost anything.

The designers also celebrated the chair for the craft they recognised in Dinges's still-followed process. 'When one sees an Emeco,' says Starck, 'one can feel the experienced hand, one can feel the hours of polishing, the perfection of the gesture repeated over and over again.'

THE 77-STEPS, SIMPLIFIED

The 1006's two-week production cycle remains unchanged since 1944.

Emeco technicians begin by cutting the chair's 12 pieces from aluminium sheet and square stock (A) with an eight-ton power squaring shear and radial-arm saws. Presses stamp out the seat pan (B) and bend the curves into spindles and rails, says Josh Fisher, an 11-year Emeco veteran who's worked on every step of the process. 'And we use forming dies to make the front legs from sheet.'

With the 1006 components ready, workers cut holes into the chair's body where pieces join together (C). 'The pieces actually fit into one another instead of just being butt-welded on the surface,' Fisher says (D). 'It is one of the most difficult steps in the process because you have to be very precise with the routered holes. Exacting joints make for a strong, nearly flawless chair.'

Assembly mates the prepped parts with hundreds of inches of aluminium welding, all done by hand. Once built, craftsmen grind most of the welds flat (E) and polish the seams. As the weld beads disappear, the chair begins to appear as if it was cut from a block of metal. 'The undersides on the chairs still have the raw welds left to be seen,' Fisher says. It's the calling card of an original Emeco product.

The soft aluminium is then strengthened with the application of heating and cooling cycles to produce uniformity of the particles

PHOTOGRAPHY: EMECO (CHAIR DRAWINGS), PREVIOUS SPREAD:TY FEAGUE/UNSPLASH (HEADLINE BACKGROUND)

B

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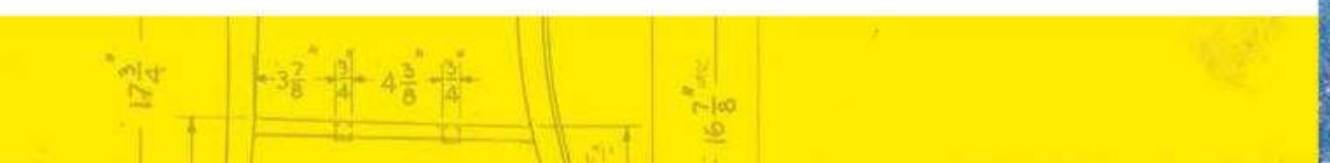
THE PROFILE OF SUBTLE CURVES AND ROUNDED CORNERS OVER POLISHED JOINTS IS NEUTRAL YET ELEGANT. IT WENT WITH ALMOST ANYTHING.

C

D

E




F
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YOU NOT ONLY GET THE CHAIR, YOU GET A PIECE OF THE CRAFTSPERSON.

G

within the metal's grain structure. This limits movement and flex for a stronger chair. 'The best way I can describe our heat-treat process,' Fisher says, 'is to imagine a stack of paper. When you bend it, the sheets slide on top of one another. As it goes through the ageing process, it's like running big staples down through that stack of paper so they no longer slide freely on top of one another.'

The details of Emeco's heat-treatment are proprietary, but an initial 515°C salt bath (F) takes the aluminium from zero-temper to T4. The T-codes designate different types of thermal treatments used to harden the aluminium. The chair is cooled in a water bath for 10 minutes, squared up to eliminate wobble, and baked overnight to take the aluminium up to T6 – three times the hardness of steel.

'The next stop for the chair is sanding and polishing via the "Sand-O-Flex" process' (G), says Fisher. 'The chair gets clamped into a vice and a skilled worker applies the final finish with handheld brushing tools. It's a dirty job that takes hours of work.' Once it's clean and smooth, the final step for each chair is anodising (H) – dunking it in an acid bath with an electric current – to transform the outer aluminium to a durable aluminium oxide finish 'next to the hardness of a diamond,' says Emeco.

'After that, we box them up,' says Fisher (I).

The chairs ship across the world to high-end designers, stadiums, schools, businesses, restaurants, and anyone who wants to have a piece that will last forever in their homes. 'Though originally made for warships, the 1006 – and the heart and soul that goes into making it – will last a lifetime no matter where in the world it ends up,' says Fisher. 'You not only get the chair, you get a piece of the craftsperson.' **PM**

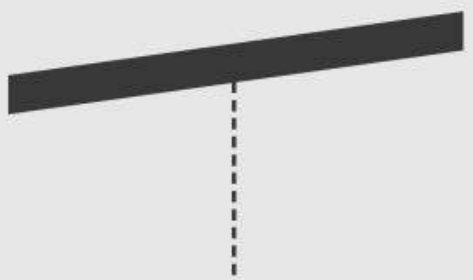
H

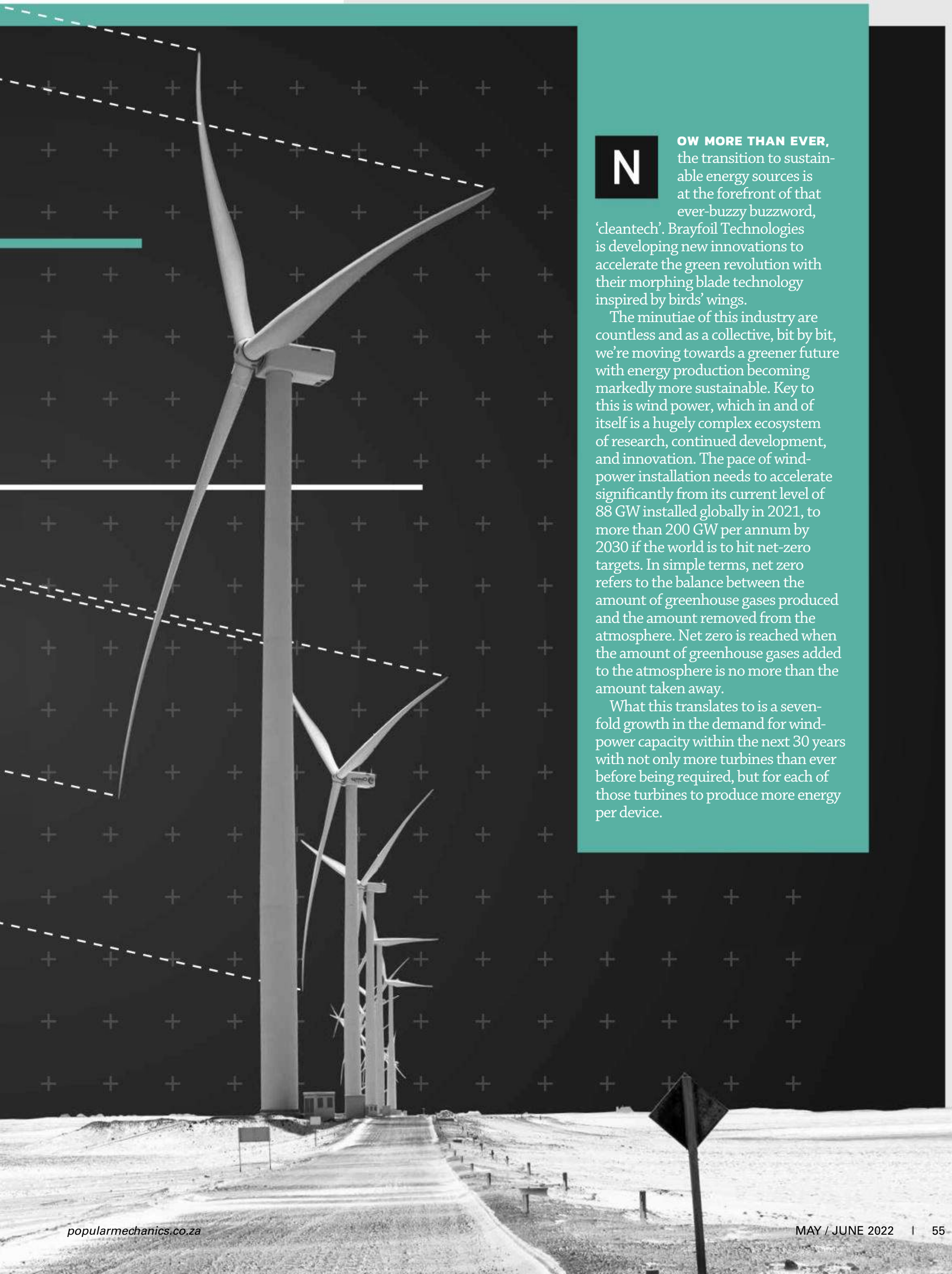
I

/ BY JOHN WHITTLE /

WINDS OF CHANGE

Local start-up Brayfoil Technologies is fast becoming an established name in the sustainable energy sector, with their pioneering work creating shape-altering biomimetic blades for wind turbines.

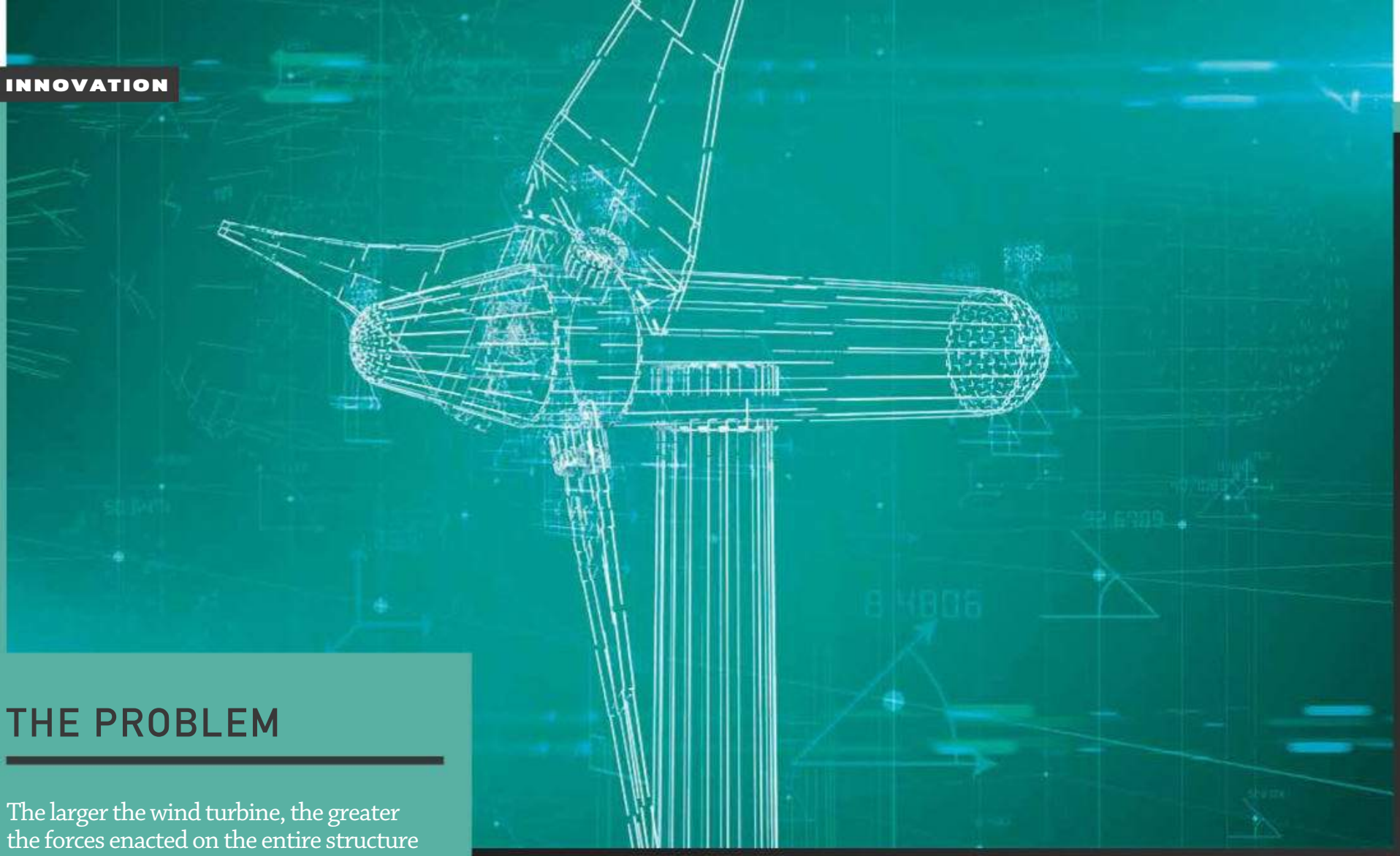




NOW MORE THAN EVER, the transition to sustainable energy sources is at the forefront of that ever-buzzy buzzword, 'cleantech'. Brayfoil Technologies is developing new innovations to accelerate the green revolution with their morphing blade technology inspired by birds' wings.

The minutiae of this industry are countless and as a collective, bit by bit, we're moving towards a greener future with energy production becoming markedly more sustainable. Key to this is wind power, which in and of itself is a hugely complex ecosystem of research, continued development, and innovation. The pace of wind-power installation needs to accelerate significantly from its current level of 88 GW installed globally in 2021, to more than 200 GW per annum by 2030 if the world is to hit net-zero targets. In simple terms, net zero refers to the balance between the amount of greenhouse gases produced and the amount removed from the atmosphere. Net zero is reached when the amount of greenhouse gases added to the atmosphere is no more than the amount taken away.

What this translates to is a seven-fold growth in the demand for wind-power capacity within the next 30 years with not only more turbines than ever before being required, but for each of those turbines to produce more energy per device.



THE PROBLEM

The larger the wind turbine, the greater the forces enacted on the entire structure – this is an inherent issue with large wind turbines. Aero forces are created from all wings, including wind-turbine blades; this is what allows them to generate power from the wind. However, these shapes also create forces beyond what is required to generate power, resulting in excess loadings during operation and massive loadings during storm events.

These maximum loadings are what entire wind turbine structures are designed around, ultimately impacting material costs, turbine size and energy outputs. Larger turbines are better turbines due to the non-linear way in which wind power scales – a blade length increase of two times results in a threefold output increase. As a result of this, wind turbines have been getting bigger, with the largest offshore units sporting blades of up to 116 m in length.

Due to the limiting factors of loadings, size and reliability are limited too. As a result, turbine manufacturers are actively seeking load mitigation solutions that can bring down extreme loads, while maintaining the power outputs of the turbines.

1

1. One of the main factors limiting the size of turbine blades is the logistics around transporting them – they are often more than 100 m in length.
2. Brayfoil's patented technology allows for the morphing of a blade to suit prevailing conditions, the desired outputs, or both.
3. The design of Brayfoil's blade is inspired by the dynamic nature of the wings of a bird of prey.

THE SOLUTION

What if the intrinsic shape of the blade could change? Perhaps in the same way that a bird's wing changes shape during different flight scenarios, giving lift when needed but then morphing in shape to dial back the forces as the wind gets stronger.

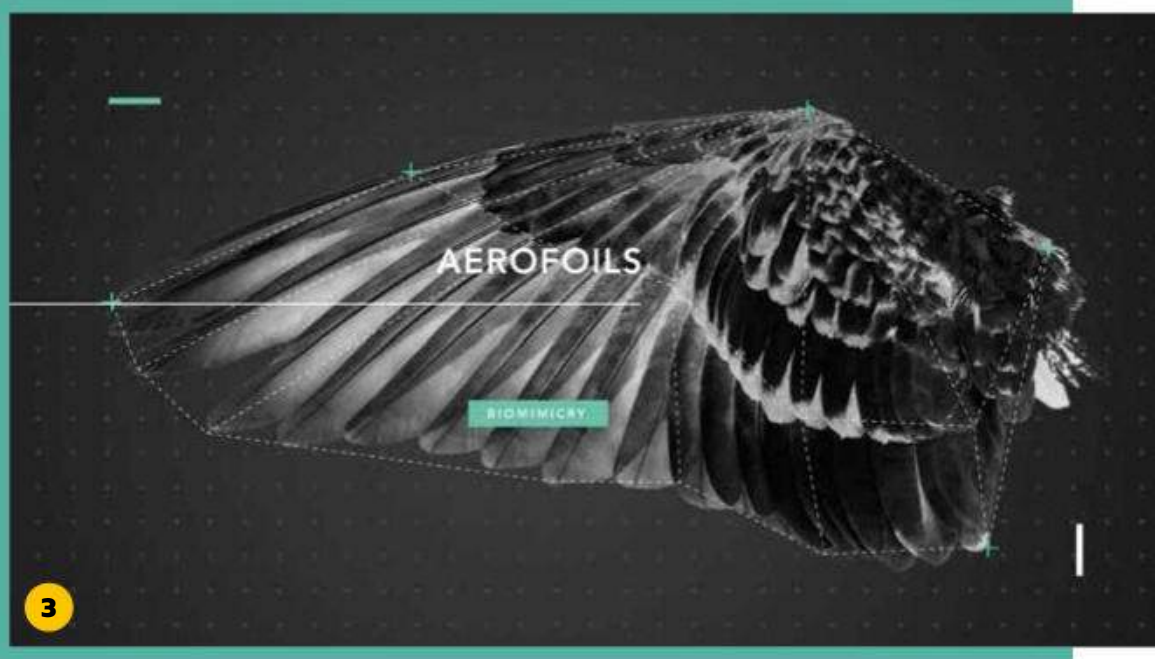
South African start-up Brayfoil Technologies has patented a method of changing the shape of a wing in operation, while linking that shape change to the pitch of the wing. A technological breakthrough sought after by some of the world's largest innovation and aerospace agencies, but never quite perfected to the point of being viable, Brayfoil's intellectual property offers a groundbreaking new way of thinking about how wings operate, which replaces complex shape-change systems (such as flaps and ailerons on aircraft wings) with a simple shape-changing shell.

Coupled with a unique approach to pitch angle, with pitch being driven by the physical forces created by the shape, this makes the blade's shape adapt faster to changing winds, much in the same way a bird's wing changes both the angle and the shape of its wing as it comes in to land.

What this translates to in a wind-turbine application is a reduction in the twist and camber in the blades, an astonishing reduction in storm loadings of up to 90 per cent, a decrease in operational loads of up to 24 per cent, and an increase in performance of up to 60 per cent during unstable wind scenarios.

The net effect here is lower forces on the entire structure, which can be used in a number of ways. Wind turbines can either be made more reliable, or the blades can be made longer. For the same structural strength at the base, the introduction of this tech is projected to allow a 13 per cent increase in blade length, which relates to a significant 25 per cent annual energy production increase. Technology such as this would change the economics of wind power even further, resulting in a 20 per cent decrease in the lifetime cost of energy, particularly valuable in offshore floating wind-turbine applications which are currently in need of enabling technologies in order to bring costs down.

Another important aspect of this is the advances in recyclability. Recyclable resins and composites are becoming the industry standard, and these are advances with which Brayfoil's technology is well aligned, while not changing the manufacturing process significantly. With cost estimates suggesting that the tech could be capex and opex neutral, this will be a major focus of future development.



▲ Matthew Bray, Co-founder and CEO of Brayfoil Technologies

WHERE IT ALL STARTED

During Matthew's school years, he and his father Robert Bray worked together on many of his science projects. These included exhibiting in the Taiwan and Namibian international science fairs, as well as building an electric car together when Matt was 14.

Matt and Robert's shared passion for innovation, coupled with Robert's illustrious career as a prolific architect in South Africa and Matthew's background in finance at Goldman Sachs and BASF, made for the perfect foundation for Brayfoil's revolutionary technology. Brayfoil has grown from a passion project in Robert's garage into a groundbreaking emerging technology that has gained international recognition from some of CleanTech's most respected institutions. It's all a remarkable legacy left behind by Robert Bray, who sadly succumbed to complications from COVID-19 in 2020.

1. Highly experienced artisans lay up composites for a blade section; a whiffletree test rig and a scaled-down prototype can be seen in the background.
2. Offshore wind power generation amounted to a whopping 25 TWh in 2020.

GAINING TRACTION

Brayfoil's morphing blade technology has been wind-tunnel tested at the University of Stellenbosch and the CSIR, with thorough computational fluid dynamics (CFD) analysis having also been performed. The team has built working prototypes (at 7.5 m long) of a 1:10 scale five megawatt blade and a 1:3 five megawatt blade segment, all of which morph effectively.

$1m (around R14m) was raised from the Technology Innovation Agency in 2019 for the construction of a pilot project, which is set to go up at the University of Stellenbosch during the second quarter of this year. The turbine will be 24 m high with 7.5 m blades, and will be coupled with dynamic modelling of large-scale turbine performance using software from the National Renewable Energy Laboratory in the United States.

In total, the team has obtained $2.3m (approximately R35m) since inception in 2017, from angel investors, government grants and venture capitalists. Funding was also raised from the Norwegian venture capital fund Katapult Ocean in 2021, one of the top 50 climate investors in the world, while Brayfoil has just been selected to receive grant funding from the UK government as a part of the TechX accelerator with the Net Zero Technology Centre, in collaboration with bp Ventures, Equinor Ventures and Accenture. At Hello Tomorrow 2019 in Paris, Brayfoil was identified as one of the Top 100 Deep Tech Pioneers, and in 2021, they were a part of the prestigious CleanTech Open accelerator programme out of the USA, as well as Creative Destruction Lab's Climate Stream at the HEC Paris business school .

The path ahead for Brayfoil is not straight cut, but in a world where wind energy is very clearly one of the major components in the push towards 'net zero', the company's technology stands out as a viable and cost-effective way forwards for the energy industry. Following the pilot project, the team will be seeking further funding to build a full-scale pilot project. They will also be engaging with industry partners, ultimately taking their breakthrough technology to market, either via licensing to manufacturers to incorporate into the next generation of turbines, or by building blades for the retrofit market.

The company was started by father-and-son team Robert and Matthew Bray, on the back of 15 years of research and prototyping by Robert. Brayfoil's remarkable technology was inspired by the shapes formed by bird's wings in flight, particularly how they change curvature. This was first observed by Robert in Cape vultures at Marakele Game Reserve. What he saw subsequently tied in with further investigations carried out by Oxford University researchers in 2009. This work showed similar shape changes in owl wings. This is all yet another example of nature inspiring advances in industrial design, which is bringing us closer to a more sustainable future. PM

THE BRAYFOIL TEAM

While their work is set to be revolutionary, it's the personnel at Brayfoil who deserve special mention:

- **Matthew Bray** (MScFinance; ex-Goldman Sachs and BASF): **Co-founder and CEO**
- **Shailin Moodley** (Aeronautical Engineering, Wits; sold his AI/ML start-up to IBM): **Lead Engineer**
- **Mushir Khan** (MScEng, University of Houston; ex-head of Engineering for Worley SSA): **CTO**
- **Hrishabh Rajeev** (BEng, University of Cape Town): **Junior Engineer**
- **Kieron Baart** (Final year BEng, University of Pretoria): **Engineering Intern**
- **Thamba Nkabinde: Workshop Manager**
- **Flerry Tshabalala: Composite Artisan**
- **Reuben Nkadibeng: Composite Artisan**

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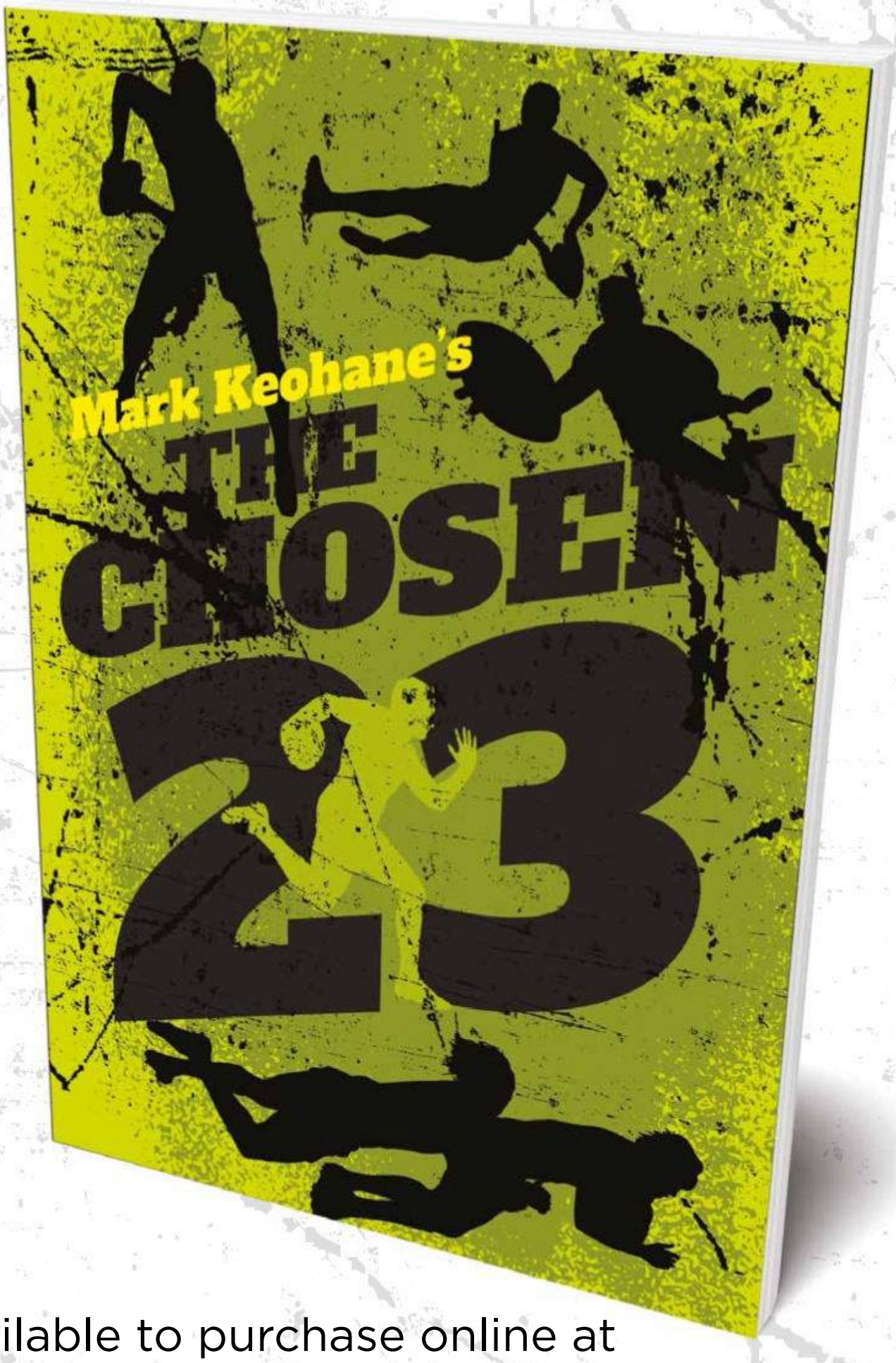

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/ BY BRENT ROSE /

The smart bulb that gave light a new purpose

BEING ABLE TO CHANGE THE ENTIRE LOOK and feel of a room with the press of a button or a quick voice command is one of those rare things that makes you feel like you're living in the future. Colour-changing lights have existed for years, but never in a form that was useful. They were typically big, clunky fixtures that you had to plug into a wall, took up valuable shelf space, and required a remote to control. They certainly weren't elegant – mere novelty items at best.

The Philips Hue bulb as it looks today – not much different from its original debut LED form in 2011.

Plain white LED bulbs had an equally rocky start. By the end of the 2000s, you could replace a standard incandescent bulb with one, but they were still generally ugly, with bizarre fins around the bases, and they often cast an unpleasant shade of light. That left room for the development of LED bulbs that weren't eyesores and produced light that was more pleasing and useful. In 2011, a team at Philips had the idea of a bulb that could address several of those issues while providing some health benefits. But they ended up with something far more versatile, creating colour-changing lighting that didn't require a specialised gadget.

'When we started the design of Philips Hue, we were going for tunable whites,' says George Yianni, head of tech for Philips Hue and the person who originally conceived the project. 'We were aiming for something that could go from warm whites to cold whites.' The benefits

they were after ranged from boosting concentration and making reading more comfortable to helping you wind down for sleep.

'The only way we could actually build that and still have a decent light output was to use these special colour LEDs (whitish green, a red/orange, and a blue/purple), and mix those to get these different shades of white,' Yianni continues. 'And that gave us the benefit of colour, which we found very early on in the process was actually very well appreciated by consumers.'

Yianni said he and his team realised they were on to something after they seeded some very rough prototypes of Hue to consumers to see how they would use them in their day-to-day lives. Many testers refused to give the bulbs back.

What engendered that love were the two major aspects that differentiated Hue – and fixed the problems with LED whites and colour-changing lights in a single product. Not only could the bulb emit virtually any colour of the rainbow, but it pretty much looked like a normal light bulb. The weird fins were gone, and the light it cast was even and diffuse. Most importantly, it fitted in the standard E26-size light sockets. You could pop a Hue into virtually any fixture you already owned, from overhead lights to your grandma's antique lamp, and it could transform the look of the whole room.

The other big differences were the way the bulbs communicated with each other and the way you communicated with them. Hue had a Bridge, a small puck that plugs into one of the Ethernet ports on your WiFi router. This allowed you to create and save elaborate lighting schemes, control them all from an app on your phone, or even automate them with other devices, in turn making those better and more useful. One Philips tester had the light blink pink whenever she received an email from Facebook. And the bulbs being able to talk to each other effectively extended the range, with each acting as a relay station, so you could control your lights even in rooms where the WiFi might be spotty.

To get Hue ready for prime time, Philips had some engineering hurdles to overcome. Getting an LED array, a microchip controller, and a radio into a standard bulb was challenging. Yet surprisingly, that wasn't so much due to size limitations as it was thermal constraints.

'Early LEDs were very much heat-limited because you can't run them super hot or the electronics fry,' Yianni says. 'You kind of play this balance of how you manage the heat with getting enough light output. We actually had to make

YIANNI AND HIS TEAM REALISED THEY WERE ON TO SOMETHING WHEN MANY TESTERS REFUSED TO GIVE THE BULBS BACK. ONE HAD SET THE HUE TO BLINK PINK WHENEVER SHE RECEIVED AN EMAIL FROM FACEBOOK.

custom LEDs to get a decent amount of light output in white. So we developed a special lime LED – kind of a whitish green – that's super energy-efficient. Your eye is most sensitive to green light wavelengths, so at the time this was one of the most energy-efficient ways to create perceived brightness. These multiple lime LEDs, together with direct red-orange and royal blue LEDs, were what we combined in our first-generation Hue bulb to deliver good-quality white light.'

Similar to how Philips set out to make tunable white bulbs and ended up with full-spectrum colour-changing ones, another crucial design decision within Hue, was sort of a happy accident. In the lead-up to the launch, Yianni and his engineers were behind schedule and didn't have time to develop all the features they had hoped to build in. They had to back-burner some in favour of working on a new one: making the software in the bulbs themselves updatable. This ended up being a boon, allowing Philips to roll out numerous updates and features over the years, including tricks for automation, compatibility with various sensors and switches, and rapid channel adjustments.

Philips sold out its launch stock in the first week, and the same has happened for many subsequent Hue releases. Yianni says the team has ambitions towards sleeker automation, but also to pivoting back to focus on those potential health benefits that were the original goal. Whether or not we can have better living through better lighting remains to be seen. But homeowners appreciate good design and problem-solving (and evidently, attractive colours). **PM**

PHOTOGRAPHY: PHILIPS HUE

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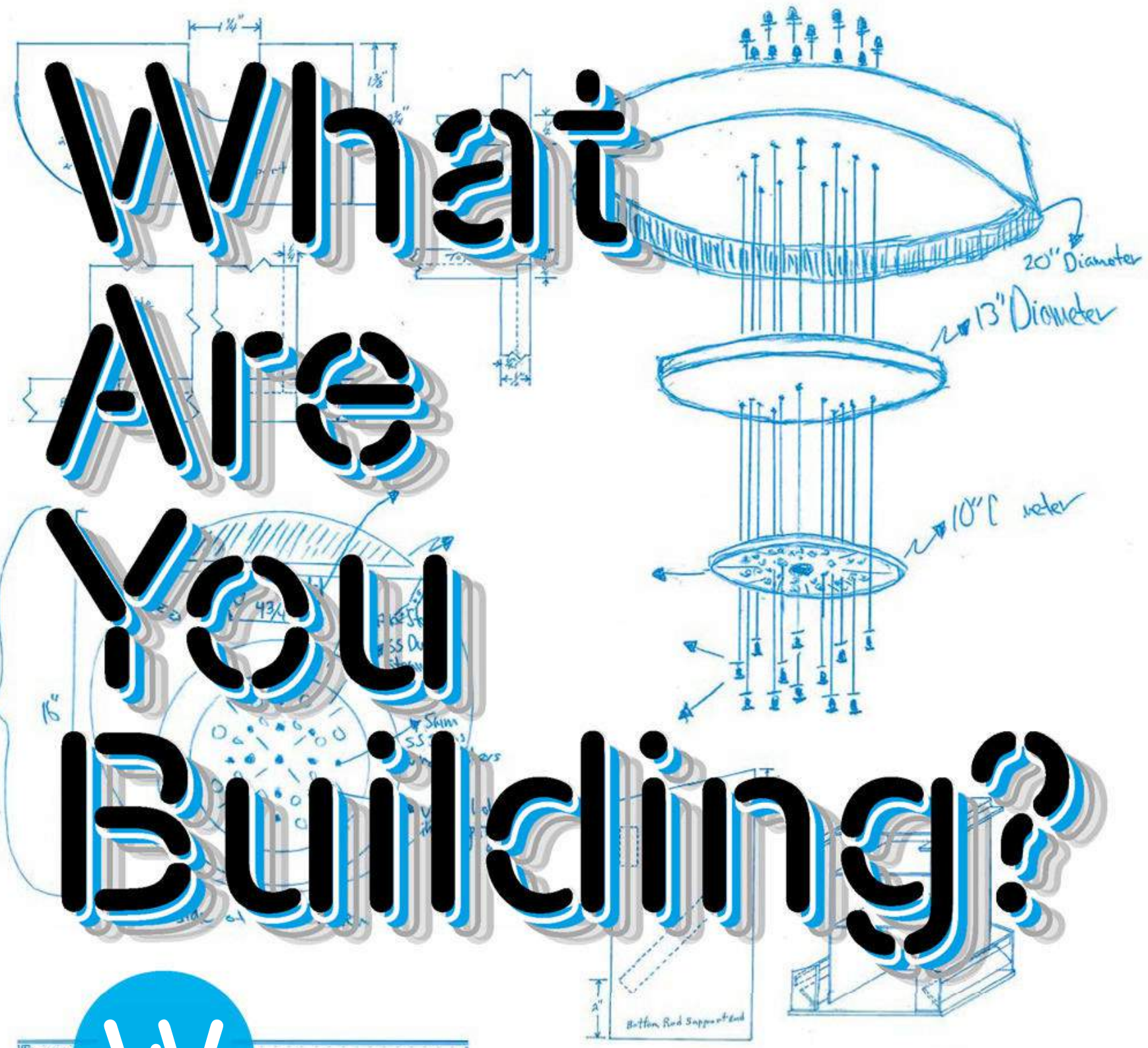
What Are You Building?



We build to solve problems, to help friends and family, and to enjoy the satisfaction of creating. But even in a time of cancelled plans and distancing, we still rely on each other for tips and direction. To strengthen the connection among builders, we reached out to some members of the Pop Mech community to share what they've made recently. You'll find inspiration in how they were able to make their lives a little tidier, more comfortable, and a lot more fun.

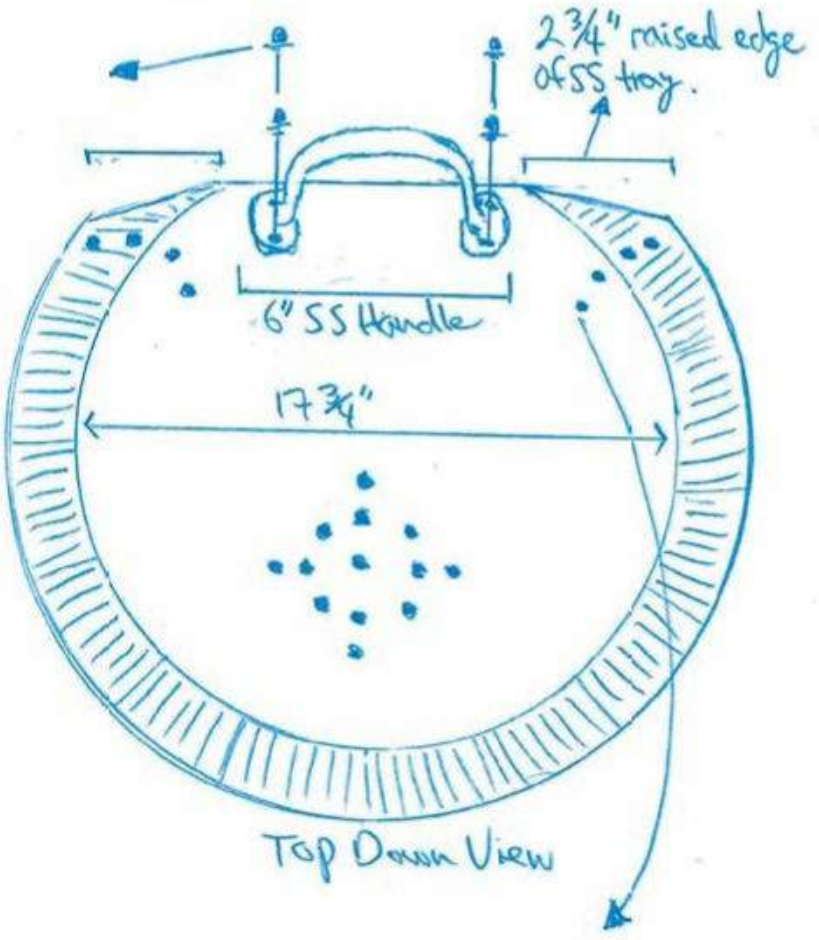


ILLUSTRATION: DEVIN STEWART, TIM FASZER, SCOTT FLICKINGER

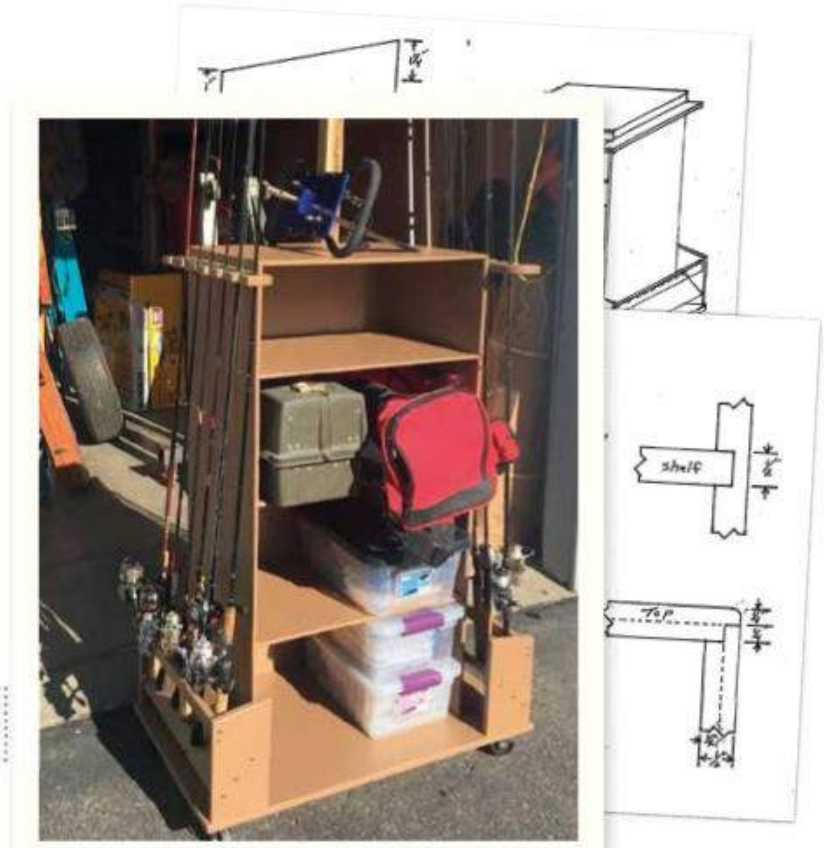
BY TIM FASZER, AS TOLD TO JOSEPH TRUINI

A cabinet for my fishing tackle

My son Matthew and I are avid outdoorsmen, and we fish year-round in the freshwater lakes and rivers near our home in eastern Washington State. Like most anglers, we've collected tons of rods and reels, tackle boxes and bags, and organisers for lures. And it's nearly impossible to keep it all neatly organised and safely stored away.

We saw a cabinet specifically designed for fishing tackle at our local outdoor-gear store. We liked the idea, but I knew I could build a better, sturdier cabinet with more capacity for a lot less money, and I could customise it for our specific equipment.

After taking inventory of our gear, we finalised the design on paper, bought the necessary materials, and built the fishing-tackle cabinet shown here. It features three storage shelves, and two fishing rod holders that each hold six rods and reels.



Part	Qty	Size/description
A	2	(sides) 12 mm plywood, 406 × 1 219 mm
B	1	(top) 12 mm plywood, 406 × 610 mm
C	3	(shelves) 12 mm plywood, 394 × 597 mm
D	1	(base) 19 mm plywood, 508 × 915 mm
E	1	(back) 6 mm plywood, 597 × 1 219 mm
F	2	(upper rod racks) 19 mm stock, 70 × 495 mm
G	4	(ends) 19 mm stock, 140 × 267 mm
H	2	(guardrails) 19 mm stock, 38 × 457 mm
I	2	(angled bases) 19 mm stock, 140 × 457 mm
J	4	(casters) 50 mm wheels, 2 with locks

MATERIALS

- 32 mm finishing nails
- 32 mm and 50 mm washer-head cabinet screws
- 20 mm pan-head screws
- Carpenter's glue
- Paint or other finish
- Adhesive-backed felt
- 120-grit sandpaper

CUT THE PLYWOOD PARTS

Cut the cabinet sides, top, and shelves from 12 mm plywood. Then cut the cabinet base from 19 mm plywood, and the cabinet back from 6 mm plywood.

Next, rout 6 × 6 mm rabbets into each end of the cabinet top and into the upper ends of the side pieces. Then cut 6 × 6 mm rabbets into the rear edges of the cabinet top, sides, and base to accept the back.

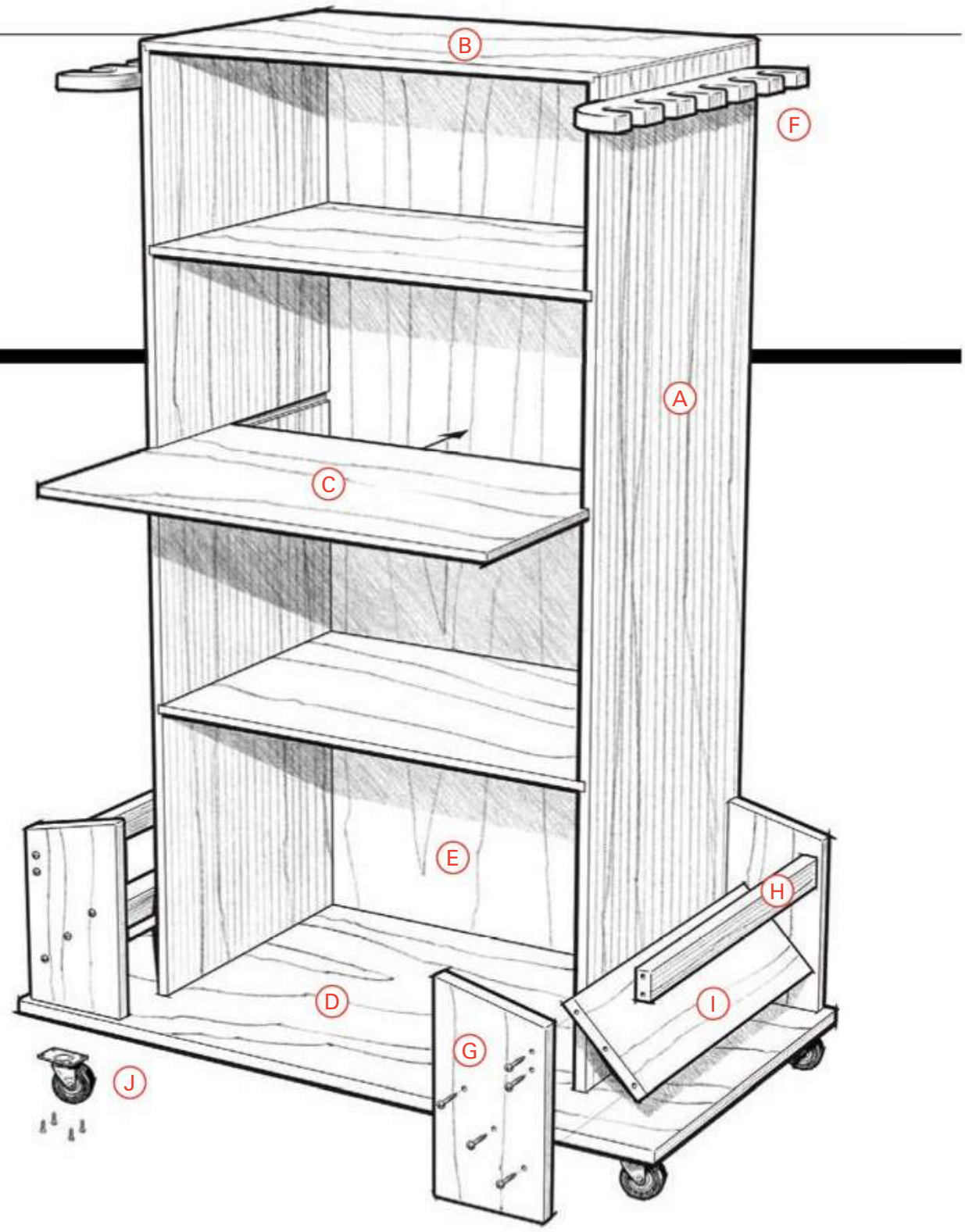
Lay the two side pieces on your workbench, and rout the 6 mm-deep dado joints that hold the shelves. I installed three shelves and spaced the top two 254 mm apart, and the lower shelf about 330 mm above the cabinet base, resulting in four storage compartments. Cut the dadoes using a router fitted with a 12 mm undersized plywood bit. Clamp a straight-edge guide in place to ensure straight cuts. Prepare to cut two 6 mm-deep × 13 mm-wide dadoes into the 19 mm plywood base to accept the cabinet side pieces: First, notch the bottom front corner of each side piece so it'll conceal the ends of the dadoes once the cabinet is assembled. Outline the notch in pencil on each side by measuring 13 mm back from the front edge, and 6 mm up from the bottom edge. Then use a jigsaw or handsaw to cut out the notches.

Clamp the cabinet together, with the top and shelves in place. Then set the assembled cabinet on top of the 19 mm plywood base, centred left to right and flush with the rear edge. Draw lines along the inside and outside of each side piece, marking their positions on the base. Mark the ends of the notches cut into the side pieces, too. Now move the cabinet out of the way and rout the two 6 mm-deep dadoes into the plywood base.

ASSEMBLE THE CABINET

Apply carpenter's glue to the six shelf dadoes, and to the rabbet joints cut into the top of the side pieces. Clamp the parts together and then hammer 32 mm finishing nails down through the cabinet top, and through the sides and into the ends of each shelf. Space the nails about 76 mm apart.

Lay the cabinet face down, and squeeze glue into the rabbets routed into the rear edges. Set the 6 mm plywood back into the rabbets and secure with nails. Now apply glue to the dadoes cut into the base. Stand the cabinet on the base, fitting



the side pieces into the dadoes. Secure the cabinet by nailing up through the underside of the base and into the bottom ends of the side pieces.

CUT THE FISHING ROD HOLDERS

I mounted a fishing rod holder to each side of the cabinet; each holds six rods and reels and has an upper and lower rod rack.

Each upper rack is a 70 mm-wide board with six notches cut into it – one for each rod – fastened to the cabinet side 25 mm below the top of the cabinet. The lower rod racks are made up of four pine parts: two ends, a guardrail, and an angled base.

Cut the upper rod racks to length from a 19 × 89 mm pine plank, then rip them to 70 mm wide. Use your jigsaw to cut the notches.

To make the two lower rod racks, cross-cut the four ends and two angled bases from a 19 × 89 mm plank. Cut the two guard-rails from a 19 × 38 mm plank.

BUILD THE FISHING ROD HOLDERS

Assemble each lower rod rack by setting the guardrail and angled base between the two end pieces. Position the guardrail about 25 mm below the upper front corner of the end pieces, and 6 mm back from the front edge. Place the angled base 50 mm from the bottom of the end pieces, and then tilt it back to 45°. Secure the guardrail and angled base with glue and screws.

Spread glue along the bottom ends of one of the assembled lower rod racks. Set it on to the cabinet base, and secure by driving 50 mm screws up through the underside of the base and into the rack's end pieces. Repeat to install the second rack to the opposite side.

Attach an upper rod rack to each side of the cabinet, positioned 25 mm below the cabinet top. Drive four 32 mm screws through the inside of the cabinet and into each rack.

Once the cabinet is assembled, ease all the sharp, square edges with a router equipped with a rounding-over bit.

Use a 5 mm-radius bit to ease the edges of the 12 mm-thick cabinet parts, and a 6 mm-radius bit to round over the 19 mm-thick parts. After routing, fill any cracks in the plywood edges with wood filler if needed. Once the filler is dry, sand all edges and surfaces with 120-grit sandpaper. Wipe away the dust with a tack cloth.

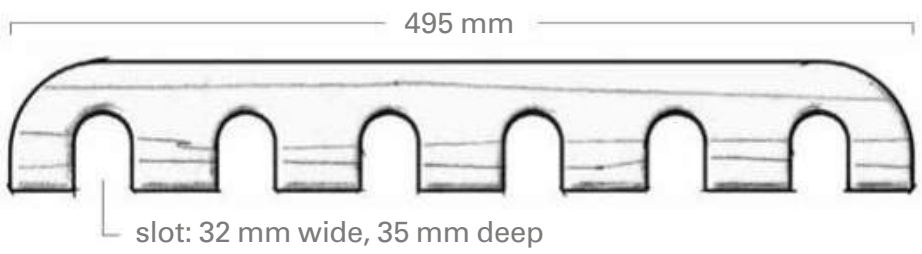
PAINT AND PRIME

Apply one coat of primer, followed by two topcoats of acrylic latex paint.

Allow the paint to dry overnight, then attach four 50 mm-diameter swivelling casters to the underside of the cabinet – locking casters in front, and non-locking in the rear. Fasten each caster with four 20 mm pan-head screws.

Last, line the notches in the upper rod racks with felt. Cut a 228 × 305 mm sheet of adhesive-backed felt into 19 mm wide strips, and stick to the inside of each notch.

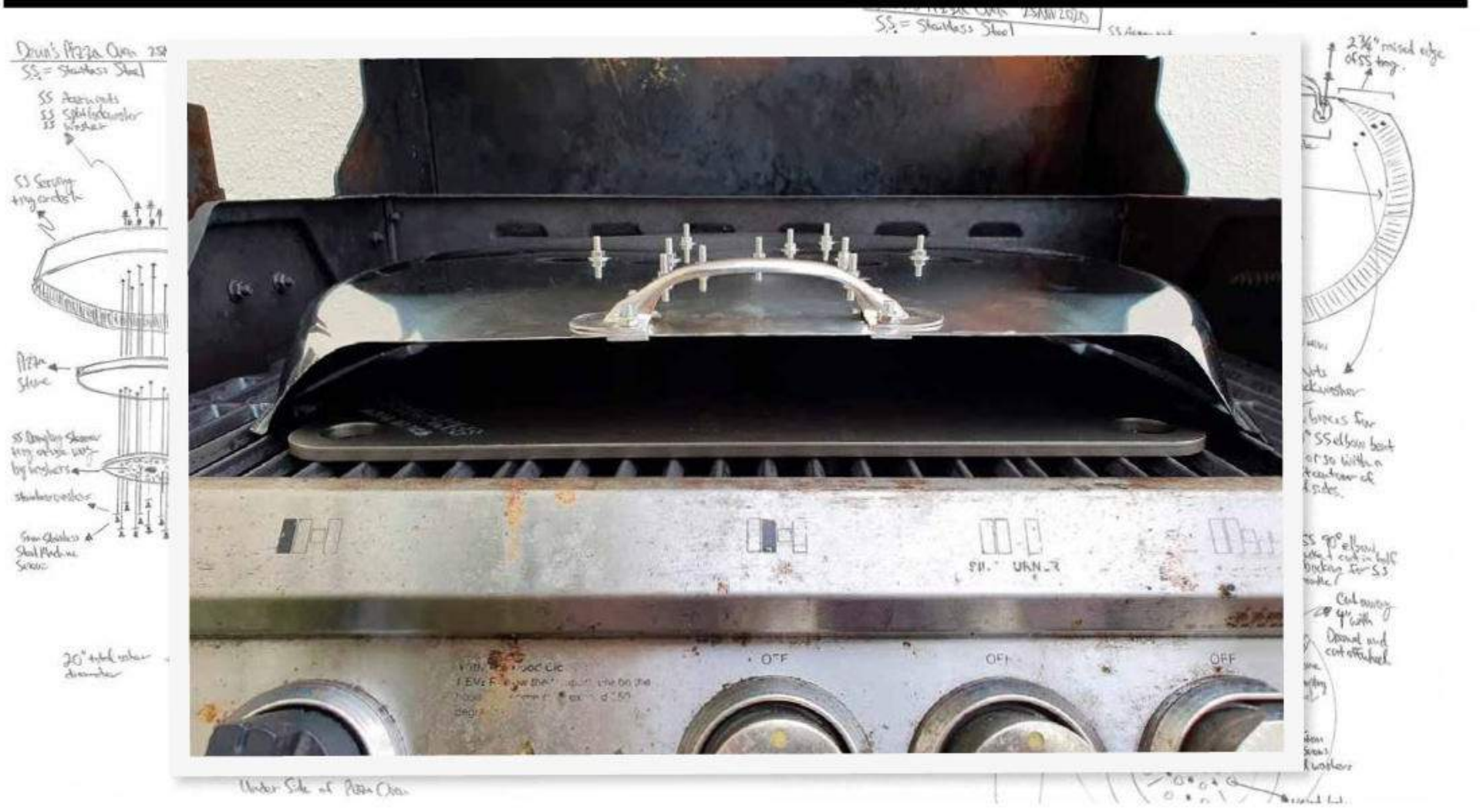
upper rod rack



ILLUSTRATIONS: GEORGE RETSECK; PHOTOGRAPHY: TIM FASZER

BY DEVIN STEWART, AS TOLD TO TAYLOR ROJEK

A grill-top pizza oven



Here in Singapore, we went into full-on lockdown in 2020. We were allowed to go to the grocery store, but otherwise we could not go anywhere.

And I just got a hankering for some pizza. But the ovens here are pretty small, like the size of a microwave. I tried to make a pizza on my gas braai by sliding it directly on to the grid, but it was just all right. I wanted that leopard-spotted bottom, and the charred bubbles on the crust. I saw online there were some pizza ovens selling in the US that go on top of a gas braai. And I thought, *maybe I can make something like that*.

My design uses a thick steel baking tray as the base, covered by a stainless-steel dome with a pizza stone attached at the top. The baking tray is a better heat conductor than the stone, which lets it run several degrees hotter. It works really well – it gets super hot on the bottom to give the crust that pizza crunch, while also trapping heat and reflecting it downwards to melt the cheese and make the top crust pillowy.

I'm originally from Texas, where barbecue is big. It's the simplest food, but to get it perfect is so hard. Pizza's like that too – to get it just right, it takes so much practise. I'm always trying to perfect it by studying types of dough and how to get the heat right (for tips, see 'How to make the perfect pizza' sidebar on p68).

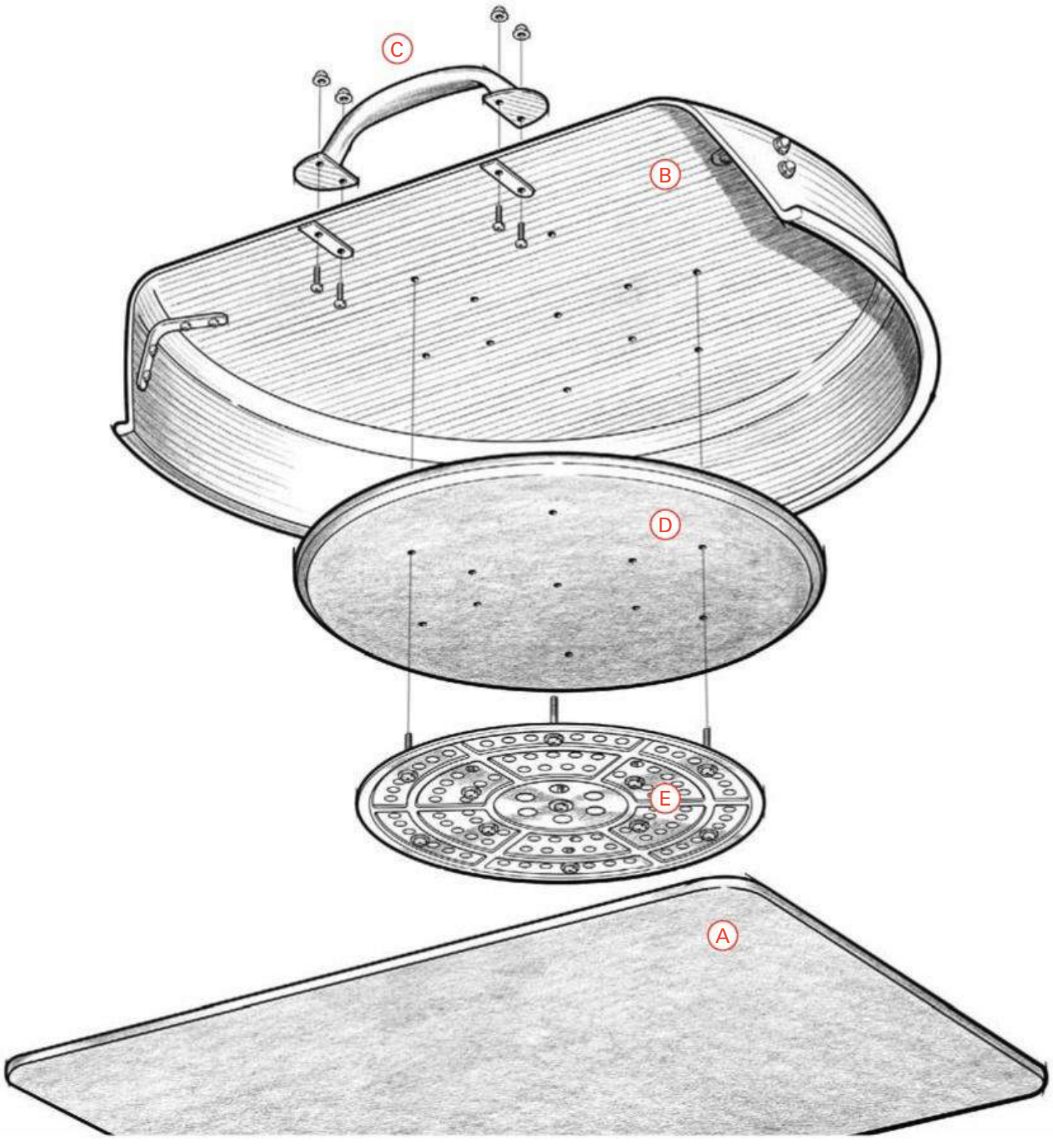
Creating the oven was a way for me to escape mentally and creatively during lockdown. It's also helped me reconnect with friends. Lockdowns have since eased up and we now have a few people over at a time. And people are pretty amazed. Like, 'Oh my goodness, you're making this on your grill!' Even in the middle of a pandemic, there's nothing better than good home-made pizza to share with friends.

MATERIALS

- **A** Steel-baking tray to fit your grill
- **B** Stainless-steel serving tray
- **C** 15 cm stainless-steel handle
- **D** Pizza stone – mine is 32 cm in diameter, but use what fits.
- **E** 25 cm stainless-steel dumpling tray

- 35 washers
- 23 5 mm stainless-steel screws
- 23 stainless-steel acorn nuts
- 23 split-lock washers
- 2 stainless-steel elbows

Even in the middle of a pandemic,
there's nothing better than
good home-made pizza to share with friends.



ILLUSTRATIONS: GEORGE RETSECK; PHOTOGRAPHY: DEVIN STEWART

FIT THE TRAY TO YOUR GRILL

My serving tray was too big to fit on my grill grate, so I cut off 10 cm on one side. That way, I was able to close the lid of the braai while the tray was on it without obstructing anything.

ATTACH THE PIZZA STONE

Install the stone towards the back as far as you can – it'll be warmer back there because the opening at the front allows hot air to escape. Use a mortar bit to drill holes to attach the stone and tray. Use all stainless-steel

hardware because with the heat and the expansion, it may get a little bit loose. I used 11 screws, with a dumpling steamer tray as one big retaining dish for all of them. Individual washers per screw would be fine; I just used what was available to me, and dumpling steamer trays are common here. It worked out really well because it's thin stainless steel.

With the dumpling tray, I needed a 25 mm-long washer for the 5 mm screw in the centre, but I didn't have one handy. I know in Japan and China, some of their coins are minted with holes in them. So I got a Japanese yen coin and it fitted right in the middle, and the hole that it's minted with fits a 5 mm screw perfectly.

ATTACH A HANDLE

The opening on the side of the pizza oven isn't big enough to slide the pizza peel in with the pizza on it. So I attached a stainless-steel cupboard handle to the top of the oven with

A Grill-Top Pizza Oven cont.

stainless-steel screws and washers. That way, I can just pick the oven up as one piece, get the pizza on the pizza tray quickly, close it down really quickly, and then shut the braai lid. The handle I used is 9 cm long, but I should have gone with a bigger handle (around 15 cm) so it could fit a gloved hand easier.

Tip: *I use a welder's glove rather than an oven mitt. The leather lasts and protects my hand better. Depending on how good you are with sliding the pizza off the peel, sometimes you have to hold on to the handle for a while.*

ATTACH ELBOW BRACES FOR STRENGTH

I had a problem with the stainless steel bowing with the weight of the stone and the heat. So I put elbow braces in the opening to keep it from flexing. The elbows were at 90°, so I just opened them each up by banging on the corner with a hammer until it conformed to the tray – about 120° or so.

HOW TO

MAKE THE PERFECT PIZZA

PLACE THE STEEL BAKING tray and oven top on the grill grate. Turn the grill on high, and let it heat up for 45 minutes. Check the temperature of the baking tray with a laser temperature gun – it should be about 260°C.

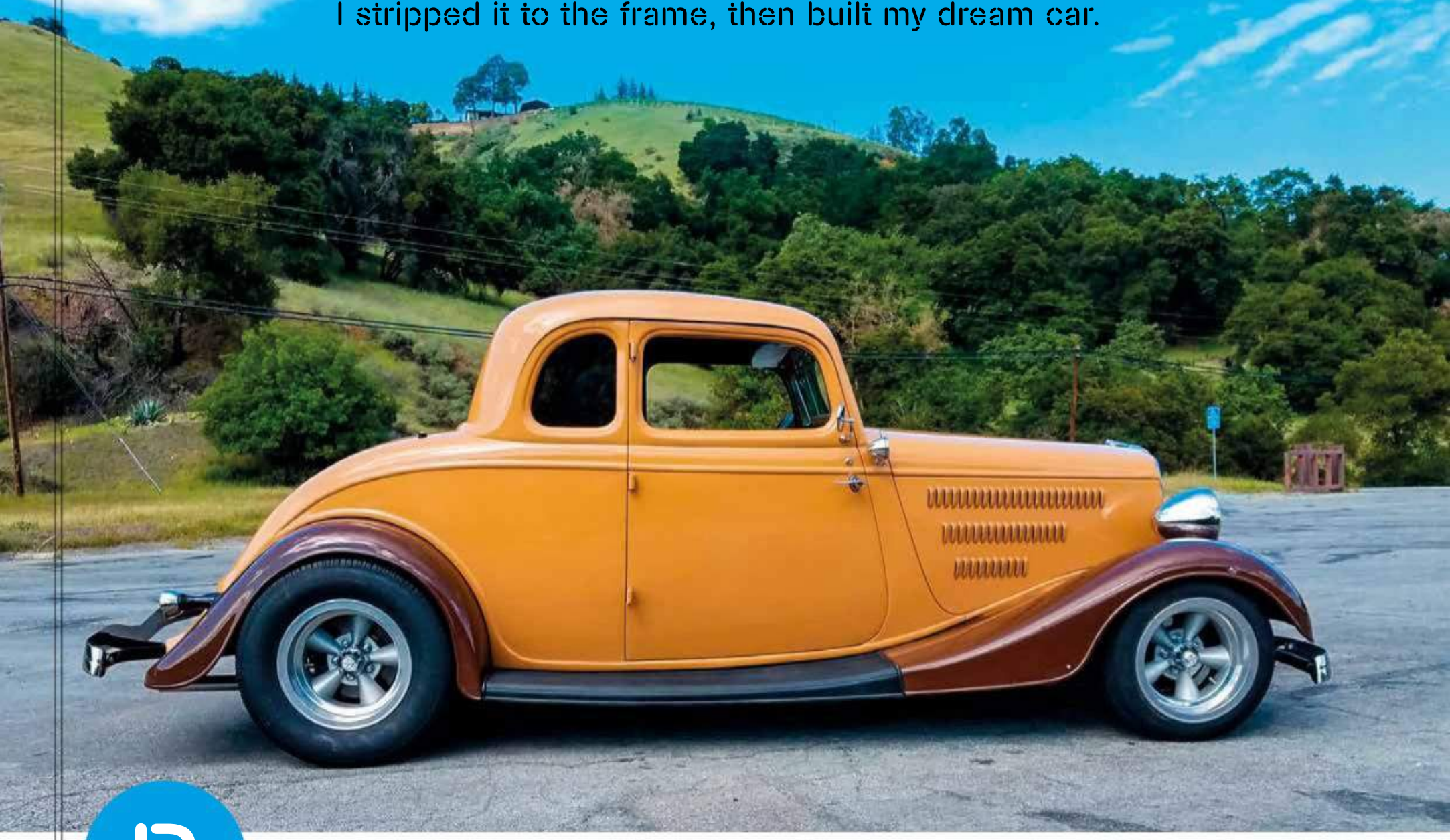
Use semolina flour to prepare your pizza peel. Lift the grill and oven lids, and slide the pizza on to the tray. Close everything, and let it cook for four and a half to six minutes, checking for doneness as you approach the end of the cooking time. Look for leopard spotting on the bottom, melted cheese, char-bubbles on the top crust, and slightly charred tips on a piece of onion or pepperoni.

PHOTOGRAPHY: DEVIN STEWART

BY JACK HAGEMANN, AS TOLD TO STEF SCHRADER

A 1934 Ford Coupé

I stripped it to the frame, then built my dream car.



Building cars is a family thing for us. After World War II, my dad built racing cars – midgets, hot rods, that sort of stuff. He actually raced for a while himself in the San Francisco Bay Area and was the first to hit 100 mph on the Oakland Speedway. When I was a kid, I always hung around the workshop with dad, helping him out, and kind of got the knack of it.

After I got out of the navy in the late '60s, I started building aluminium bodies on racing cars: midgets, dragsters, funny cars, and sporty cars. I also started building motorcycle petrol tanks for the Harley-Davidson XR-750 flat-trackers in the early '70s.

I've been a fabricator, building cars and parts for other people, almost my whole life. But a little over a decade ago, I bought this '34 Ford. That's the year that Fords started having nicer lines – a more flowing look. I looked for a five-window '34 coupé for a long time and paid way too much money when I finally found one, but it's what I wanted.

It was a running car, but it needed help. It was just in primer when I bought it. It had a Chevy 350 in it, which I'm not particularly fond of – I'm a little bit of a purist. To me, a Ford's a Ford, and a Chevy's a Chevy. It sat with me for years, then I finally decided I'd just take the car apart and do a restoration on the thing – reassemble it, paint it, and everything.

I stripped it down to the bare frame, but the further I got, the more problems I found. This is where the car really became a project.

I took the body to a specialist sandblasting company in Oakland, who took off the paint down to the fresh metal. Well, we discovered that the only thing holding that steel body together was body filler. The bottom had rotted out and it was terrible.

From the way the body was beaten up in all four corners, I'm almost positive the car was raced. I pulled the running boards off and one was a much different shape than the other, and both were an inch shorter than they should have been. Nothing on this car really matched up as far as stock sizes were concerned.

PHOTOGRAPHY: JACK HAGEMANN

> It's up there around 500 horsepower and instant RPMs. It's kind of fun to nail it on the highway once in a while, though.

The chassis was twisted, too, so I had to straighten and box the frame up quite a bit to make it roadworthy. Luckily, I saved a lot of money by fabricating and replacing basically everything myself: the deck lid in the back, the boot lid, the cowl to accommodate a modern air-conditioning system, and the side panels from the firewall back.

I used an English wheel to stretch the metal in the shapes I needed, and finished by hand using mallets, sand bags, and steel dollies. The basic shape was all there, though. One thing about the rounded form of a '34 is that it's more forgiving than the flatter door skins, where it's easy to stretch the metal out too much.

Gary Allen, who builds drag motors, built a Ford 351 Windsor engine with a bit too much horsepower for the car. It's up there around 500 horsepower and delivers instant RPMs. It's kind of fun to nail it on the highway once in a while, though.

Gary built the Windsor like a racing engine with Trick Flow cylinder heads and an MSD distributor. Everything's all balanced. It runs a simple 650 four-barrel carburettor atop an air gap intake manifold. The intake chambers sit above the manifold base itself so there's air in between them. It stays cooler, so you get better flow and performance. The first transmission I got – a C4 automatic that didn't come with the car – was a mess. The C4 was very common in '60s and '70s Fords and popular with hot-rodders for being light and compact but still able to handle lots of horsepower. But as near as we can tell, the guy who built mine used mismatched parts. There are three C4 transmissions and they are all different. You cannot take parts from a C4 number one and put it in a C4 number two or three. So, Bob's Almaden Transmission in San Jose ended up just chucking the transmission, buying another C4, and rebuilding it up to their standards. It's now good for 600 horsepower.

Left: The Ford's first drive since the rebuild started.
Above: Hagemann refabricated the doors, rear quarter panels, rear apron, and deck lid.
Below: Hagemann straightened the frame by hand, and strengthened it by boxing in (reinforcing) the existing frame rails.

I replumbed the brakes and rewired the car with an off-the-shelf wiring harness with hook-ups for its new heating and air-conditioning system. The car used to have a fuel tank in the very back, but I built a new tank to go further up in the boot. If anybody ever smacks me in the rear end, it's not going to blow.

The front is still a straight solid axle, which is typical for the '30s. All four shocks are more modern now. Instead of having the leaf spring in the back, I put coil-over shocks. They're a little simpler, and you can adjust the ride.

> The doors, the deck lid, side panels, fenders, and everything else that could come off of the body came back wrapped in shop blankets for me to assemble.

Above: Hagemann chromed the grille shell and windscreen frame to contrast with the paint. **Left:** Hagemann modified the stock dashboard, upgraded the cubbyhole, and installed a reversing camera and radio combo. The new centre console serves as a transmission cover and has cup holders.

I ended up putting in rack-and-pinion power steering, which is a little simpler than the Vega steering box it came with. When you're trying to park a car like this, it gets a little tough. I put a tilt steering column in, too, so my wife could drive it and tilt it back a little bit if she wants to.

There are plenty of '33s and '34s around in the US, and they're all a little too hot-roddy for me – fenders off, fat tyres, $50 000 paint jobs. I wanted more of a stock look, though I kept the wheels that came with it because they're original one-piece American mags that go way back, probably made in the '60s.

I kept as much as I could on the car around the upgrades, such as the vent window that cranks out. I put power windows in the doors, though. It's just a little thing that makes it convenient. I even installed a reversing camera.

Mods Hot Rods in Fountain Hill, Arizona, painted the car piece by piece. The doors, the deck lid, side panels, fenders, and everything else that could come off of the body came back wrapped in shop blankets for me to assemble.

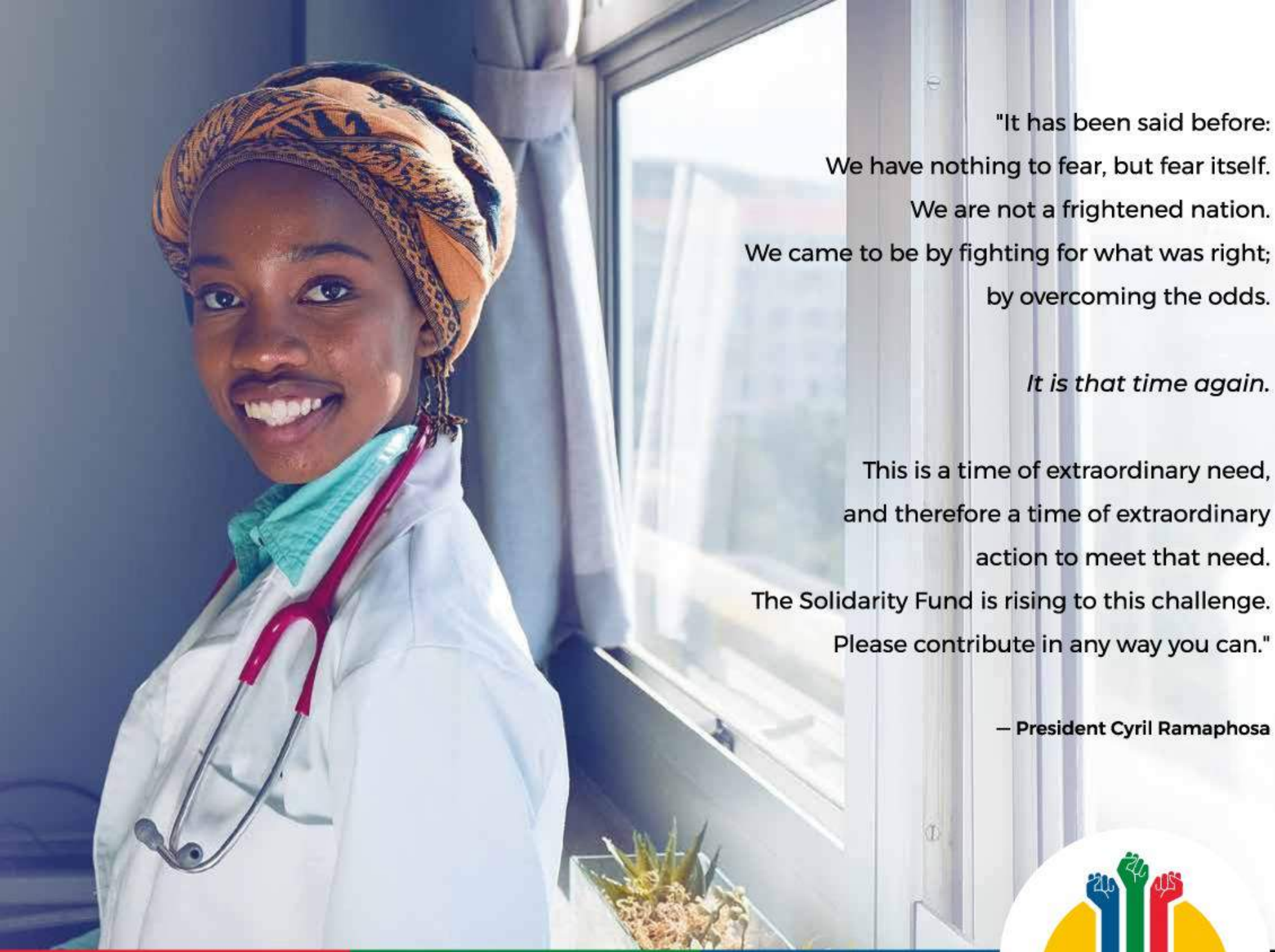
I didn't want a pricey show paint job I wouldn't want to take anywhere, and I didn't really want to go hog-wild with scallops or flames. I just wanted something nice and clean. I went for a tannish-coloured body with dark chocolate fenders for a nostalgic look, but with a bit of modern flair. When I went to get a custom licence plate for this thing, my wife Jan said, 'How about Milk Duds? It looks just like a Milk Dud to me!' Milk Duds are caramel with chocolate on the outside, and the car kind of resembles that. So the licence plate says 'MLK DUDS.'

After building a car like this where everything is fresh, you've got to shake it down – drive it around, put miles on it. You always have little issues here and there. When I first started driving it, I had to readjust the power steering to correct some pretty serious oversteer. The first pair of shocks and springs on the back were too loose and could bottom out, so I got some that were an inch longer with more adjustment. A couple of my exhaust hangers were too short and the heat from the exhaust melted the mount's little rubber pucks. And my emergency brake assembly was also hitting the inner wheel, so I had to massage that a little bit to move it out.

Gary's going to come down one of these days to do the final tune-up on the engine, but right now, it's pretty snappy just the way it is.

I'm going to keep building my own cars from now on. After this car, I'm building a '27 Ford for myself. I've always wanted one because I had an original '27 pink slip that I believe came from my grandfather. I've got my workshop here and I still like doing what I'm doing. There's no pressure. I take my time. Life is what you make it, and you've got to keep going. **PM**

PHOTOGRAPHY: JACK HAGEMANN



"It has been said before:
We have nothing to fear, but fear itself.
We are not a frightened nation.
We came to be by fighting for what was right;
by overcoming the odds.

It is that time again.

This is a time of extraordinary need,
and therefore a time of extraordinary
action to meet that need.
The Solidarity Fund is rising to this challenge.
Please contribute in any way you can."

— **President Cyril Ramaphosa**

Solidarity Fund
Unity in action

The Solidarity Fund was founded to help a united South Africa face the challenge of COVID-19 – today and into the future. Although we're independent, we work closely with Government and Business, co-ordinating our efforts to achieve the most meaningful impact.

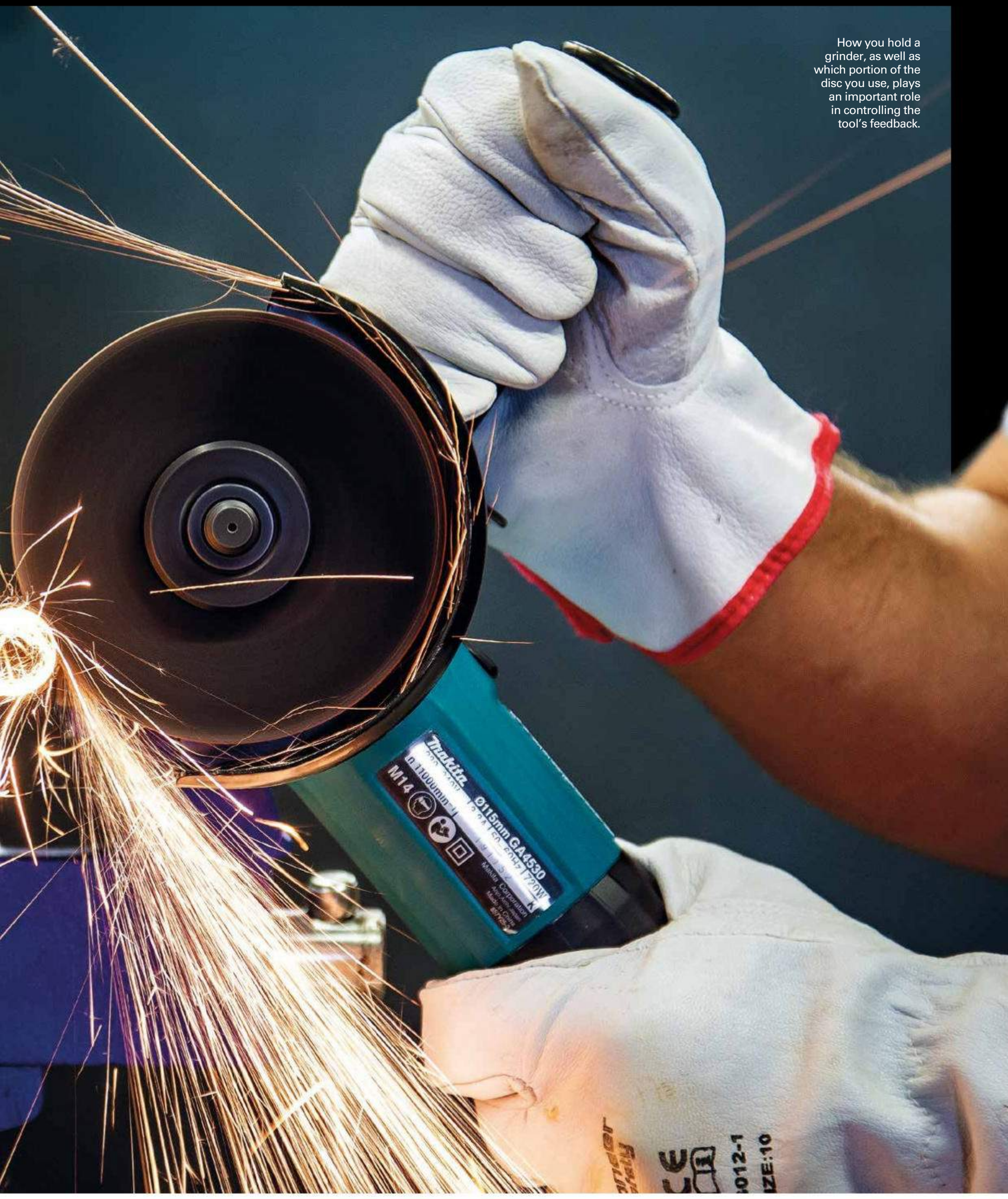
The Solidarity Fund has already acquired R1 billion in personal protective equipment to protect our brave South Africans at the frontlines of the fight against COVID-19. The Fund has bought R120 million worth of food and is working with social partners to deliver this to 250 000 families facing hunger during the lockdown. In addition, we have made available R250 million for mass testing. Please join the fight and contribute to the Solidarity Fund's next initiative.

Any assistance, large or small, will make a difference.
Go to **www.solidarityfund.co.za** to play your part.

GETTING A GRIP ON GRINDERS

A grinder can be an intimidating power tool. To be more confident and safer while using one, here are some of the most common angle-grinder mistakes, and how best to prevent them.

/ BY GRANT SPOLANDER /



How you hold a grinder, as well as which portion of the disc you use, plays an important role in controlling the tool's feedback.

↓ GRINDER SAFETY


1

2

IT FEELS LIKE EVERYONE I know has an angle-grinder horror story to share. Most of the time it's a 'friend of a friend' story, but that doesn't make them any less terrifying. While I've had a few close calls myself, these days I seldom get the *skriks* when using a grinder. Part of this has to do with practice as well as exposure to the tool, but mostly, it's that I no longer fear them.

As I stated in the grinder comparison article in the March/April issue, in my experience most angle-grinder accidents happen when the operator isn't confident in what they're doing. Of course, that doesn't help first-time angle-grinder users, as it often takes time to get comfortable with the power tool.

If you're new to angle-grinder operation, here are a few tips as to why things typically go wrong, and how to prevent them.

THE RIGHT DISC FOR THE JOB

Here's how a common scenario often plays out: You're using an angle grinder to cut a piece of steel with a dedicated cutting disc that's much thinner than a regular grinding disc. Once the steel is cut, you choose to de-burr the edges by grinding them smooth.

But, instead of taking the time to swap the cutting disc for a thicker grinding disc, you think to yourself: '*Ag*, it's just a couple of edges. I'll just use the cutting disc and press down gently.'

I've seen this happen many times while working as a fitter and turner. The problem is that cutting discs aren't designed to endure lateral forces, and when you use the face of the disc in this way, the disc not only gets dangerously thin, it also flexes to a point where it inevitably shatters, while rotating at an incredibly high speed.

It's also vitally important that you read the information sticker on the disc, to make sure you're using the right disc for the material you're working with.

Lastly, most general-purpose angle grinders have a maximum-disc diameter that must be adhered to. Exceeding this specification may not only push the grinder beyond its abilities, but the disc itself may not be able to handle the high revolutions.

KICKBACK

'Kickback' is arguably the thing that most people fear when they think of operating an angle grinder. This is when the disc 'bites' into whatever you're cutting, then violently and unexpectedly jumps backwards. Making sure the cutting disc is upright and perpendicular while using the machine is the first step towards mitigating kickback.

You also want to be sure the item you're cutting is either clamped in a vice, or securely supported on either side of the cutting area. For example, if you're cutting a sheet of corrugated roofing or ceiling board, make sure the sheet or board is supported in the middle, so it doesn't collapse inwards and pinch the disc.

When it comes to disc placement, you want to use the 8 or 9 o'clock positions on the disc's circumference when cutting most materials – where 12 o'clock is considered the top of the grinder. Importantly, if you lower the angle-grinder's body below the cutting height, the grinder's own weight helps to control any kickback or radial movement.

In short, if the disc does happen to bite, you want the grinder to 'kick' away from your body, and not backwards towards you. With that in mind, it's always good practice to offset yourself to the side of the angle grinder's line of operation.

1» Comparing a 5 mm grinding disc, with a 3 mm and 1 mm cutting disc… Never use a cutting disc to do grinding work. **2»** Always use the dedicated tool to tighten the disc; don't rely on making the tool just 'hand tight'. **3»** If you're cutting boards or sheets of material, make sure the cutting area is supported on either side. If not supported correctly, you run the risk of the disc being pinched and the grinder kicking back. **4»** The direction of the sparks shows that the wrong area of the disc is being used here. If the grinder suddenly 'bites' from this position, it's going to kick back towards you. **5»** Because the tail end of the grinder is being held too high, the weight of the tool isn't offering any kick-back mitigation. **6»** The safest way to cut with a grinder is to use the 8 or 9 o'clock positions on the disc, and to have the weight of the grinder pointing downwards as a kick-back 'buffer'.

KEEP IT NEW

In my experience, I've seldom had a brand-new cutting or grinding disc kick back on me. Old, cheap, or blunt discs are a leading cause of angle-grinder kick back. If you use high-quality discs, and discard anything you're unsure about, you'll greatly reduce your chances of having a bad angle-grinder experience.

STANCE

In a perfect world, you should only ever operate an angle grinder where you're able to get your weight – and a firm stance – behind the power tool. In reality though, there may be times when you're forced to cut or grind something above your head, or even worse, while standing on a stepladder.

If you find yourself in this situation, make sure the ladder is securely planted on the floor, and that you can't easily fall off with a cutting disc that's spinning at 11 000 rpm in your hands. Better yet, use scaffolding if it's available.

But what if you're grinding overhead? Unfortunately, the weight and strength of your arms will be the only thing fighting the feedback from the tool, so be sure to take breaks while you work, and don't over-fatigue your arms and shoulders.

CONFIDENCE IS KEY

I highlighted it earlier… Confidence is everything when operating an angle grinder. If you feel in control of the tool, you can even bend the rules in terms of conventional operation. But it all comes down to confidence, which is a difficult thing to explain because … well, how do you define it?

For me, it's knowing how to firmly control the power tool so I'm always actively fighting the forces at play, while acknowledging that if the tool does decide to do its own thing, I need to be fluid enough to go with the flow.

Perhaps the best way to describe this is to think of a vehicle breaking traction on a wet road. Once this happens, there's not much you can do to fight it, but you can still control the direction of the wheels, until the tyres find traction again. **PM**

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TIPS FOR SAFER ANGLE-GRINDER OPERATION

- Wear protective clothing, including gloves and proper eye protection.
- Keep both hands on the power tool.
- Never try to hold the item you're cutting or grinding.
- Don't apply too much force to the power tool.
- Be mindful of sparks and any potential combustibles nearby.
- Be aware of the people around you and make sure they're not in harm's way.
- Wait for the disc to come to a complete stop before putting the angle grinder down.

PHOTOGRAPHY: GRANT SPOLANDER

DIY PROJECT
TRADITIONAL JOINTS

LEARN TO MAKE THROUGH-DOVETAIL JOINTS

In our series on woodworking joinery, we've covered lap joints and mortise and tenons, and now, in part five, it's time to take a closer look at the classic dovetail joint.

/ BY TOBIAS LOCHNER; TECHNICAL: MATTHEUS ODENDAAL /

ASK ANY WOODWORKER which joint they'd love to master, and the answer is always the same: dovetails. These have always been regarded as the holy grail of cabinetmaking joints. And it's not only because they're highly attractive to both woodworkers and non-woodworkers – they're also extremely logical and exceptionally strong, striking the perfect blend of form and function.

The term 'dovetail' makes sense – the tenons resemble the fan-like tail of a dove. The usefulness of this joint is self-evident – when the two parts are brought together, how they are shaped means they cannot be pulled apart in the direction of the joint's length.

Because they appear complicated, many woodworkers are hesitant to attempt cutting dovetail joints. But in reality, they aren't complex at all. Hand-cut dovetail joints have been in use since pharaonic times in Egypt, and are as relevant today as they were then.

Probably the easiest way to describe them is 'finger joints with sloping sides'. The trapezoidal shape of dovetail-joint geometry is where woodworkers get hung up and seem to overcomplicate matters.

There are numerous dovetail jigs on the market, and they all make a form of the classic joint, but the results, in my opinion, always appear very clearly machine-made. I am a strong advocate of the hand-cut dovetail. I still haven't seen or used a dedicated machine or jig that can make a classic thin pin (London pin) set of dovetails. It simply cannot exist, as the diameter of the router bit shank is the limiting factor. The smallest pin width in machine-cut dovetails is ¼" (6.35 mm). As a comparison, in fine cabinetmaking, I typically aim for a pin width of less than 2 mm.

Dovetail joints vary from through-dovetails to lapped (half-blind), to full-blind- (full-mitred), single-, multiple-, houndstooth- and very large condor-tail joints. There are also several seemingly impossible variations of the joint, predominantly found in Japanese woodworking, such as rising-sun dove-tails, among others.

Whether you opt for single dovetails or a row of them for casework, these joints are as rewarding to make as they are beautiful. As with any woodworking process, the more you practise, the better the outcome.

In this exercise we show you how to build a 140 mm-wide set of three classic thin-pin through-dovetails. Keep in mind that several factors go into the design of a dovetail joint, including the size and spacing of the tails and pins, as well as the slope of the tails. Most dovetail joints begin and end with a half pin on the outsides, with the rest of the space subdivided into a number of pin and tail sets. This joint creates plenty of long-grain glue surface as well as excellent mechanical strength in connecting the two components together. And always, when laying out dovetails, use as few steps as possible.

WOOD FOR THE PROJECT

Brendan and Seamus Harcourt-Wood of Rare Woods South Africa (*rarewoods.co.za*) again supplied the wood for this project. We chose to work with sapele and French sycamore.

SAPELE (*ENTANDROPHRAGMA CYLINDRICUM*)

Also called sapele mahogany, this wood species is economically important to Africa. It's quickly gaining popularity across many industries, and is commonly used as a substitute for genuine mahogany. It's considered moderately durable and stable in use, and colour can range from a light golden brown to a darker reddish or pinkish brown. Sapele is renowned for its often dramatic figure, which comes in an array of styles, including ribbon, pommel, quilted, mottled, waterfall, wavy, bee's wing, tiger-stripe, and fiddleback. It works well with both hand and machine tools, and possesses a beautiful natural lustre.

FRENCH SYCAMORE (*ACER PSEUDOPLATANUS*)

As with all other members of the true maple genus (*Acer*), European sycamore is a hardwood whose sapwood is greatly preferred over its heartwood. The sapwood can vary from an almost pure white to a light cream colour, with tinting ranging from a golden yellow to a muted red. The heartwood is typically a medium to dark reddish-brown. Grains are generally straight, but can also be wavy. Combined with its fine texture, it's easy to work with using hand and machine tools alike. It glues and finishes well, with a good natural lustre. Not unlike its *Acer*-genus counterparts, pieces can sometimes exhibit dramatic figure.

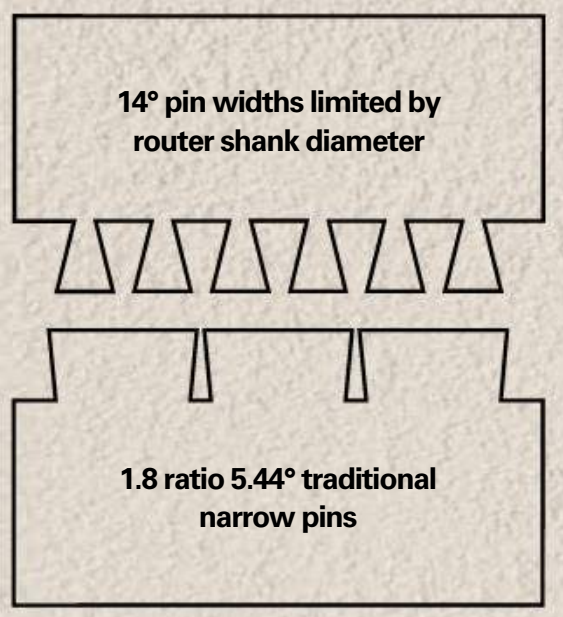
Boards are typically found quarter-sawn, as European sycamore is the lumber well-known for its preferential (and historical) use as a body wood for stringed orchestral instruments (such as violins, violas, and others). It possesses superb resonance qualities and full-spectrum frequency response at a very moderate weight.

TOOL LIST

You'll require the following tools to create classic through-dovetail joints by hand:

- Accurate try square
- Western dovetail saw or Japanese dozuki saw
- Marking knife
- Sharp bench chisels
- Coping saw or fret saw
- 3M blue painter's tape
- 0.5 mm mechanical pencil
- Marking gauge
- Block plane
- Pair of dividers
- Sliding-bevel gauge or dovetail guide

MACHINE-CUT DOVETAILS

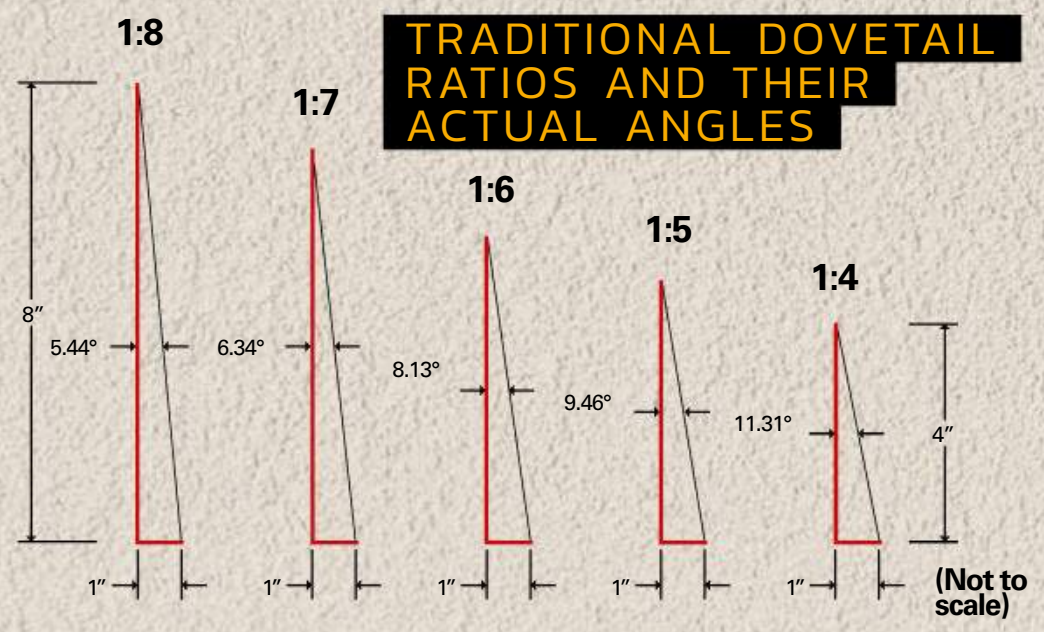


HAND-CUT DOVETAILS

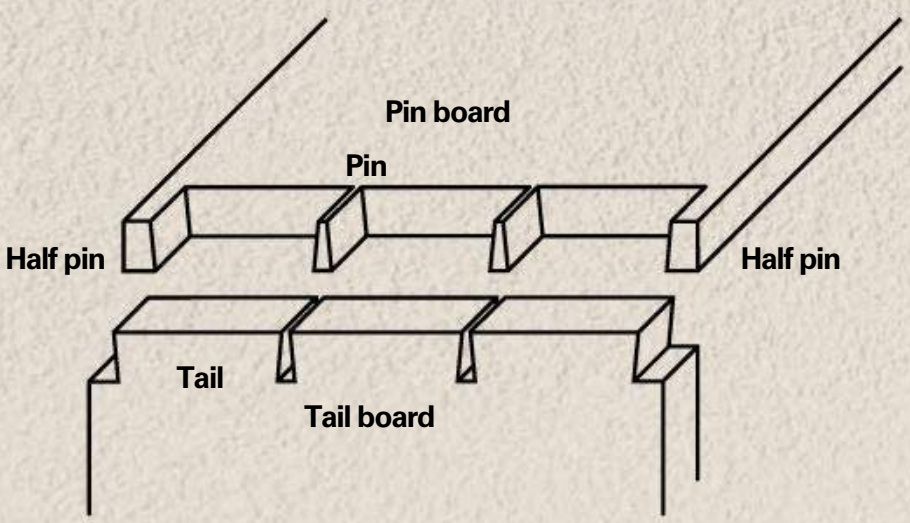
DOVETAIL ANGLES

Some say hardwoods require a steeper angle compared to softwoods. Dovetail angles are usually quoted in ratios, for example 1:5, 1:6, 1:7, and 1:8. This is a remnant from times gone by. It means that if you draw a 90° angle and one line of the angle is five inches long and the other is one inch long, a line (hypotenuse) drawn between the ends of the two initial lines will give you the slope angle required for your dovetails – in this case, 1:5. (Refer to the dovetail ratios and angles drawing, below.) The angle you choose is entirely up to you. We opted for a 1:8 ratio for our joints.

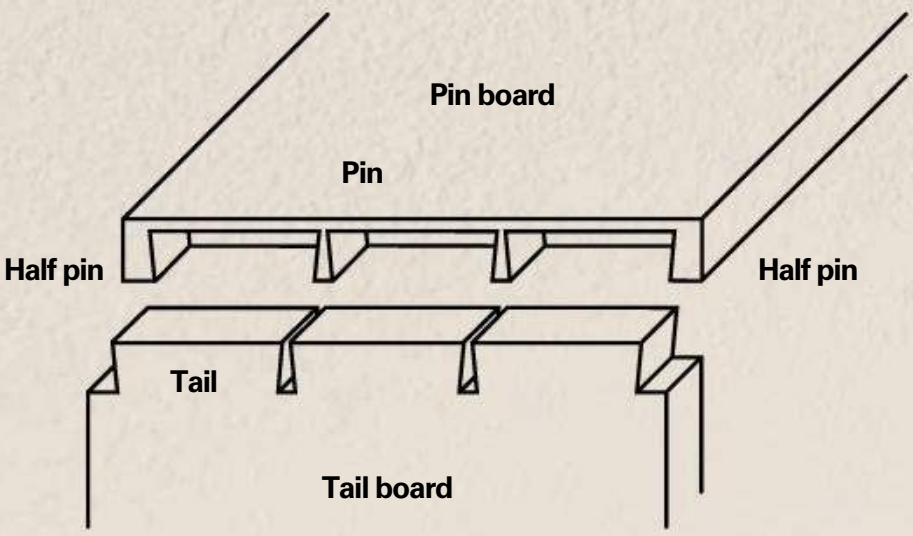
TRADITIONAL DOVETAIL RATIOS AND THEIR ACTUAL ANGLES



THROUGH DOVETAILS



HALF-BLIND DOVETAILS



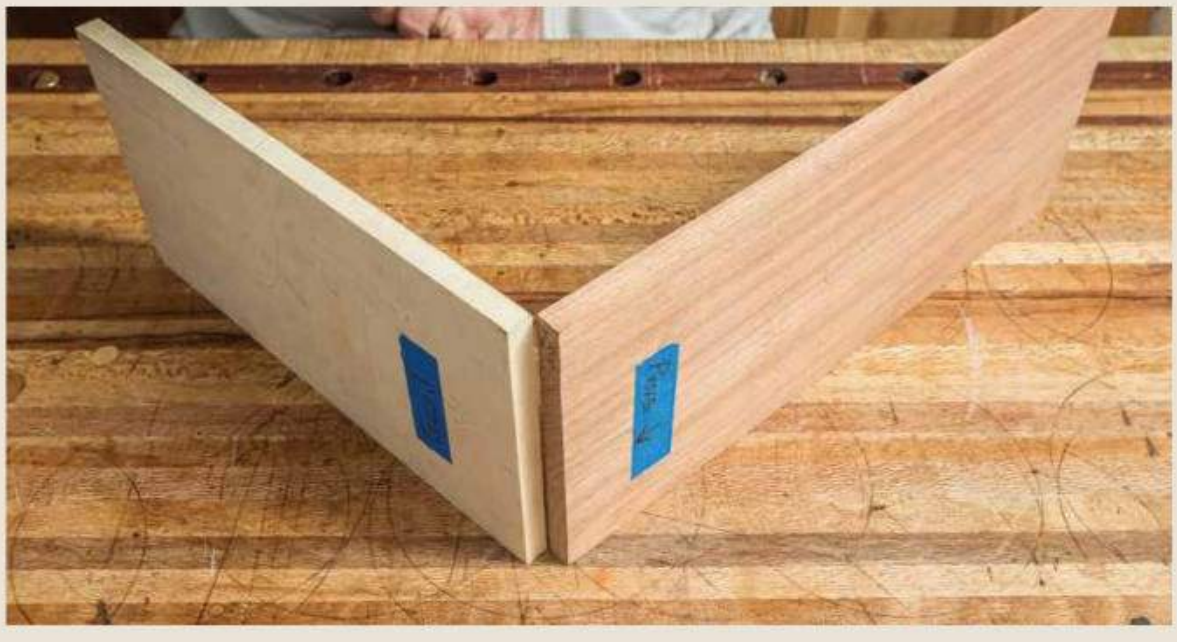
DOVETAIL GUIDES

There is a wide variety of dovetail-angle guides available, from magnetic ones that keep your saw against the guide, to guides created specifically to use with a marking knife and pencil. As you become more proficient in cutting these wonderful joints, you'll gradually dispense with the guides and revel in the pleasure of quickly cutting these handsome joints freehand.

PROCESS

STEP 1: Four-square your two pieces of wood for the joint. Make sure they are exactly the same width and thickness as each other. For this practice joint, the boards should be 150 mm to 250 mm long, 140 mm wide and 12 mm thick.

STEP 2: Begin by marking out the orientation of the pin and tail boards – inside and outside faces, top and bottom, front and back. Remember that in cabinetry, the tail boards always make up the sides of drawers and carcasses, and the pin boards are usually the fronts and rears of drawers and tops and bottoms of carcasses due to the mechanical 'locking' action of the joint.



STEP 3: Apply blue painters tape to the boards as per the images. An eternal argument exists among woodworkers as to which part of the joint to cut first. We always use the 'tails first' approach – our students find it easier, and by doing so you can lay out and cut multiple tail boards simultaneously when clamped together, for example when matching drawer sides.

Once you've established the orientation of the boards and marked them clearly, scribe the joint baselines on both boards using the marking gauge set to the exact thickness of the board. Scribe the tail board on both edges as well. There's no need to scribe the edges of the pin boards. Setting the gauge to the board's exact thickness means there are no proud pins that will interfere when you glue and clamp the joint.

STEP 4: Lay out the joint for strength and pleasing aesthetics. Set the marking gauge to about half the thickness of the boards. From the edge of each side of the tail board, scribe a line on the end grain. This will be the final width of your 'half-pins' on either side.

Use a pair of dividers to lay out the three dovetails. With the tail board clamped end grain up in your vice, start at the half-pin line on the left, and walk the dividers across the board, counting the number of tails you want to incorporate into the joint. The distance that the dividers extend beyond the right half-pin line represents the pin spacing between the tails. Work back across the board, starting with the right-hand half-pin line. Adjust the dividers and repeat the exercise until you achieve three dovetails with your required pin spacing between them. (We chose 2 mm spacing.) Using the divider marks, scribe the required lines on the end of the tail board with a try square.

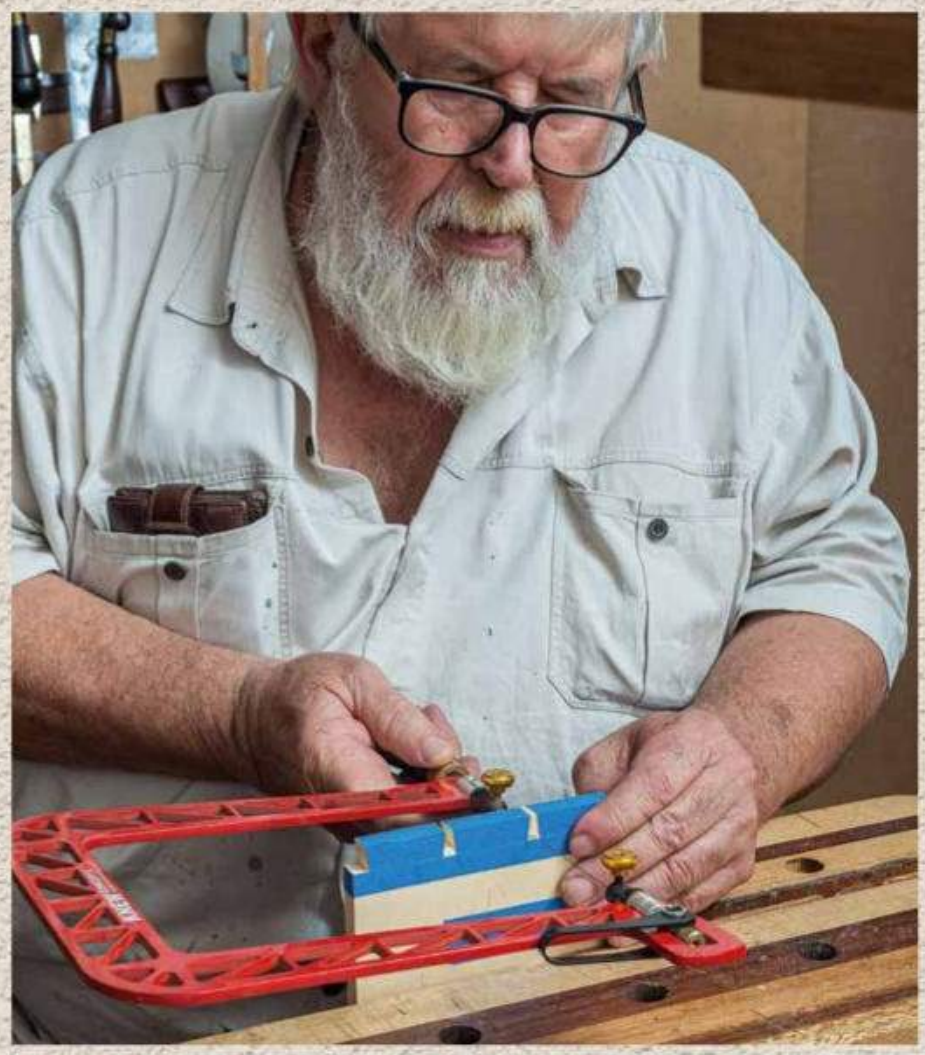
STEP 5: Using a 1:8 dovetail template or a sliding bevel set at approximately 5° to 5.5°, mark out the tails on the front and rear of the tail board with a sharp marking knife. Position the marking knife into a previously scribed end-grain kerf and slide the dovetail guide up to bear firmly on the blade. Now scribe a guide line on the front face of the board. Repeat with all of the other tails on both faces of the tail board.

Peel away the blue tape from the waste areas and you are ready to begin cutting the tails.

STEP 6: Using a dovetail saw or Japanese dozuki and your dovetail guide (or freehand), cut all of the tails to a hair above the baseline. Make sure you are cutting 'just' on the waste side of your lines, as clearly shown by the blue tape.

STEP 7: With the tail board on its side in the vice, cut the two shoulders a hair proud of the line. With a sharp chisel, pare the shoulders accurately down to the baseline.

STEP 8: Using a coping saw or fret saw, remove the waste between the tails, staying just proud of the base line.

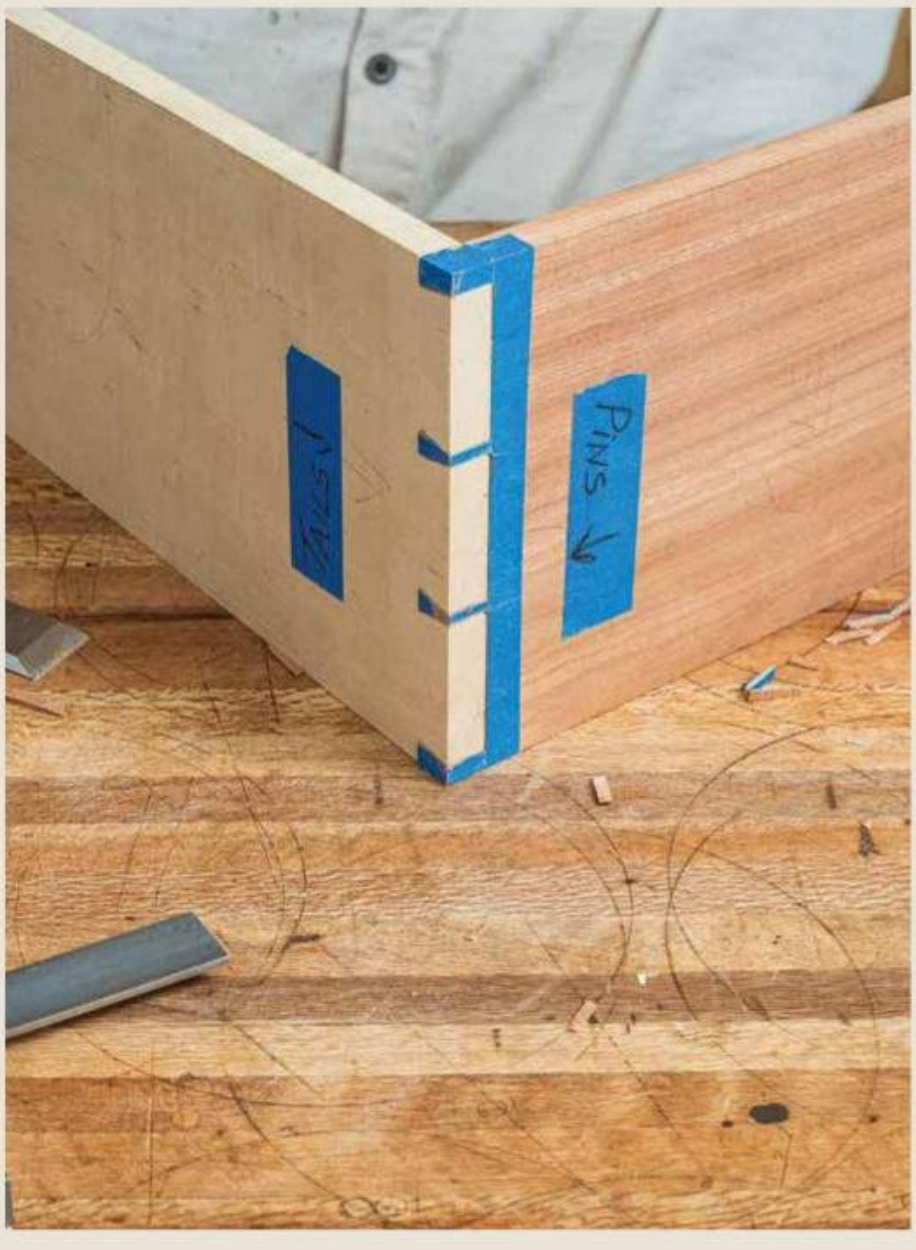


STEP 9: Place the tail board flat on your bench with the tails facing you, and secure it well. Now chisel out the remainder of the waste between the tails (the pin sockets), working from both faces of the tail board towards the centre. Take great care in this step, ensuring you don't bruise the side walls of the tails. Constantly check with a small try square that the bases between the tails are absolutely at 90° to the faces of the board and that these pin sockets are totally clean of any debris.

STEP 10: Apply blue tape to the pin board as you did previously to the tail board. With the tail board at 90° to the pin board in its final intended position, and making sure everything is absolutely square and the tail board is flush with the pin board outer edges and face, gently copy the tails on to the pin board by scribing each line position a couple of times. Remove the tail board. With your small try square, place your knife into the first scribed line on your pin board and scribe both faces of all the pins. Remove the blue tape from the waste areas.

Using the dovetail guide (or freehand), saw all of your pins 'just' on the waste sides of the blue tape. The aim is to get the joint to fit the first time. Now remove the bulk of the waste with your coping saw, and pare the sockets neatly down to the baseline on both faces of the pin board with a sharp chisel.

STEP 11: Test-fit your joint. Don't force the components together. Light taps with a mallet should bring the parts fully together. If the joint starts to bind at any point, mark where this occurs, separate the components, pare extremely finely, and test again.



A COUPLE OF VERY FINE PASSES WITH A SMOOTHING PLANE IS ALL THE JOINT SHOULD REQUIRE.

STEP 12: Once the joint is fitting perfectly, glue the two components together. The two boards must sit at exactly 90° to each other. When the assembly is cured, a couple of very fine passes with a smoothing plane is all the joint should require.

STEP 13: It's time to pat yourself on the back for a job well done! We suggest that you make a few more through-dovetail practice joints, aiming to improve the fit every time. As you become more at one with your hand-cut dovetail joints, why not attempt a lapped (half-blind) set of dovetails? (It's helpful to keep all of your practice joints, and hang them up in your workshop. It's a great way to gauge your progress.)

BUY YOUR WOOD HERE: RARE WOODS SOUTH AFRICA

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 make a classic cutlery and condiment tray, using the through-dovetail joinery techniques learnt in this issue's article.

PHOTOGRAPHY: HENK VENTER

↓ RUST REMOVAL

/ BY GRANT SPOLANDER /

WHICH RUST-REMOVING PRODUCT WORKS BEST?

IF YOU ENJOY RESTORING old cars, tools or antiques, there's a good chance you've used a rust-removing product at some point, and you might be wondering which formula works best… Let's take a look at the chemistry, before we talk about product options and their performance differences.

ACID-BASED

Typically speaking, most rust-removing products use an acid-based solution. Milder products tend to focus on citric acids, while the more potent stuff is generally phosphoric-acid based.

That said, you might be wondering why you've seen social-media videos where Coca-Cola or vinegar is used to remove rust. Well, the latter is a form of citric acid, while Coke has phosphoric acid listed as one of its ingredients.

Of course, the quantity of phosphoric acid in soft drinks is very low. In concentrated form, however, the rust-removing properties of phosphoric acid are fast-acting and highly effective.

Unfortunately, the down-side to all this rust-busting performance is that the acid solution doesn't discriminate between what is rust (iron oxide) and what is bare metal. And that's precisely why many of these products should never be used on sensitive compo-nents, or on stainless-steel or chromed surfaces.

In the case of this test, we're comparing two completely different rust-removing formulas, Q12 and EVAPO-RUST. Here are some of the pros and cons of each:

Q12 RUST REMOVER

Q12 is an acid-based product with a 55-year track record that delivers incredible results from its secret-sauce formula.

1» Although deeper rust may require some wire-brush prep work, Q12 will generally cut through most forms of surface rust. **2»** Simply apply the acid-based solution with a paintbrush, and allow 15 to 20 minutes of contact time. **3»** Rinse the component with plenty of clean water to remove all traces of acid. **4»** Once de-rusted, remember to coat the component with fresh oil to prevent rust from coming back. Use vegetable oil on cookware, and Q20 on tools and machine parts.

ADVANTAGES

- Fast-acting with potent results.
- Jelly-like consistency means it can be brushed on to vertical surfaces without completely dripping off.
- Only a small quantity is required.
- Can be applied accurately to specific areas.

DISADVANTAGES

- Protective gear should be worn when working with any acid-based solution.
- Careful storage is needed – keep the bottle upright and away from children.
- The solution should not be left on any metal surface for too long.
- Q12 will not discriminate between rust and bare metal.
- The used solution is harder to dispose of and must be rinsed with lots of water.
- The solution cannot be reused.

EVAPO-RUST

EVAPO-RUST is an award-winning relatively new product that features a five-parts water formulation, where the water itself acts as a depository for the oxide. This rust-dissolving process is known as 'selective chelation', where molecules within the EVAPO-RUST specifically bond to rust particles, without attacking the bare metal.


1


2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4

1» EVAPO-RUST is the ideal rust-remover for cast-iron cookware, as the formula is non-toxic and completely safe. **2»** No prep work is necessary; simply submerge the component in a bath of EVAPO-RUST and wait for the results to speak for themselves. **3»** Try to match the container size to the component you're de-rusting. This will ensure you don't waste any formula. **4»** For this demonstration EVAPO-RUST was used on only half this cast-iron pot, so the results were more clearly defined.

ADVANTAGES

- Won't attack bare metal.
- Non-corrosive and completely safe on all metals and materials.
- pH neutral.
- Non-toxic.
- Safe on skin and eyes.
- Biodegradable and easy to dispose of.
- Can access hard-to-reach places, for example inside fuel-, water- and storage tanks.
- Can be reused multiple times, depending on the extent of the rust.

DISADVANTAGES

- Premium product with a premium price.
- Results work best when components are fully submerged.
- Results may take longer than with an acid-based rust remover.

FINAL THOUGHTS

When I first came across EVAPO-RUST, I thought the results were too good to be true. I've never known a product to do exactly what the manufacturer claims, without any downside or risk. It's a product so powerful it can restore an old, rusted brake disc like new, and can then be poured down the drain without worrying about adverse affects on the environment.

There has to be a catch, right? Well, some people will tell you that the 'catch' is in the price. As far as rust removers go, EVAPO-RUST comes at a premium. But if you keep in mind that the solution can be reused two to three times, depending on how deeply rusted your components are, the price becomes cheaper with every use.

Q12, on the other hand, is a low-cost product that's been used and trusted for decades. I've found that the jelly-like consistency of Q12 is much easier to use on specific locations, such as a rusted patch on a classic car's corroded body, or a threaded bolt or stud that cannot be removed or submerged into a rust-dissolving liquid.

In the end, I keep both products in my garage, but find that 90 per cent of the time I'm reaching for EVAPO-RUST when it comes to hand-tool restorations, vehicle components, and garden tools. All you have to do is drop the rusted item in a container, fill it up with EVAPO-RUST, and then get on with other things while the solution does all the work for you. Because there's no risk of damaging the bare metal, you can leave the component in EVAPO-RUST for as long as you like. Afterwards, pour the used liquid back into its bottle through an old rag as a filter, and reuse it when you need it again.

EVAPO-RUST is a highly effective product with very few limitations. And for all your other rust-removing needs, keep a bottle of Q12 close at hand. **PM**

FIND YOUR SOLUTION

For the full range of products, technical data, and helpful DIY tips, visit *q20.co.za*.

PHOTOGRAPHY: GRANT SPOLANDER

THE SMART WAY TO CLEAN GREASY AUTOMOTIVE PARTS

If you're an automotive enthusiast or workshop owner, you'll know that finding an effective way to clean vehicle parts is only half the problem; the bigger issue is disposing the toxic waste when you're done.

There's now a smarter way to clean vehicle parts thanks to CRC's **SmartWasher®**.

The SmartWasher® uses a scientific process called bioremediation, which means: It uses microbes to break down and neutralise hazardous substances and contaminants.

The CRC SmartWasher® consists of three main components:

- The parts washer
- The OzzyJuice
- The OzzyMat

OzzyJuice is a powerful water-based solution that's non-hazardous, non-flammable, but tough on oil and grease.

The **OzzyMat** is the most important feature of the CRC system.
Microbes, within the filter, are activated by the OzzyJuice. These microbes then work to break down the washed-off oil and grease and produce a harmless byproduct of carbon dioxide and water.

In short: OzzyJuice cleans the parts, and the microbes within the OzzyMat clean the OzzyJuice.

This bioremediation process keeps the OzzyJuice clean and strong for repeated uses.

The SmartWasher® is fully mobile and easy to move around your workshop or garage area.

How does the SmartWasher® work...

❶Pour in the OzzyJuice ❷Insert the OzzyMat
❸Plug the unit into an electricity supply and allow the fluid to heat up ❹Start cleaning!

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www.crcindustries.co.za

↓ HOW TO BE GOOD AT WHAT YOU DO

/ Mike Vallely, 50, Owner of Street Plant, Long Beach, California /

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

MADE HERE

THE MOMENT I SAW skateboarding, I knew I'd be in it for life. I started skating in 1984, then turned pro in 1987. I ended my career after winning an X Games gold medal in 2015 but still wanted to be in the industry. So that same year, I started Street Plant.

We produce standard skateboards, but this involves wood and urethane – two elements with a significant ecological impact. I had the idea for eco-friendly boards since the start of Street Plant, but the bigger manufacturers balked at it. So three years ago, I reached out to Danny Creadon, owner of Factory13 Skateboards. He's been in the industry since 1999 and doesn't follow anybody's playbook.

We created Street Plant Naturals, a line of sustainable, resin-based boards made of high-quality maple-veneer plywood, a bio-based epoxy, and water-based inks and sealants that eliminate the need for oils or animal by-products. We estimate that it has an overall 70 per cent less detrimental effect on our environment.

Skate, create, enjoy. That's Street Plant's mantra. Skating is an art that brings people joy – and that approach informs everything we do. **PM**

PHOTOGRAPHY: TED NEWSOME/POP MECH VIDEO

HOW IT'S DONE

"Bio-based resin laminates seven plies of maple-veneer plywood inside a concave mould that evenly distributes 40 tons of pressure. It cures for 24 hours, then we drill the mounting holes for the wheelbase. We cut and shape the board, creating a fillet on the bottom with a quarter-inch round router bit. We sand and sculpt a slight fillet on the top edge, and coat on a water-based polyurethane before and after silk-screening. There's a quality control inspection, then it's all set for the world to enjoy. *– Danny Creadon*

81/1000
CHILDREN BORN IN AFRICA IN **2015** DIED BEFORE AGE **5**

5 children under 5 years of age dying every minute

2/3 DEATHS ARE PREVENTABLE

1/3 OF DEATHS ARE IN THE NEONATAL PERIOD

THE RED CROSS CHILDREN'S HOSPITAL IS A BEACON OF HOPE IN AFRICA

IT MANAGES **260 000** PATIENT VISITS EACH YEAR

1/3 of Red Cross Children's Hospital patients are UNDER THE AGE OF 1

THE CHILDREN'S HOSPITAL TRUST has fundraised for the Hospital since 1994

The Trust has raised over **R678m** since inception

The only specialized dedicated burns unit in Africa

Only surgical skills training centre of its kind in sub-Saharan Africa

Only **2%** of registered nurses in Southern Africa are trained in paediatrics

THE TRUST HAS HELPED FUND THE TRAINING OF OVER **300** AFRICAN DOCTORS AND NURSES

These trained paediatric specialists take their skills back into African countries

Clinical research at the Hospital has influenced global WHO guidelines

OVER **R100m** WAS RAISED IN **2016** FOR AFRICA'S LARGEST **PAEDIATRIC ICU**

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↓ PM GARAGE

Opinions on cars we've driven

Mazda2

FIGURES

» 1.5 L petrol
» 6-speed automatic
» 3-year/unlimited km warranty
» 3-year/unlimited km service plan
» 85 kW; 148 Nm
Priced from R284 800 (base model)
mazda.co.za

THIS LITTLE Mazda2 caught me rather off guard. I don't usually gravitate to small cars, but this one really appealed to me. For a daily commuter, this size vehicle makes a lot of sense, and this particular compact hatch will serve you diligently on that front. Comfort levels are high, finishes and workmanship are impressive, and there are features aplenty … most of which you might only expect in more premium vehicles.

Standard across the entire Mazda2 range now are LED headlights (which are also self-levelling), front and rear electric windows, driver and passenger airbags, a multi-function steering wheel, push-start (keyless) ignition, 60:40 rear-seat split, and ISOFIX connection points for child seats.

The power plant is punchy, with the 1.5-litre putting out 85 kW at 6 000 rpm and 148 Nm at 4 000 rpm. Handling is fantastic – cornering, lane changes, and highway cruising are all melt-like-butter smooth.

There are four spec levels in the range: Active, Dynamic, Individual, and the flagship Hazumi, the features list for which is very impressive. It includes items such as head-up display, blind-spot monitoring, wireless charging, and many more.

Comfort levels are high, finishes and workmanship are impressive, and there are features aplenty.

It's hard to fault Mazda's exterior styling, throughout the range of vehicles, and the little 2 retains those desirable aesthetic cues that make its bulkier siblings so good to look at. Naturally, there isn't a lot of space inside – there's sufficient in the front seat, but if you're slightly larger than average, you're not going to fit in the back too easily. – ***Mark Samuel***

Land Rover

Range Rover Sport SVR Carbon Edition

FIGURES

» 5.0 L petrol
» 8-speed automatic
» 5-year/100 000 km warranty
» 5-year/100 000 km service plan
» 423 kW; 700 Nm
Priced from R2 831 000
landrover.co.za

Given the ever-escalating fuel price, a vehicle like this is difficult to justify. But you don't buy one of these because of its fuel economy figures. (That said, I achieved an acceptable 12 L/100 km driving to the Garden Route, albeit nursing the throttle like I was syringe-feeding an injured bird.)

There's nothing subtle about this high-performance SUV – from the price tag, right through to the roaring tailpipes, it demands attention. Beneath the conspicuous aesthetics is the most powerful vehicle ever created by Land Rover. The 0–100 km/h sprint time of 4.5 seconds and top speed of 283 km/h claimed by the manufacturer are extremely impressive figures, considering the vehicle tips the scales at more than 2.3 tons. To achieve these stats, under the bonnet lies an engine-bay-filling 5.0-L supercharged V8, dishing out a prodigious 423 kW and 700 Nm of torque.

Carbon-fibre elements adorn the exterior, and the gloss-black 22-inch alloy wheels are shod with low-profile 285/40 R22 Continental tyres, which do an admirable job of keeping this beast connected to the tar.

Beneath the conspicuous aesthetics is the most powerful vehicle ever created by Land Rover.

While everything about this vehicle roars 'speed', its off-road credentials are impressive too, though it's unlikely owners will ever venture far from the tar. It has height-adjustable air suspension (up to 274 mm), and a maximum wading depth of 850 mm.

The interior is opulent and spacious, yet slightly austere. All the luxury features and finishes you could dream of are present, making for an exhilarating overall driving experience. Would I buy one? No. But it would still be immensely fun to own.
– Mark Samuel

Volkswagen
Tiguan 1.4 TSI R-Line

FIGURES

» 1.4 L petrol
» 6-speed automatic
» 3-year/120 000 km warranty
» 5-year/90 000 km service plan
» 110 kW; 250 Nm
Priced from R670 200
vw.co.za

There's a lot to love about this mid-sized SUV, so in that regard not much has changed for the VW Tiguan since its launch in the late 2000s. But a closer look at this new release reveals several upgrades and improvements, making it an even more desirable family commuter. Our 'Lapiz Blue Metallic' test unit was the 1.4-litre TSI bedecked in R-Line trim. While the engine's displacement might seem relatively small, its performance is anything but, kicking out 110 kW of power and a respectable 250 Nm of torque. That's more than enough to easily take a family of four plus all of their luggage on a long road trip.

Fuel consumption too was respectable, though not very low by modern standards. The manufacturer claims economy figures of around 7.7 L/100 km; in our real-world experience it was closer to 8.5, but that included a lot of stop-start city driving. On the open road you can expect that to drop.

While the engine displacement might seem small, its performance is anything but.

The interior is spacious, seating up to five comfortably. Finishes feel classy – leather seats all round (heated for the driver and passenger), air-con controls in the rear, tinted privacy glass, and 60:40-split rear seats, behind which is a 520-litre boot that's boosted to 1 655 litres with the seats folded down.

Several driver aids bolster the value offering, including adaptive cruise control, pedestrian monitoring and autonomous emergency braking, to name just a few.

Suspension is firm, but that facilitates crisp and responsive handling. That said, for short commutes or hours on the open road, it's difficult to fault this as an excellent all-round family vehicle. – ***Mark Samuel*** **PM**

PHOTOGRAPHY: NICKY LLOYD, MARK SAMUEL

↓ SEND US YOUR HINT AND SCORE!

Clever tips and lifehacks

CORD CONDITIONER

Many of us have probably experienced the frustration of an edge-trimmer cord breaking at each and every touch of a hard object. I live in Gauteng, and after the long, low-humidity winter months, the cords are particularly brittle during the first outing along the garden edges, and this results in a constant feed (and wastage) of cord.

The answer to this is to soak the cord overnight (with the drum and all if necessary) in water. If you forget to do this, a couple of minutes in boiling water before you work will suffice.

For me this is more about avoiding the nuisance of the cord breaking off short right up against the drum and having to take the whole thing apart time and again, than the saving of nylon cord, but it's nice to reduce wastage too.

Spare rolls of cord can be left in water until you need them.

Chris Marx

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 M1 Excell Padlock:

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

Master Lock 4-Dial Combination Lock:

The 6 mm-diameter and 26 mm-long shackle is made from cutting- and saw-resistant chrome-plated steel. Set your own combination.

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 Rod Lock:

The 15 mm-wide metal body and 3 mm-diameter steel shackle and cable are highly resistant to tampering and cutting.

Master Lock Tower Combination Lock:

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

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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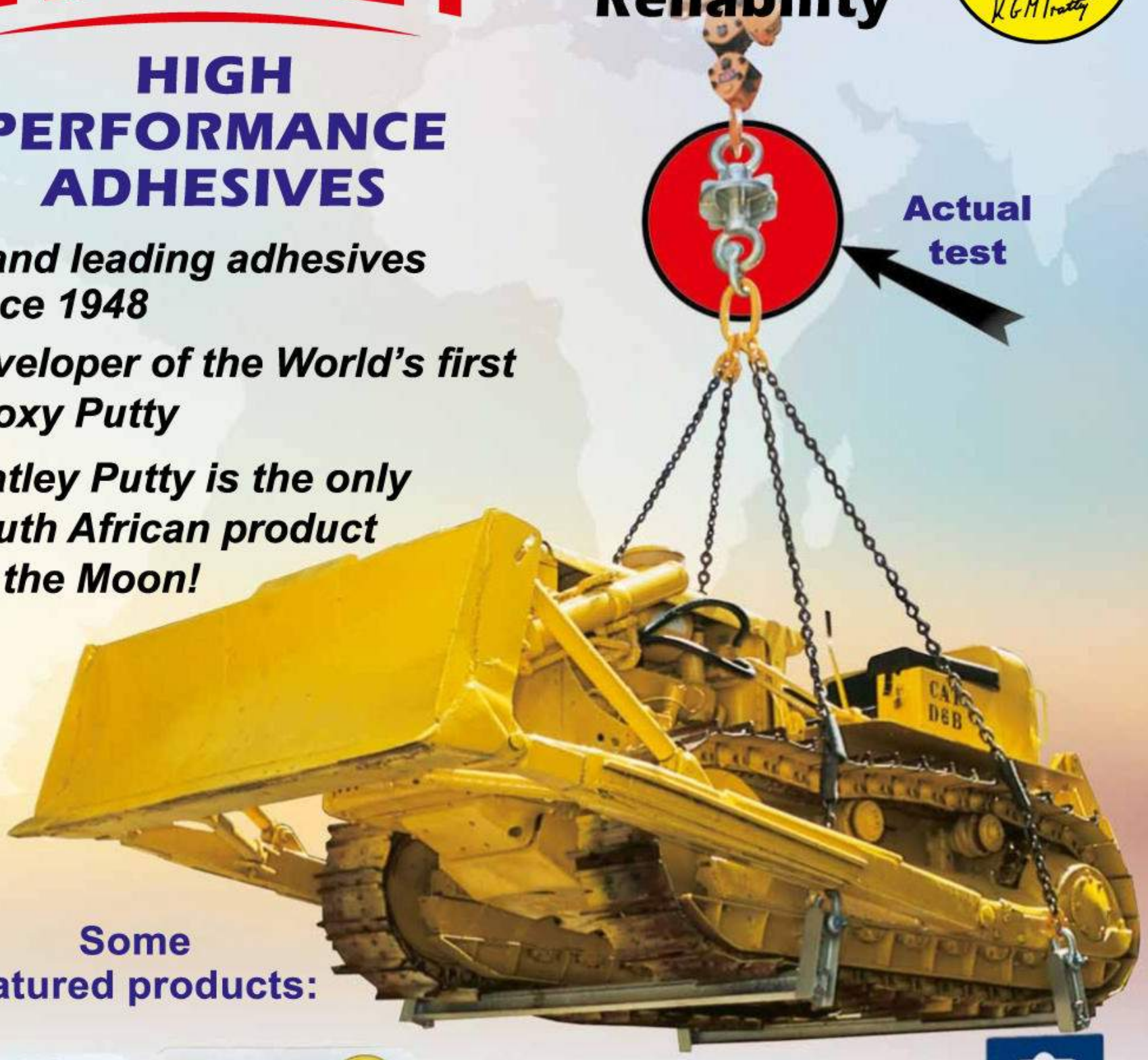

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THE STRANGER AND THE ENEMY, WE'VE SEEN HIM IN THE MIRROR."
– GIORGOS SEFERIS