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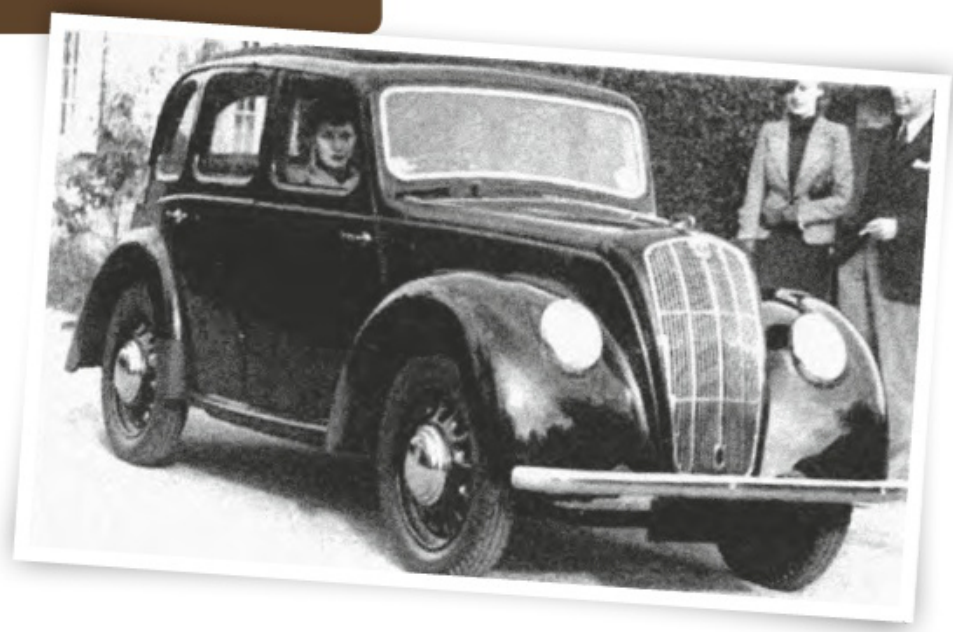

LARRIKINS

Our feature article in this issue about the grunty Cowper 4x4 off-roaders has reminded me of a misspent youth with my off-roading pursuits with my chums.

I was born and grew up in West Auckland next to a creek with a whole expanse of bush on the opposite side to our home. This was a magic place to grow up as it felt like living in the country, with trees to climb, bush huts to build, and corrugated iron canoes to construct and paddle down the creek.

Eventually Robin Hood and Zorro games turned more automotive as we all turned 15 years old and obtained our driving licences. Now we wanted fast and noisy cars — the faster and noisier the better.

With all this space on my doorstep and something of a track kindly created by the council for creek access, maintenance, etc., our minds turned to off-road racing — well, why not?

The chariot of choice that we seemed to be able to get hold of for next to nothing was a Morrie 8. Sure, not grunty, but hey, it was still a car and we could play merry hell with it and our piggy banks wouldn't notice.

So, for many months we drove our entire neighbourhood crazy every weekend as we raced up and down, around and around — sometimes we even had a muffler on the car!

As word spread more mates joined us for even more larrikin behaviour. We went through three Morries and we thrashed them so hard that eventually they chose not to operate any longer.

Two incidents involving particularly stupid behaviour that I recall are trying to roll the wee rocket as we did donuts on a grassy slope, and putting a brick on the accelerator to see if we could make the engine explode. We failed with both of these experiments, much to our intense disappointment.

So, you don't need to sell me on the adventures of off-roading that the Cowper-made vehicles featured in this issue are such an truly outstanding example of — hugely tough, hugely powerful, and built like the proverbial.

I got the off-road racing bug real early if not legally. Yet somehow, luckily, I am here to tell the tale of my teenage off-road exploits.

Stay safe, sheddies, and in these weird and crazy times, be even kinder to each other than usual.

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THE Shed WHERE DREAMS ARE MADE REAL
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ISSN: 1177-0457

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CLIMB EVERY MOUNTAIN, FORD EVERY STREAM

MEET A MAN WHO LIVES LIFE ON THE EDGE, LITERALLY

By Helen Frances Photographs: Tracey Grant

Rugged, grunty, daring, muddy — 4x4 truck motorsport and the associated fabrication are both Dan Cowper's livelihood and his leisure.

In fact, he is the classic example of someone who turned a hobby he had lived and breathed since he was a nipper into a job. He is self-taught too.

Every year, on his 32-hectare farm at Turakina near Whanganui, Dan hosts the Suzuki Extreme 4x4 Challenge, which he created and has filmed for television. Dan prepares the 10 to 12 tough, challenging courses over four hectares — courses that test the mettle of participants, many of who drive the trucks that he and co-worker Cameron Hastings have designed, and made from steel pipes.

"If I go to a national trial 20 trucks out of 40 have come out of my workshop. In the beginning I was constantly stressed out about them all holding together and working properly. I've got over that and now I can quite happily just watch and see how all my customers are doing," Dan reveals.

Dan Cowper in the co-driver's seat during the 2019 Suzuki Extreme 4x4 Challenge

Designer motorsport 2020

"Gone are the days where the guys are buying a Suzuki Jeep off the showroom floor and putting a roll cage in it and some mud grips and idling around these courses," says Dan. "Now we've got 600 or 800hp [447 or 597kW] and all this flash suspension and we can really go up some insane banks."

Dan's aim is to design a vehicle that is capable on steep hills and can handle well over bumps at speed. In this particular buggy he says he is almost trying to combine the ideas of two sports: off-road racing and 4x4 trials.

"In the beginning I was constantly stressed out about them all holding together and working properly"

"Years ago four-wheel-drive trials were done in little Suzuki jeeps and Toyota Land Cruisers over slow obstacles because they were low horsepower machines with a high centre of gravity," Dan says. "Over the last 20 or 40 years everything's become steeper and higher and we've got all this horsepower in the world now, so speed is becoming involved. You not only need a vehicle that can go slowly over stuff with traction, you need something with which you can hit these banks fast and hope it doesn't flip over backwards. So, they've got to handle well on the sides of hills and stuff. That's where our sport's heading." ▶

Heaps of grunt

The trucks are designed to drive up 70-degree banks. They are automatics and top speed in one of Dan's trucks could be 80kph, which it can reach from almost stationary. There is no mucking around in first gear.

"You could put it in top gear, stand on the gas, and it will just wheelspin and throw all the gravel out behind it. You'll reach that top speed very quickly. But what it means," he tells us, "is when you are going down a steep hill and the courses are pegged and designed with sharp corners at the bottom, you can be in that gear and just go and you'll have all this wheel speed."

At the time of interviewing late last year Dan had just knocked off from a long day's work fixing aluminium panels to his latest buggy design. Home was only a few steps from his massive shed/workshop, where a number of trucks were lined up in various stages of fabrication or suspended in mid-air.

"You need something with which you can hit these banks fast and hope it doesn't flip over backwards"

Dan had been working on his latest design for a couple of customers who, he says, have given him free rein to improve on his usual model and to come up with something "cool and different" that works well. He has already made 25 trucks of similar design using 'beam' axles: solid axles from hub to hub.

MIG welding is the preffered method of welding on the majority of buggy components

Dan driving a Cowper truck at the New Zealand National 4x4 Trials in 2018


New buggy frame tack welded together on jig

"Now we're just changing the idea a bit," he says. "We're putting the motor in the back, turning it around between the seats, and using independent suspension. These independent ones, the diff head is mounted to the frame solid, but the axles and the hubs can move independently to each other. It's a whole different ball game to get all the suspension geometry right and the steering right, so I've had to do a lot of R&D to try and nut this out best as I can."

Making the buggy

A jig is crucial to this process. A large steel plate is used to make one. They build a rough mock-up with a few components — seats, motor, bits of pipe — to determine the layout and rigid framing.

"Then you've got the problem of trying to make it look aesthetically nice. Everything's got to blend in," Dan explains.

Strength is the critical factor in the design and fabrication of these space-frame vehicles, also called 'tubular chassis', and achieving that has come through experience, many trials and errors, and returning to the drawing board.

[Customers have] given him free rein to improve on his usual model and to come up with something "cool and different"

"The place where every bit of tube intersects with another bit of tube creates a strong point. You don't want a tube intersecting at a point where there's not another tube behind it," he says.

Dan spent about a year mocking up the vehicle and frame, making many different versions. Once he gets it right he builds a jig to duplicate the frame so he can make more the same.

"I'm not planning on doing one-offs. I'm investing a lot of time and money into hopefully being able to sell quite a few of these," he says.

Dan's trucks sell for upwards of $80K each.

A lot of time went into building the steel plate with uprights that bolt to the jig. ▶

The winch truck

Dan is just starting to "poke his nose" into the winch challenge sport and truck fabrication. When he was interviewed, he had a winch truck buggy on the shop floor. The difference is in the independent suspension and the positioning of the motor in the back. It also has a hydraulic winch, which allows the truck to be winched up vertiginous banks.

"It's going to be a whole different ball game," Dan explains. "The winch challenges haven't really seen a buggy like this come into their sport before. This winch truck will handle like a trials truck and an off-road racing buggy, but it will have a big, hydraulic winch on it as well. So, it's going to have the best of both worlds. It will be interesting to see how that goes."

"You imagine all that tubular framework, once it's all welded up," he says. "You've got to be able to get it off the plate. So, you can't weld all your jig together; it's all got to bolt and come apart. It's like that Jenga game where you pull the bricks out and it falls down. This whole jig was a mission in itself to build."

Dan built the frame and jig at the same time then welded as much of the frame as he could while it was in the jig so that the frame would hold its shape. He then unbolted the jig, lifted the frame off, and braced it on the floor, tacking on pieces of steel to hold everything in the right place. That done, "You can roll it around and weld it all up so it holds its strength," he tells us.

Everything depends on its accuracy and its strength to hold all the parts in place under great duress

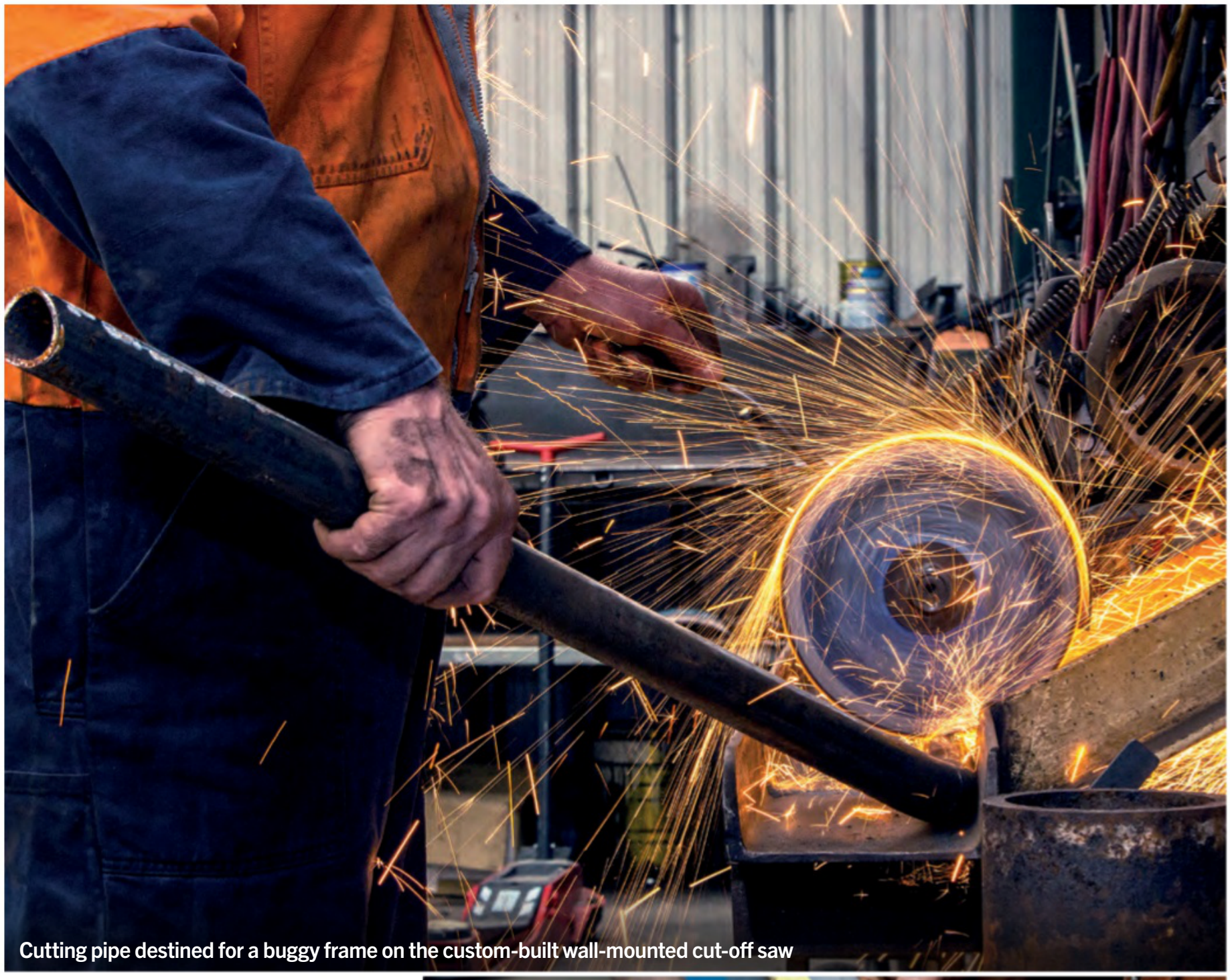
Framing up

The frame is the heart of the truck. Everything depends on its accuracy and its strength to hold all the parts in place under great duress. A stack of steel tubing — 1¼-inch (3cm) medium-wall and light-wall mild steel pipe — sits ready in the pipe rack. To make the frame Dan pulls out what he needs, cuts the pipe in the drop saw, and bends it in the hydraulic bender using set angles.

"Bending a bit of tube isn't as easy as anyone thinks," he explains, "because it's very hard to bend two bits of tube the same because the tube flexes. If you're building something against the jig, everything has to be exactly the same because if you bend a bit of steel and put it on a jig and it doesn't sit on the steel properly, it doesn't fit. So, you've got to make another piece until it is the right angle."

When he's bending a piece of steel, after doing a few vehicles and adjusting diagrams, Dan puts a ruler on the hydraulic ram, and measures how true he has made the earlier ▶

Dan Cowper and Cameron Hastings share a laugh while imagining taking the latest build for a test drive



Cutting pipe destined for a buggy frame on the custom-built wall-mounted cut-off saw

bends. He then angles the end so it slots over the other piece of tube.

"They've all got to come into the same point. You might do a bend and then cut the end and put it on, but the cut has to be exactly right and leave a minimal gap so you can weld it," he says.

Dan MIG welds the frames and tests them and the panels to check if they match up. He says there are tolerances; however, he doesn't tolerate gaps or pipes and panels that don't line up when painted, as that spoils the visual appeal.

"If it's not in line with the centre of the pipe, it's not in line with the centre of the pipe. I'm real fussy. That's probably the reason I've been able to make a business out of this, but I'm not a millionaire because I take so long to make something. Unfortunately, you can't turn these around quickly. If you do a rough job no one will buy your vehicles or you can't charge it out for the time you spend on it."

Bending pipe on the custom-built hydraulic pipe bender

If you look closely you can see there are three new buggy builds lined up here

Health & safety

Many health and safety standards and inspections are involved in making these trucks.

"It's never-ending," says Dan. "We now have to have a certain clearance between the top of our heads and the roll cage. We have to have 100mm between our helmet and steel plates in the roof so that if we land upside down, we don't sink into the ground and damage our bodies. We have so many different scenarios on how we could get injured. Seat-belt mounting points and the type of seats we use are now really important."

Taking into account the requirements of New Zealand Occupational Health and Safety, Dan has to be extremely careful in the way that the Suzuki Extreme 4x4 Challenge is run. All vehicles are scrutineered and safety gear checked. Competitors' helmets and belts are all checked prior to starting a course. He has first aid and health and safety plans in place, paramedics on-site, security at the gate, and traffic management for the entry to the event. He has even had all the troughs on the farm drained so that children can't fall into them.

ORI struts imported from the US

Inside the frame

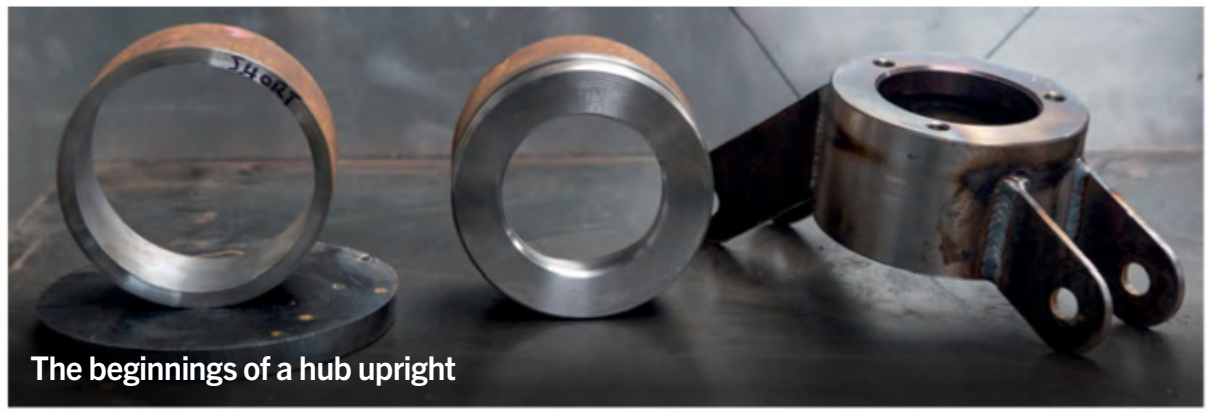
Dan makes the steel brackets, which hold everything in the frame — suspension components, engine, transmission, transfer case, steering wheel, aluminium seats, and so on.

"We try and hand-make everything, draw it all up, and get it to a point where we can put it on a CAD file. Then those components can be water-jet or profile cut out by another business. That way I can email them and say I want the set of shock mounts for this buggy and a week later they'll be here," he says.

Dan has already made jigs on his lathe for when he gets the shock mounts, machined up solid inserts to hold the brackets in the right place, and put a bolt through that holds them the correct distance apart and then against the frame: "It's not just a matter of holding them against the frame; you need to have another jig so that they're both held in the right place, etc."

During fabrication, powder coating or painting also has to be taken into account.

"You might think I can slide that shock absorber into those mounts, but when you weld them on they might pull in close together and then the shock won't fit. So, you've got to try and weld them so they spread slightly open so the shock can go on, and you've got to account for a millimetre of paint on the steel on each side." ▶


The beginnings of a hub upright

It's gotta be right

This is precision work — some things can't be painted because if the paint wears the bolt becomes loose. Many areas have to have the paint machined, sanded, or ground off so steel is on steel. Then of course there is the threat of unsightly rust to deal to.

Some parts are sent to the powder coaters after meticulous prepping. When the parts come back, a lot of time is spent running tapping dyes through all the threads and sanding or grinding surfaces so they can bolt up tight.

Once the frame is made, with all the mounting points, some parts still need to be made, such as the suspension arms and the suspension wishbones.

"For these independent trucks, it's a whole new game. It's not just making them; it's the angle that they're set in the frame so that when they hit a bump fast the suspension works in a certain way so that it doesn't bounce you off but pushes you in the right direction," Dan says.

The arms are made up on tables on pre-made jigs and clamped down tight. The hubs are made in a similar way, with all mounting points jigged to suit the arms.

Dan says the hubs were a huge job to design and required extensive R&D: "On Google you see what guys are building and you work out all the geometry and different angles you've got to get right. Now, I can look at them and go, 'I've made those; they're sitting there and let's hope they work'. But I'm pretty happy with what we've done."

Importing a necessity

Components such as the engine, transmission, suspension, transfer case, and aluminium seats are imported. The engine on this buggy is a supercharged 6.2-litre V8 LSA


One of four buggy hub uprights complete

"However, what's happening now is we're getting so much horsepower we're having to buy special gear to be able to handle it"

— $18K' worth. The Powerglide FTI transmission and the SCS transfer case were built in the US.

Dan mentions that a few years ago they would make everything: "We'd use Kiwi ingenuity rather than buying stuff into New Zealand. However, what's happening now is we're getting so much horsepower we're having to buy special gear to be able to handle it so the gear doesn't break.

"This sort of gear is predominantly made in the US where there's a huge population. We could make it here, but it would cost so much because there aren't enough people to buy it."

Dans says they can't buy a transmission and use it as is — it has to be fitted to the engine; likewise the transfer case to the transmission. Everything is customized according to the different wishes of different customers.

"You've got to pull a lot of it apart and drill holes yourself and get everything fitting properly. A transfer case you buy for one won't be the same as for another," he explains. "The lengths are different, so all the mounting points are slightly different — just enough basically to have to have everything customized." ▶

Suzuki Extreme 4x4 Challenge

The adrenaline rush of taking part in a sport like this and creating an exciting event for a 5000-strong crowd is huge. Dan's farm fills with cars and people. There are hot-food caravans, a rolling scoreboard, and music. The event is compèred by an Aussie announcer brought in specially for the occasion.

Dan describes the scene: "You have 10 to 12 courses and 10 trucks, the TV people are there, and the spectators are pushing at the boundary tape in their efforts to see it all. Each run is different; you have competitors rolling upside down in their trucks, and trucks getting stuck in the mud, breaking down, and getting carried away by tractors."

Once it's all over, Dan goes on to the next stage of making a show from film footage of the event, which is aired on *CRC Motorsport* on Three and goes around the world on the internet. He designed the event to raise the profile of the sport after a lull in publicity saw numbers drop. Now, after six years of running it, he says interest is growing: "I have people telling me that it's due to what I'm trying to do. There's no other promotion for our sport but we've got it on prime-time TV.

"Social media is huge around the world. My Suzuki Extreme 4x4 Challenge Facebook page has 18,000 people following it, which is pretty cool. I get people from all round the world messaging me. It got to a point where a reputable business in England rang me up and said, 'We want to sell Cowper Trucks. Everyone in Europe's watching your event over here and they think it's just amazing'. This led to me shipping my comp truck to the UK to compete in the 2017 Euro Trial."

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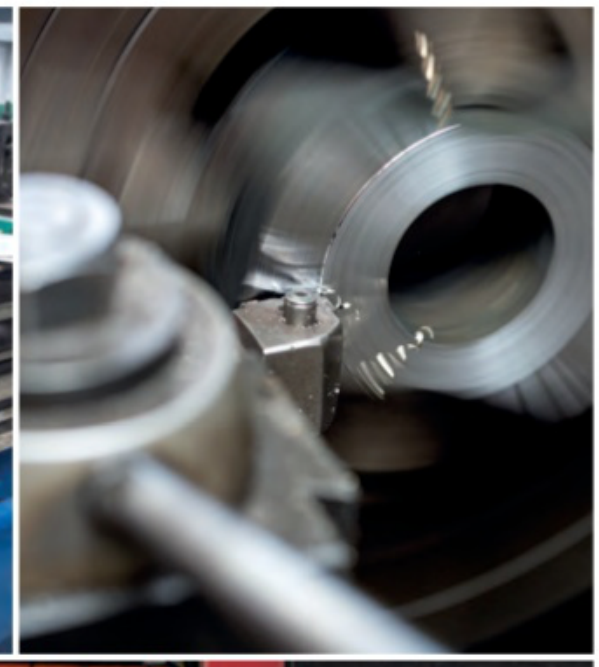
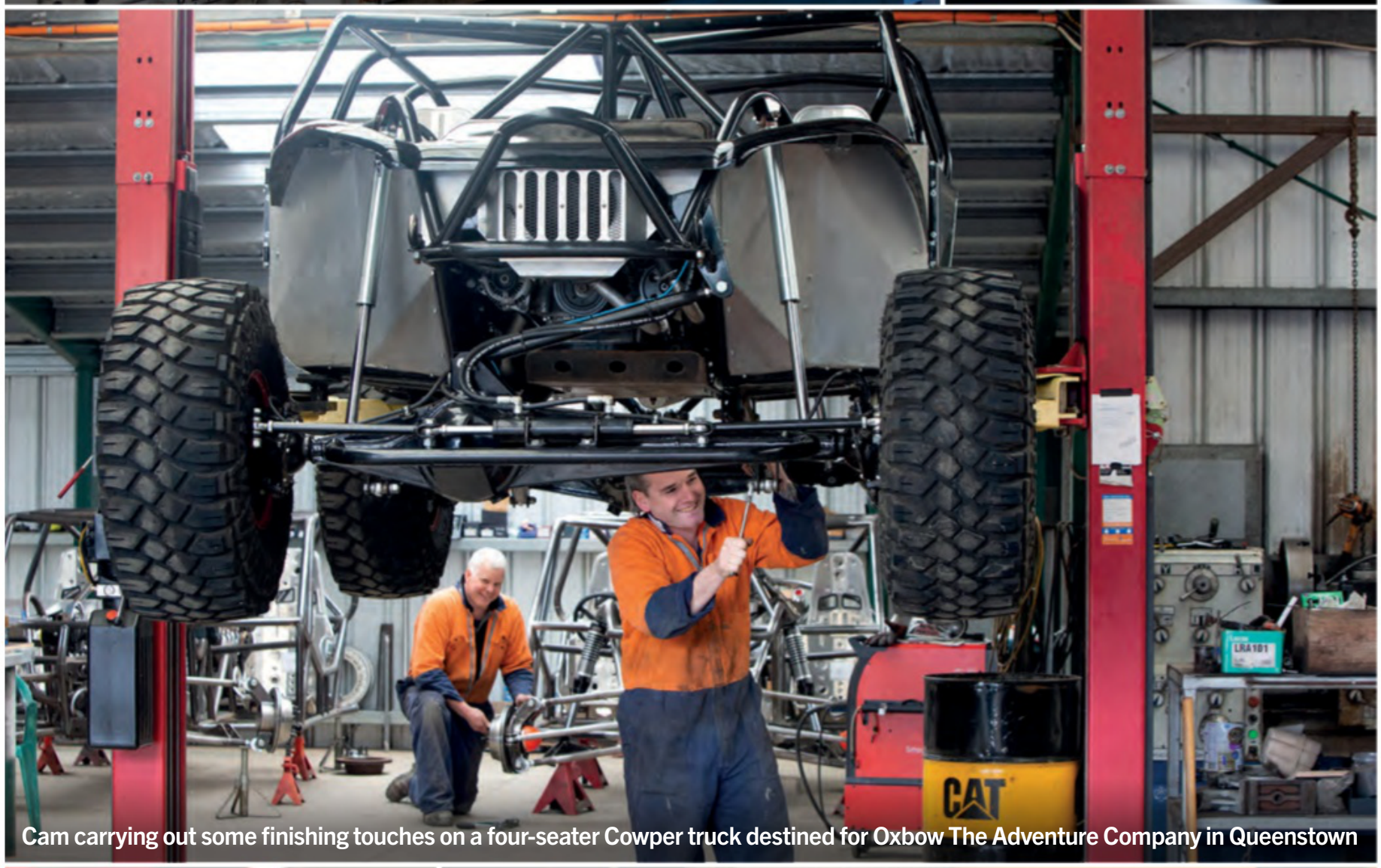
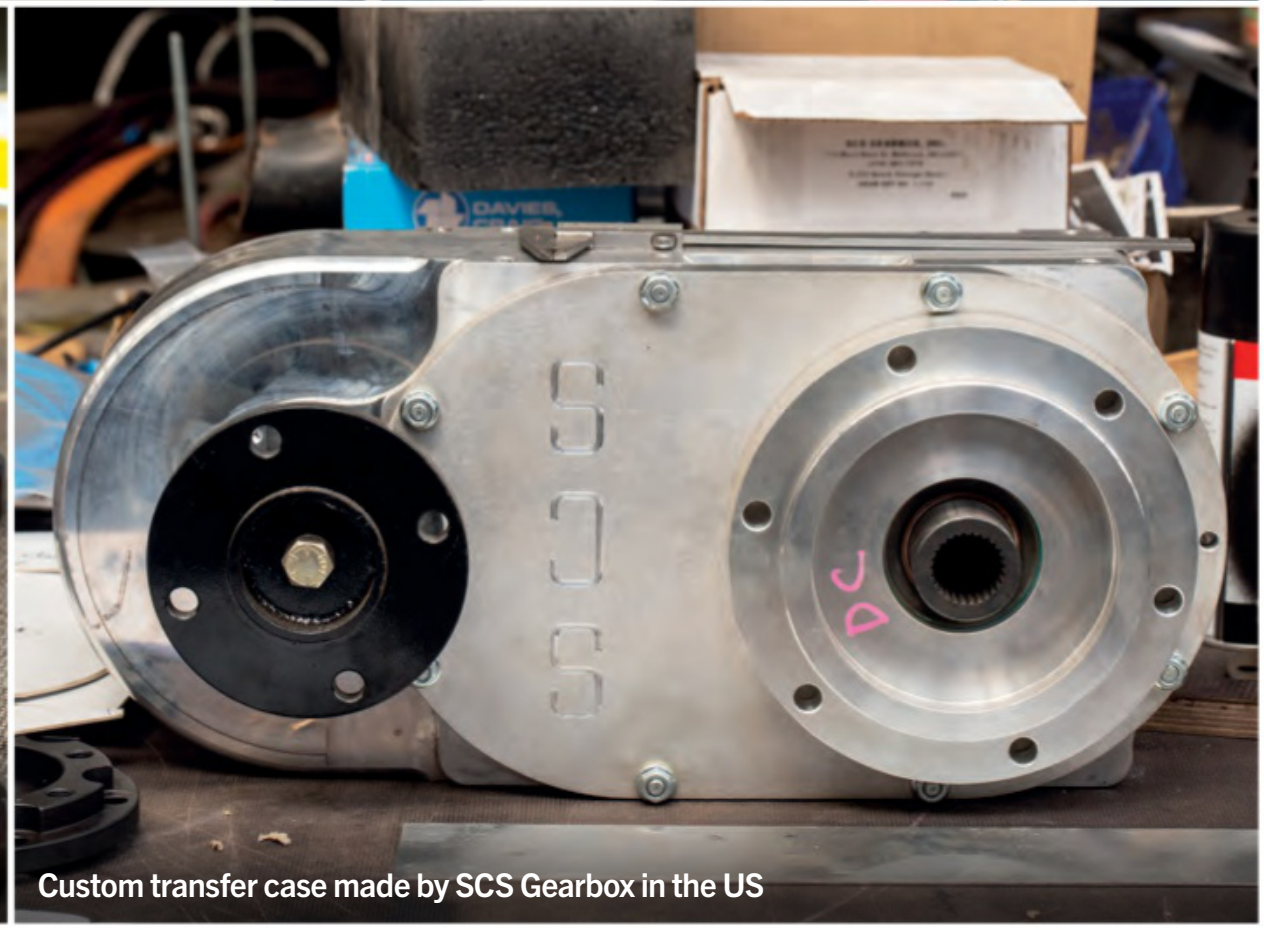
The lathe – an essential piece of equipment to have in this workshop





Cam carrying out some finishing touches on a four-seater Cowper truck destined for Oxbow The Adventure Company in Queenstown

Buggy axle components designed by Dan but made by RCV in the US



Custom transfer case made by SCS Gearbox in the US

Sales reps are often challenged to help source parts for these custom builds


A 600hp (447kW) Chev LSA V8 engine imported from the US

Wrapping the frame

Dan has a stock of cardboard, masking tape, and Stanley knives with which he makes up the outside of the body, playing around until he eventually decides on a particular design and makes up an accurate pattern.

"It's the same as the frame; you go through stages," he states. "Your original cardboard bits are just rough sticky-tape stuff, so you get an idea of what this thing's going to look like. Once you're happy, you've got to make a really good set of cardboard [patterns] so that when you trace around them onto the aluminium there's no room for error. If you fold something in the wrong place or your line's not right, that bit of aluminium won't fit on the frame. You don't get a second chance."

"I've got something to help me with the next one; otherwise I'd have to reinvent it and that takes forever"

Dan makes the aluminium panels and tapes them to the vehicle, then welds spring-loaded Dzus clips to the frame and bores all the holes through the panels. The Dzus fastener can be used like a screwdriver: "You turn it and the spring pushes the clip off. You might go bang, bang, bang on a panel with four twists and it pops off. The idea of that is that it's easy to wash. You could probably take all the panels off the truck in five minutes and water blast it."

When the panels for one vehicle are made they are used as a template to make the panels for the next truck, with Dan checking how they fit on the frame. Continual improvement is par for the course: "OK, it might not quite fit there so I've got to do a bit more angle there or add 5mm to that line, etc., but I've got something to help me with the next one; otherwise I'd have to reinvent it and that takes forever."

Locking diffs

Dan mentions that in 4x4 motorsport the diffs need to be locked most of the time because the wheels frequently come off the ground at different angles. The co-driver often has to work hard to keep them going forward.

"We have to lock our diffs so the bottom wheels, with the weight on them, drive as well, or we use independent brakes," he says. "We have four brakes, a bit like a tractor, and when we pull a brake it will lock a wheel. That's the manoeuvrability we get. We could increase the braking pressure on those top two wheels so that the diff will start driving the bottom two wheels. At the same time, if we pull those brakes really hard on the top side it will spin the truck around on the side of the hill as a turning aid."

Limited-slip differentials (LSDs) have been around for a long time. They are a plate clutch unit in a diff that gives a

certain amount of drive.

"It's in between an open diff and a locked diff," says Dan. "Some clever Kiwi guys have designed a way to make them run free when they're disengaged, but with a hydraulic pump they can pump the LSD unit, so it locks the diff. It gives an 85-per-cent lock."

These guys set them up with the wheel brakes and put proximity switches on the wheel brake levers. The diffs are locked when they are driving normally. When they want to turn, they pull a lever and the proximity switch dumps the air and releases the hydraulic fluid in the diff, opening the diff so they can turn whenever they want.

Dan says that is what they are going to have in their trucks: "We can drive around with our diffs locked, but when we want to turn, we pull on our wheel brake levers, they disengage, and we can turn. We let them go, spring-loaded, and they're locked again. That's a pretty cool thing."

Performance trans shifter for competition buggy

ARB Air Locker switches to the left and rear-steer hydraulic levers to the right

Awesome hi-tech

The trucks have computerized systems and the engines are fuel injected. There are no carburettors and the correct fuel–air ratio is delivered to the engine by sensors on the motor, controlled by the engine's computer.

They run Accusumps for oil pressure to cope with the steep angles.

"You have a sump on your engine and a pickup," he says. "All the oil goes to the back of the sump on steep inclines and the pickup sucks air; then you'll run the bearings in your engine. They're really designed only for going on flat roads. What we have are big canisters so that if the pickup does get a gulp of air, it automatically pressurizes the engine oil system to keep the oil pressure up."

The guys make all the hydraulic steering and steering rams, spending hours on the lathe machining parts and fitting seals. They buy in the wheel unit bearings and twin Wilwood calipers for the braking system.

"In this buggy the driver and the co-driver are going to have a separate braking system, which is pretty cool. It's the first time we've done this," Dan says.

This year's Suzuki Extreme 4x4 Challenge is scheduled for Sunday, 10 May, Covid-19 permitting.

Contact
Email: dan@cowpertrucks.co.nz
Website: cowpertrucks.co.nz
Facebook: CowperTrucks
Facebook: Suzuki Extreme 4x4 Challenge

Like father, like son

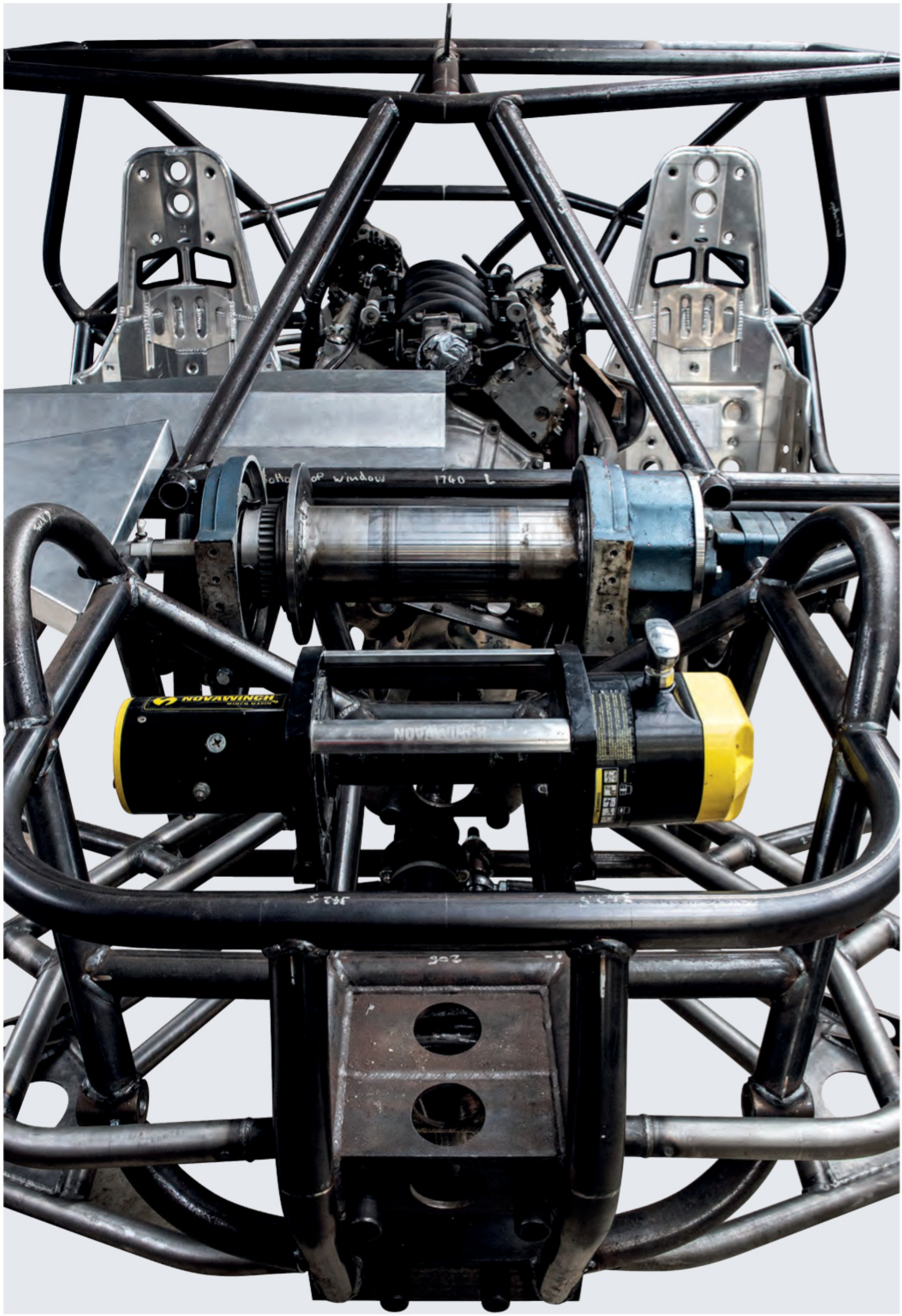
Dan, 47, has been involved in 4x4 motorsport since the year dot. His father, John, was New Zealand 4x4 champion driving a Suzuki in 1978, '79, and '80, so naturally Dan hung out around the sport while his dad was competing.

"Dad was keen," Dan recalls. "He competed in the Suzukis and then he built some vehicles. Back in the day he built one with independent suspension — out of Subaru parts — like I'm doing now 40 years later. That's when people were trialling Willys Jeeps, CJ5 Jeeps, Land Cruisers, Land Rovers, and Suzuki jeeps. All that kind of stuff was really cool."

As soon as he got his licence at 16, Dan was into it.

"The first national trial I ever did I won outright. I was only 16. Since then we've won five overall national titles."

Young Dan admiring his father's work 40 years ago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Alex Korzh sets up acoustic material on dbsorb's computerized cutting table cable

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AN AUCKLAND ENGINEER IS KEEN TO HELP FOSTER INNOVATION BY OFFERING THE SPACE AND THE TOOLS FOR IT TO HAPPEN

By Ian Parkes *Photographs:* The Shed

Globex Engineering is an Auckland product-engineering consultancy that productionizes all kinds of gadgets. While the small workshop had the 3D printers, oscilloscopes, and the like for the smaller items it prototyped, when it came to the bigger stuff, such as a vandal-proof pedestal for outdoor digital screens, principal Craig Shannon had to cast about for workshops that could cut, bend, and weld bigger bits of material.

He faced two problems: using other people's equipment soon got expensive, and when he wanted to use machines that were "big enough to kill yourself with" health and safety regulations prevented it.

Dream becomes reality

Craig's plans to have his own engineering workshop turned into reality when an engineering company that Globex worked with decided to sell off many of the machines he wanted.

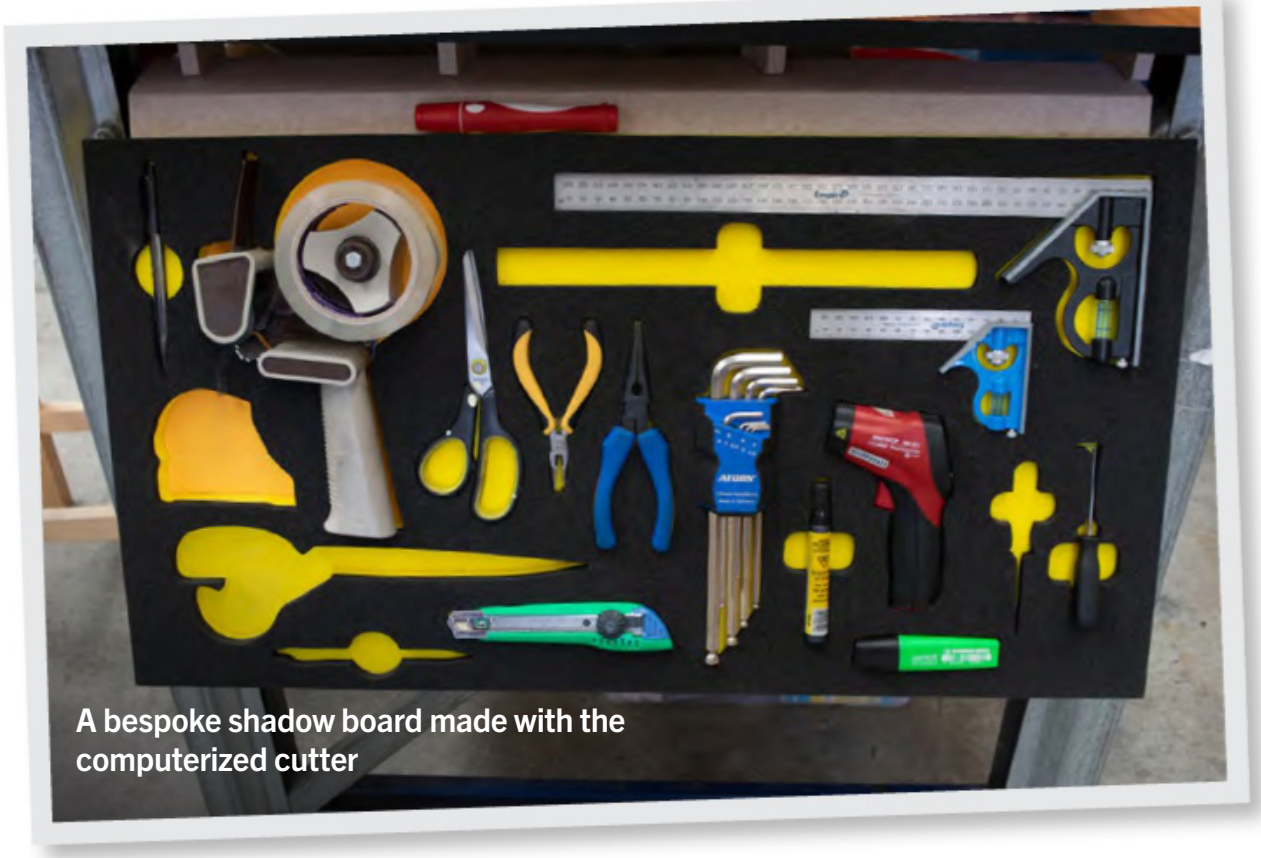
They … have installed lathes, mills, routers, presses, metal folders, and woodworking machines

Craig seized his chance — now he just needed a place to install them.

He set up a joint venture with his company so he could share space with other people working on Globex projects. They found a 200m² industrial unit in St Johns, Auckland and have installed lathes, mills, routers, presses, metal folders, and woodworking machines. Currently they are setting up a grinding room. The workshop isn't complete yet but, as Craig says, what workshop ever is complete?

Sharing shed

Craig dreams of helping others who face the same challenge as he did by making the space and machinery available to other businesses, start-ups, or just people with a bright idea who want to make their ideas take shape. It's not quite happening yet, as



A bespoke shadow board made with the computerized cutter

the safety issues that prevented Craig from using other people's deadly gear still apply. However, he is setting up procedures to recognize certification or provide the necessary training for people to use those machines.

The anonymous workspace doesn't have a name yet. We gave him some suggestions: 'Mark One', 'The Forge', 'The Jury Rig', 'Proto Types', 'Area 52', 'Trial and Area', 'Ignition', and 'Stuff That Can Kill You'.

Craig is confident his test lab concept will happen. After all, it took virtually no time for a client and friend to move in with him as a third partner. Alex Korzh of dbsorb makes bespoke acoustic control installations. He needed space to prototype some fancy new panels that had architectural as well as acoustic properties.

Jigsaw wall

On the day we visit, another of Craig's contacts is there, assembling a trial batch of reusable waxed cotton wrapping that can be used in place of cling film. There are also prototypes of another Globex project on hand: recycling bins made from recycled plastic.

"We tend to like projects that create a circular economy, that don't gobble up resources for a single use," says Craig.

Fitting that description is the most arresting feature in the workshop: a large wall assembled out of plywood using a geometric grid pattern created with the 'insert tab A into slot B' method. Craig says the 'X-Frame' is the brainchild of Victoria University PhD student Ged Finch. Ged needed to test it out; Craig needed a wall — so why not?

Craig told his mother about the wall because she loves jigsaws — the puzzle kind — so she insisted on coming along to help assemble it. It is designed to go up fast and, unlike a traditional stud wall, it is just as easy to disassemble, reconfigure, and use somewhere else. As is the way with prototypes, Ged is now making refinements to the design.

He wanted to make the space and machinery available for other businesses, start-ups, or just people with a bright idea

The available space has already been filled but Craig is still keen to fulfil his vision of giving people access to machinery, especially if they are testing out ideas or wanting to prototype commercial designs. However he expects to have to look for bigger premises for it really to take off.

Craig Shannon and the X-Frame partition wall prototype

WHAT'S HAPPENING ONLINE AT THE-SHED.NZ?

Every week we upload new content on *The Shed* website to add to the hundreds of articles and videos already on the site for readers to discover, learn from, and enjoy.

The past two months' uploads include:

Make your own hammer head for fun, not profit!

Build a basic workshop bench

A video of Eldon Peters playing his drawer organ from* The Shed *Issue No. 89

Maintain that chainsaw — basic info to keep it running in top order

MICRO BIT PROJECT BOOK?

I have read with interest Enrico Miglino's contributions about projects that use the BBC Micro Bit. I was wondering if there was any chance that he (or *The Shed*) was going to put together a collection of these projects along the lines of the *Best of* The Shed? I am a teacher and such a collection would be a much-valued resource.
Andy Gray

Thanks for that idea, Andy, and we are very pleased to learn that your students are finding these articles a valued resource. After we have a good number of these projects under our belt we will look at producing a digital publication of the series.
Editor

KEEP IT LOCAL

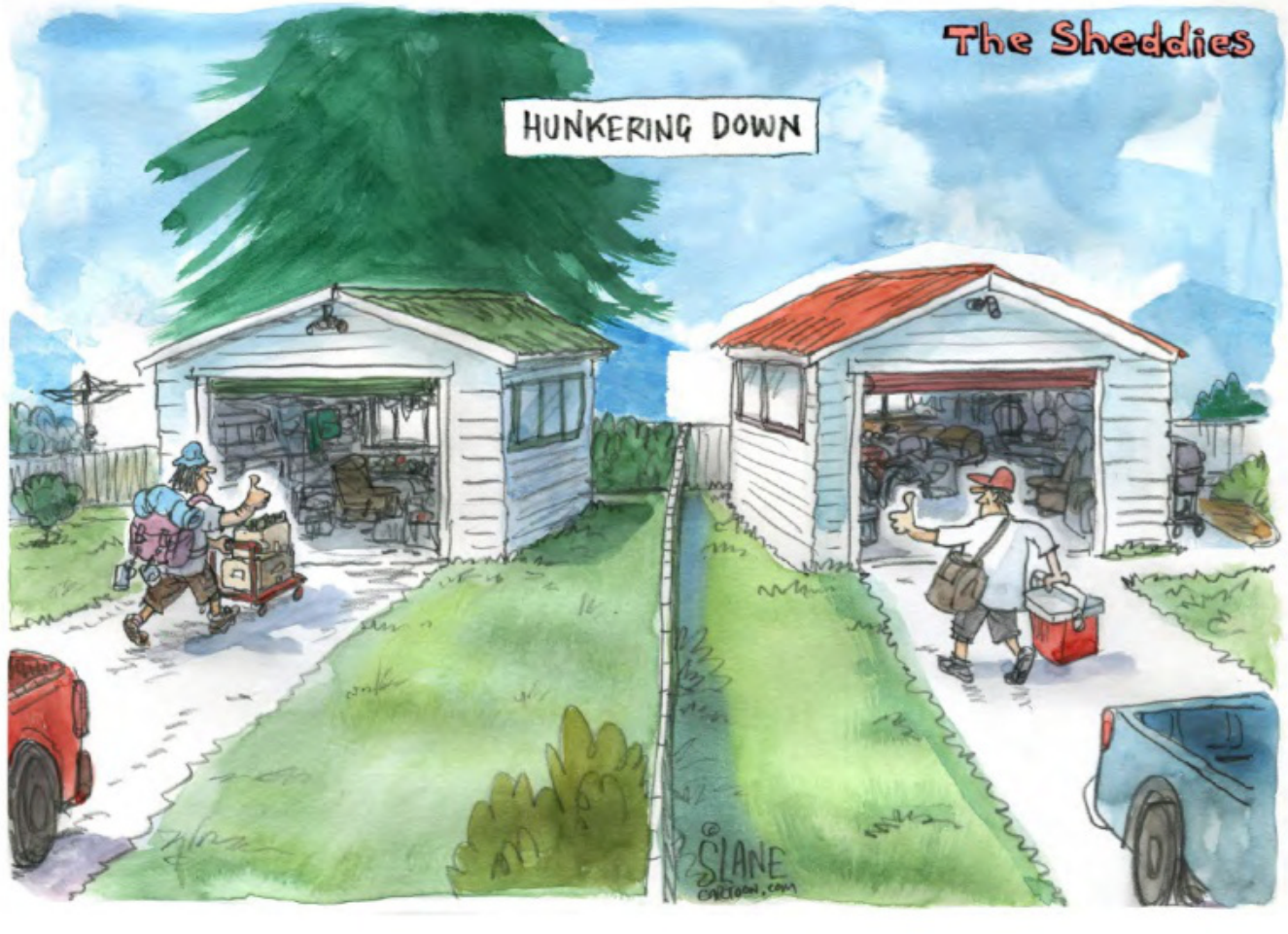
We had our local library come to the Rolleston Men's Shed and we demonstrated 3D printing a few hours before I read the article Repairing stuff [*The Shed* Issue No. 87].

Our local library will print files for little more than the cost of the plastic for members and non-members. selwynlibraries.co.nz/redevelopment/whats-on/3d-printing

The plastic they use is PLA made from corn starch, so there are no fumes while printing. It is also biodegradable and carbon neutral. However, disposal needs to be done correctly. https://m.phys.org/news/2017-12-truth-bioplastics.html

The Tinkercad website offers free online CAD software. tinkercad.com/

The writer of the article used Shapeways, which is in New York City, for his printing, which meant postage and extra time. My library is a short bicycle ride away.
Alex Ferguson



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Drill press reinvented — the Nova Voyager (right) and for the hobbyist, the Nova Viking

KIWI COMPANY REINVENTS DRILL PRESS

HOW MUCH BETTER CAN A DRILL PRESS BE? WAAAY BETTER — WAIT UNTIL YOU SEE A NOVA DRILL PRESS IN ACTION

By Ian Parkes *Photographs:* The Shed

A drill press — a handy thing to have. You don't need anything too flash because it does a pretty simple job. Clamp the workpiece down, install the right bit, switch it on, and pull the handle. Job done.

Not so fast. An innovative Kiwi company has almost reinvented the drill press, and its version is taking over the world. Despite being more than twice the price of a standard machine, the Nova Voyager is virtually the only drill press moving off the shop floor, according to its retailers in the States. Now, Nova is applying that step change in technology to a benchtop model that every DIY woodworker or home mechanic should consider.

Nova is the tool brand of Teknatool International. Based in Albany in Auckland, it made its name manufacturing lathes. Director Brian Latimer says the company knew it could never compete with the big manufacturing concerns on their terms.

"We were always going to be a boutique manufacturer, so we had to have something that made our products better, that people wanted," he says.

Boom times in woodturning

Started by Brian's parents in 1956 the company began by making and casting hardware for electricity boards, then moved into making lathes. At the time the only lathes available were large industrial machines. The business grew as hobbyists got into woodturning and woodworking in the '80s and '90s.

In the 2000s, as manufacturing everywhere moved to the Far East, Nova set up its own factory in China. However, as that began absorbing more and more effort, the company decided to refocus on what it could do here. That had to be innovating and creating intellectual property — and letting someone else worry about running the factory.

An innovative Kiwi company has almost reinvented the drill press

Nova sold the factory and went back to first principles on lathes: considering how people use them and what the constraints were. One of the biggest constraints is the need to change pulleys and belts to get the full range of chuck speeds advertised, and that people want for different tasks.

Working with input from universities, Teknatool invented a new direct drive motor that delivers massive amounts of torque even at low speeds. That meant the Nova machine could do away completely with the pulleys and belts needed to gear down from a conventional motor's operating speed. It also removes the extra noise, vibration, and losses they generate. As a result, Nova's motors will outperform even three-phase conventional motors.

The new Nova lathes were an instant success both here and especially overseas.

"We have sold thousands of them," says Brian. "If you go into any woodworking business anywhere in the US they have heard of Nova."

Power on demand

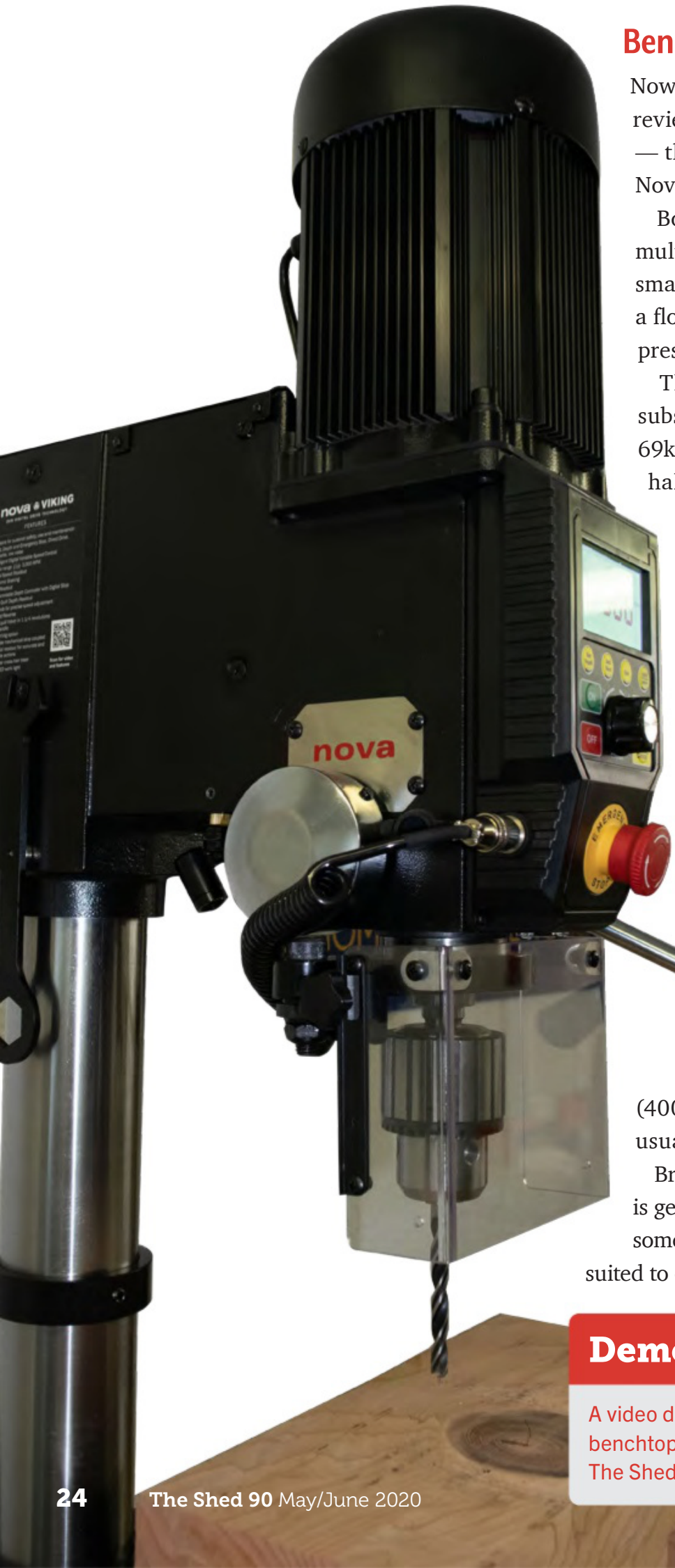
Another key innovation of the Nova lathes is that their motor operation is computer controlled. That allowed Teknatool to develop a menu, accessed through an LCD screen, to help users. You can select materials and cutter types and sizes and the computer will select the optimal operating speed. Once that speed is selected the software programming will automatically keep the chuck turning at that speed, within a couple of per cent, just by feeding more power or less power to the motor as the load demands. Unlike conventional motors, if there's no load on the motors there's no current being drawn. Brian says that's another benefit, especially for commercial operations where power consumption is an important consideration. ▶

Voyager

Three years ago Nova put all that expertise into creating its first large drill press, the Nova Voyager.

Grant Oxenbridge of Carbatec, the New Zealand distributor, who demonstrates the drill press for us, says, "If you stand a lathe on its head, what have you got?" A drill press, is what.

Once again, despite their premium pricing, Nova drill presses sold themselves on their performance.



"Say you want to drill into brass with a conventional twist drill, what's the best speed? I've got no idea," says Grant, "so I key it in, and it says here it's 1200rpm."

Grant explains that many hobbyists will be working with different materials for the first time so they appreciate the help.

"We often get someone drilling into hardwood and I'll say you see that smoke? You are going too fast."

Benchtop version

Now, finally, to the subject of this review: the Voyager's baby brother — the benchtop version, the Nova Viking.

Both Brian and Grant have had multiple requests for something smaller than the Voyager, which is a floor-standing or pedestal drill press that weighs 125kg.

The new version is still a substantial piece of kit weighing 69kg. It has a 1hp (0.7kW) motor, half the size of the Voyager's, but it still outperforms any other benchtop model. Brian says the limiting factor is almost always the round shank of the tool turning in the chuck's jaws before the motor runs out of power. It also has a 120mm stroke, compared with the 80 to 85mm of most benchtop drill presses, and the working diameter between the drill centre and the post carrying the drill head is 16 inches (400mm) compared with the usual 15 (380mm).

Brian says that the new machine is geared towards the hobbyist, so some of the Voyager's menu options suited to commercial uses have been omitted, but it also has refinements. The LCD screen is larger and brighter with a more advanced icon menu.

> *Teknatool invented a new direct drive motor that delivers massive amounts of torque even at low speeds*

Versatility

At present Nova is developing commercial metal-working or engineering drill presses and Teknatool mechatronics engineer Shi Zheng says that they have incorporated some of the features geared to that market in the Viking, because DIY users are likely to want to use it for everything.

The Viking has a single button press for reverse. Shi says this ability, along with its high torque at low speeds, means that the drill press can be set up with a tap to cut threads in metal. Not many drill presses even offer a reverse function.

The machine also features a built-in work light and laser cross hairs to act as a guide when setting up a workpiece. It has a manual depth gauge on the handle so that you drill to a set depth, but it's much easier to programme this in: simply zero the depth on the controller at the surface of the workpiece, set the desired drilling depth, then turn the handle. The machine beeps faster as it nears the target depth then it stops at the desired depth. The drill then automatically reverses for three seconds to clear itself — or it keeps going as you back it out, if it's in tap mode.

It also has a very useful auto stop/start feature. If you need to drill a series of holes, just turn on auto start and the drill will only turn when you grab the handle and lower it towards the drill press table. It will stop when you release the handle to move the workpiece. As Grant says, you are supposed to turn the motor off on a conventional machine while you reset for every hole, "but most people don't do that." This is clearly much safer.

Demo video

A video demonstration of the benchtop Nova Drillpress is now up on The Shed website: the-shed.nz

Unflappable

The most impressive feature of this drill press is seeing how the quietly working motor maintains its speed when the load comes on. Most machines, when they get into their work, will slow down considerably, by 50 per cent or more, when biting deep. A standard motor is going flat tack whether the drill is in contact with the work or not, so any resistance or load will inevitably slow it down. Not the direct drive motor. The computer controls its speed and just feeds in more current to maintain that rotor speed as required.

The engine note on the Viking barely changes; the drill bores remorselessly on. The only thing that changes is the load percentage read-out on the screen. That means the drill bit, whether it's a 6mm twist drill or a 65mm diameter Forstner, maintains the ideal cutting speed, so the operator only has to check they are getting nicely shaped shavings off the bit.

The lack of vibration and the constant cutting speed deliver beautifully clean holes, and there is far less likelihood of something snagging, going wildly out of control, or getting damaged.

You can see why these machines are so popular — especially in schools. The large Voyager retails here for about $3600 compared with $600 to $1700 for other pedestal drill presses. The benchtop Viking sells for around $1700 compared with $200 to $700. However, as Grant says, it's a choice most buyers are willing to make.

The machine also features a built-in work light and laser cross hairs to act as a guide when setting up a workpiece

We ask Brian if he's worried that the big manufacturers he's displacing will copy his products. He replies that they took 17 years to develop and, while the mechanical parts of the motor are there for anyone to see, most of the smarts are in the computer control and in the software, and that's much harder to reverse engineer.

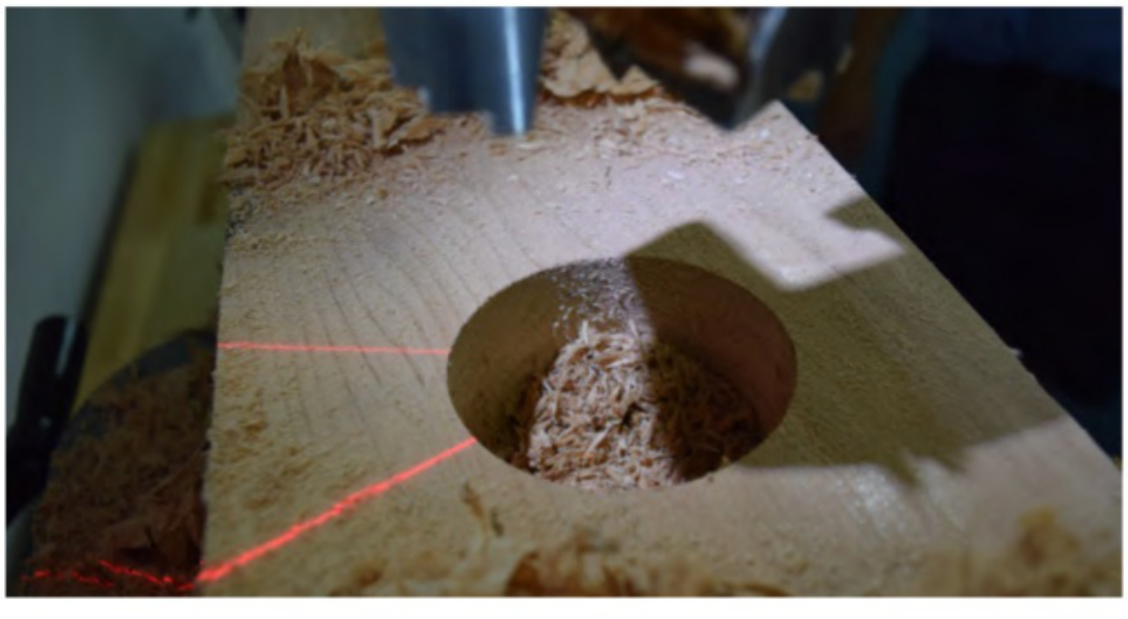
"You can look at a smartphone and see the features and what it does but it's much harder to see how it does it," he states.

No more No. 8 wire

Brian says he is pleased and proud to be part of a growing number of companies — the 'TIN 200' — in New Zealand taking their creativity to the world. It's time to recognize that the 'No. 8 wire' mentality has had its day. It's no longer about making do; it is about applying a Kiwi 'can-do' approach and imagination to create new, high-value, and high-quality products that will find their place anywhere in the modern world.

Brian lists a number of other companies already succeeding in international markets and says this innovative technology and engineering sector is poised to become one of the country's major export earners.

It's a pleasure for us at *The Shed* to share one of the success stories from this new generation of Kiwi pioneers.



Clockwise from top left: Carbatec's Grant Oxenbridge (left) with Nova's Brian Latimer and Shi Zheng; the Viking's graphical and programmable control panel; a perfect hole cut in one shot with a 50mm Forstner bit

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Welding the butt join

BASIC WELDING TECHNIQUE

PART SIX IN A SERIES ON HOW TO WELD

By: Greg Holster Photographs: Jude Woodside

Over the past five issues of *The Shed*, we have explored the basics of the main types of welding commonly available to sheddies. This has ranged from manual arc welding (stick welding) to MIG and TIG welding, with aluminium welding in between.

We plan to go further with this series but this is a good time to consolidate what has been covered to date with a short summary of some general tips on welding, welding safety, and techniques. These are aimed at the novice welder and focus on practice and what to aim for.

One of the keys to successful welding is penetration — good penetration where the weld enters the joint. Good penetration means just the right amount. In many cases the requirement may be 'full pen' of the joint. This means that the weld metal runs right through to the other side of the joint. This gives the 'weldment', the complete assembly whose parts are formed by welding, full unity — provided you haven't over-welded the joint; this can cause metal fatigue.

Over-welding

Many novice welders have the opinion that more is better. This is not papier mâché; you can't just keep piling it on and hoping for the best. Too much heat from too much weld metal can cause a number of problems.

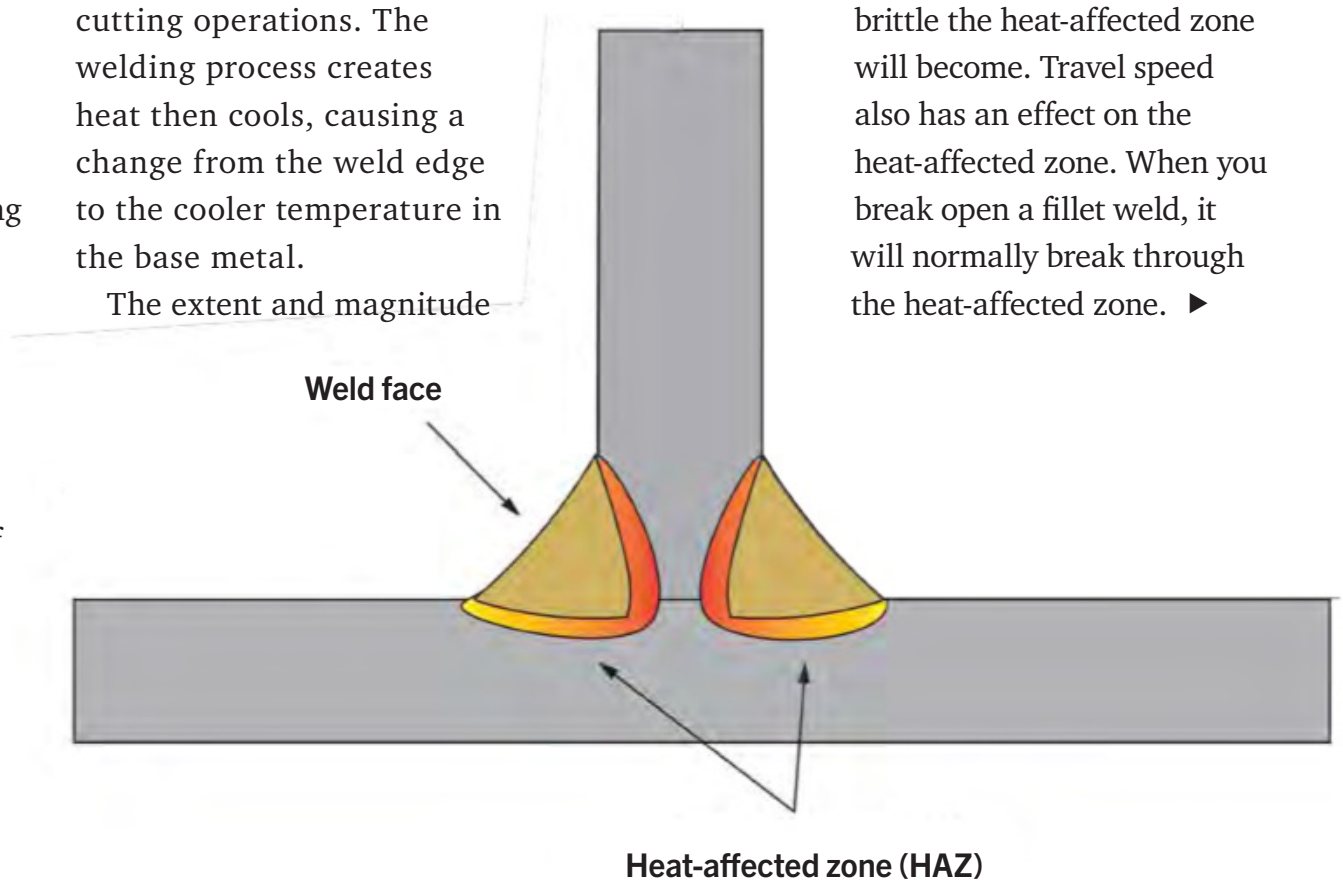
The 'heat-affected zone', the narrow area of base metal that is not quite melted, and its microstructure and metallurgic properties are altered by welding or gas/plasma cutting operations. The welding process creates heat then cools, causing a change from the weld edge to the cooler temperature in the base metal.

The extent and magnitude of the metallurgical change depends on:

- the base material
- the weld filler metal
- the amount of heat created by the welding process
- how rapidly it cools.

The faster the weld cools, the more brittle the heat-affected zone will become. Travel speed also has an effect on the heat-affected zone. When you break open a fillet weld, it will normally break through the heat-affected zone. ▶

Too much heat from too much weld metal can cause a number of problems



Welding the butt join

Butt weld

When welding a butt joint, it is ideal to have a slight gap to enable good fusion and penetration. The gap between the pieces to be welded is called a 'root gap'. It ensures that the weld metal will penetrate right through the joint.

When welding, say, 1.2–1.6mm mild steel sheet, you will find that you may not need a gap. But from 2mm upwards it would be advisable to start leaving a gap. Of course, the root gap is in direct relation to the amperage being used. For example, let's say we have two pieces of 1.6mm (1/16-inch) mild steel. To MIG weld this butt joint I would set up the joint with a 1mm gap. That is using a small MIG machine with 0.8mm hard wire and using Argoshield gas protection or 0.9mm gasless wire. At 70–80A, we will be getting a good, sound weld with good penetration.

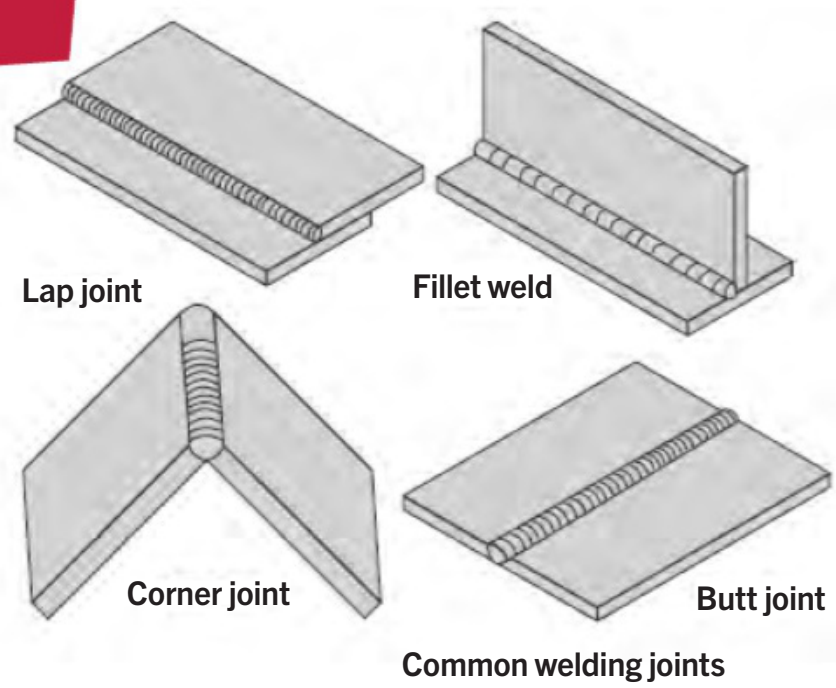
When welding the same joint using TIG at 85A, or stick welding at 80–90A, I would have no gap at all, because of the extra heat. In my opinion, if you want good penetration without too much heat input and distortion, hard wire or gasless wire would be the best choice. You would weld this best of all by moving quickly and welding vertically down.

On thicker materials, 4mm thick upwards, you may have to bevel the edges of the joint to ensure maximum penetration. Each edge should be bevelled 30 degrees, which gives us an included angle of 60 degrees.

"In a butt weld, if the weld doesn't penetrate the root gap, the joint will be weak and easily broken"

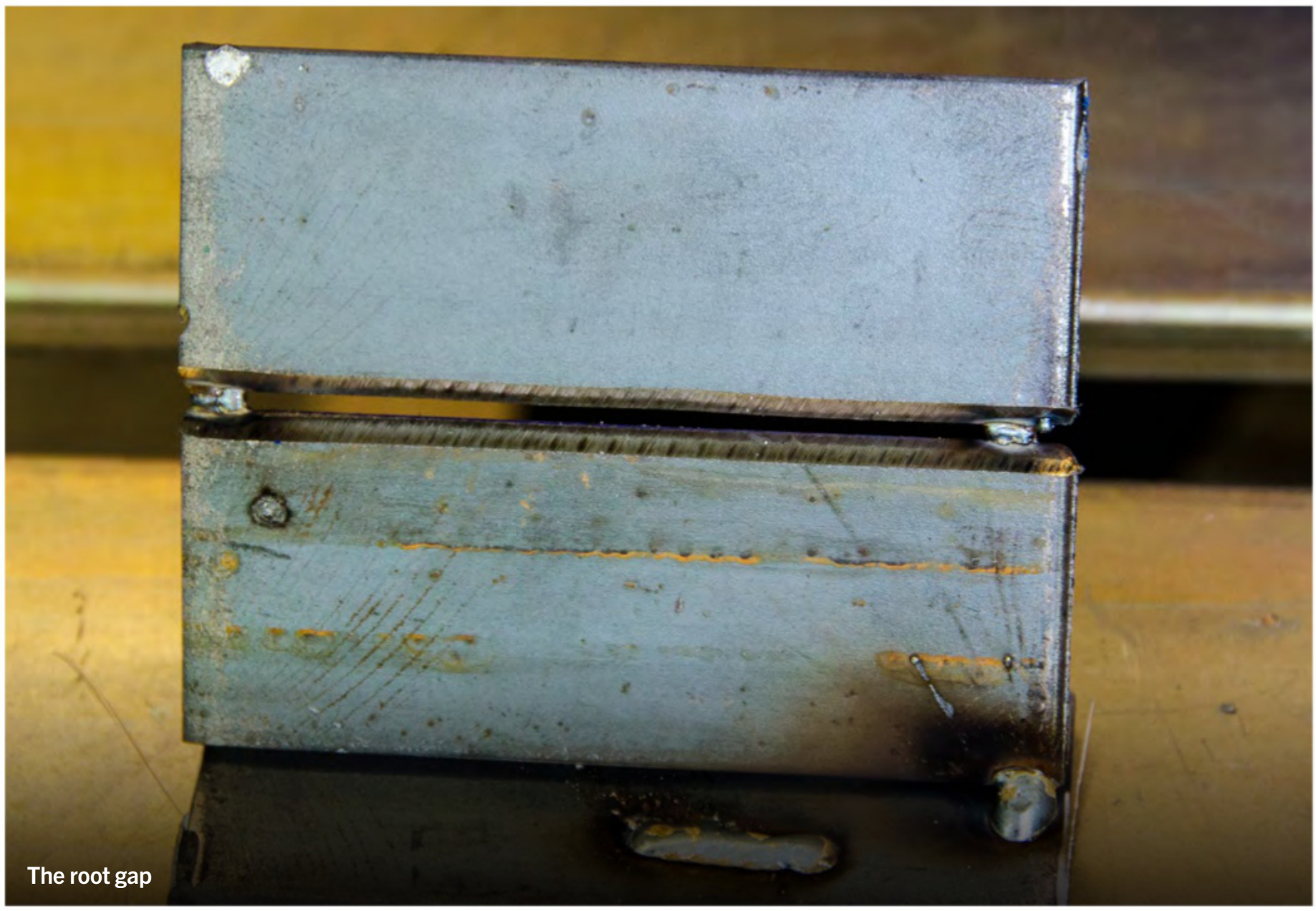
Once again, the gap will depend on the thickness of material and the welding process. It is difficult to weld a 'V' prep if the bevelled edge is tapered to a point. So a 'root face' is used to create an edge to support the heat of the arc. Without this we can burn through very easily. In a butt weld, if the weld doesn't penetrate the root gap, the joint will be weak and easily broken. It all comes down to what you are welding and what weight or stresses the welded joint will be under. There is nothing wrong with a square butt, where there is no gap and you just weld both sides.

Another option for thicker weld joints is to back-grind the first weld and then weld on the reverse side into your first weld to ensure good penetration. A properly welded, sound butt joint will be stronger than the parent metal and resist even heavy and sustained stresses and forces. ▶



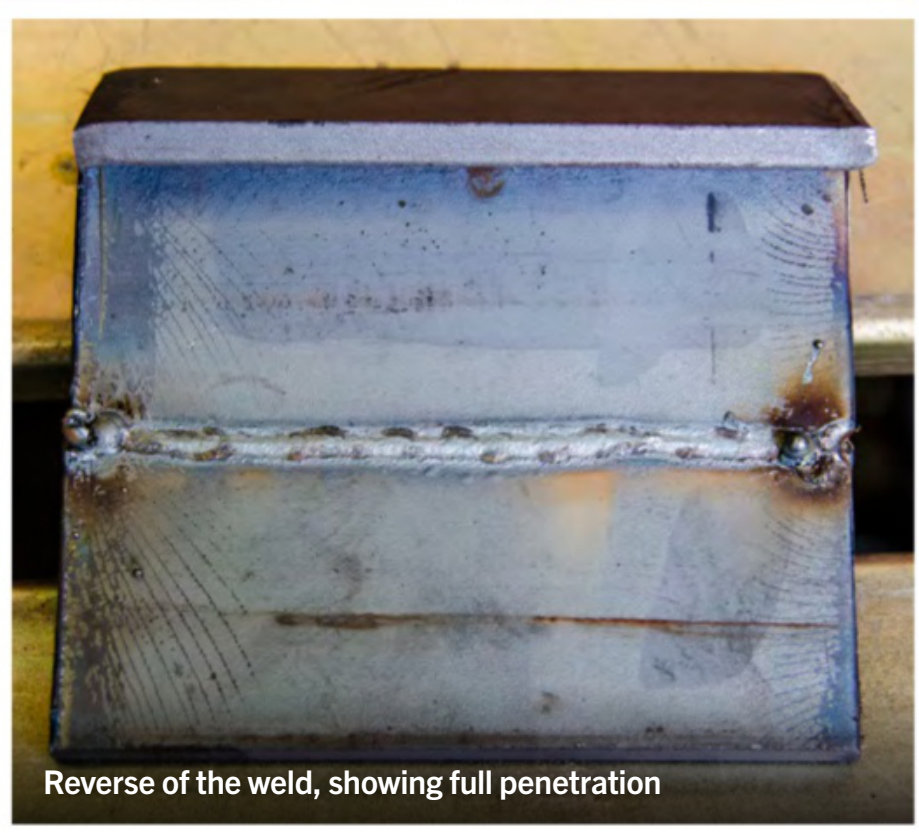
Common welding joints

V-groove preparation for butt joint



The root gap

Completed weld



Reverse of the weld, showing full penetration

Fillet weld

Fillet welds are joins between pieces that are at approximately 90 degrees to each other. They can be stronger than the base metal if the weld is the correct size and properly done. The weld should be close to the same depth as the material being joined. If the pieces are of unequal section, the weld bead should be at least the same thickness as the thinnest section. Again, this all comes back to heat input and fillet sizes. A 6mm fillet weld on 4–5mm plate may look strong but this means the fillet joint has been over-welded. For heavier sections, multiple passes may be required to build up to the desired depth of the fillet weld. In fillet welds, running a bead of weld on both sides of the joint provides maximum strength.

Large welds

For large gaps or where areas need to be built up, it is useful to use a technique called 'stitching', or 'weaving'. With this method, the electrode or MIG gun is moved in a stitching motion from side to side, laying a bead of weld successively on the preceding one to build up an area with weld metal.

You need to move relatively quickly to maintain the weld pool and pause at the end of each pass to avoid 'cold lapping', where successive layers are formed over a weld that is hard.

Another technique for larger welds involves laying down the root run and then building up the weld with 'filler runs' (aka 'hot runs') finishing with a capping run. This is instead of trying to do too much in one run and overheating the work.

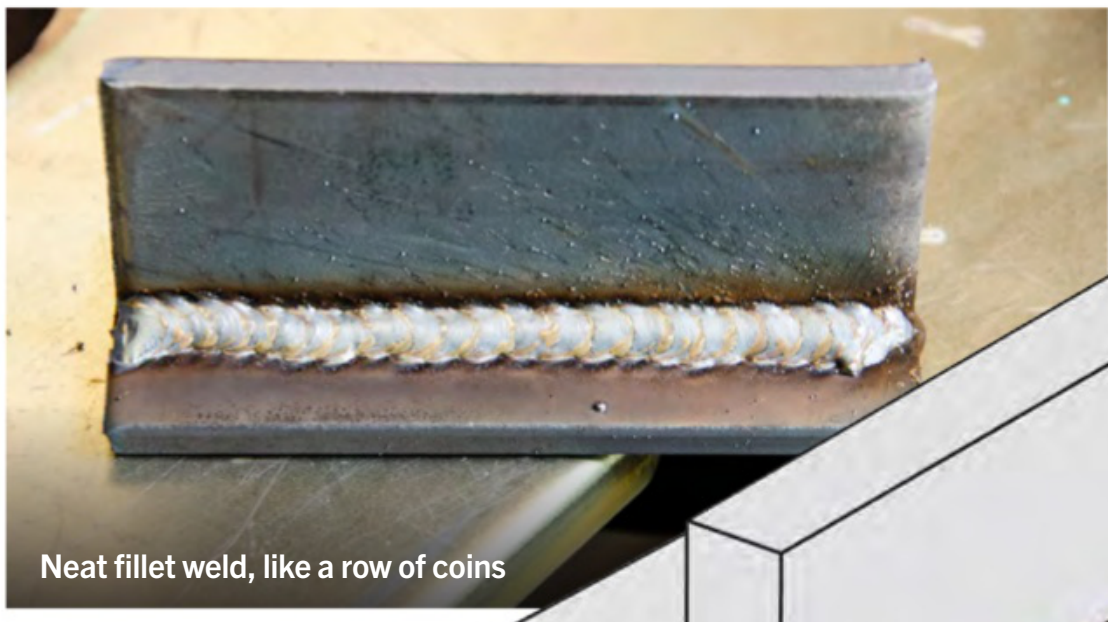
Laying alternating welds on either side of the piece helps to combat distortion

Distortion

Overheating and over-welding the work can cause distortion especially in fillet welds or welds where the two pieces to be joined are of different thickness. Using stiffeners or a jig, which can be cut off or removed once the project is cool, can counteract distortion.

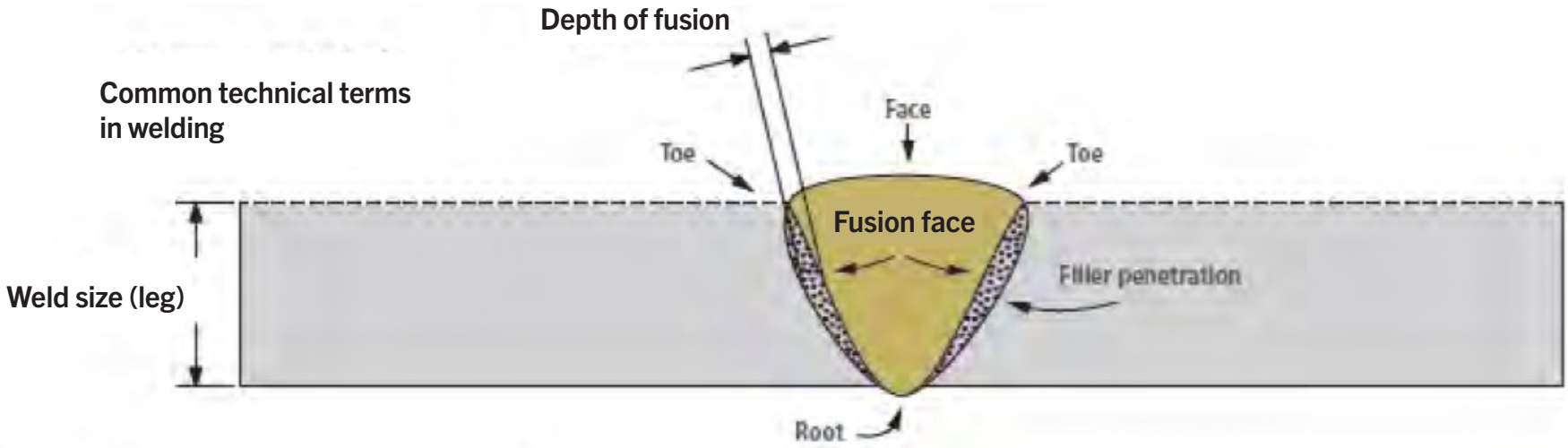
Otherwise, you can preset your project to allow a certain amount of movement, setting the parts at an angle so that, hopefully, by the time you have finished welding and everything has cooled, your project has the true and correct shape.

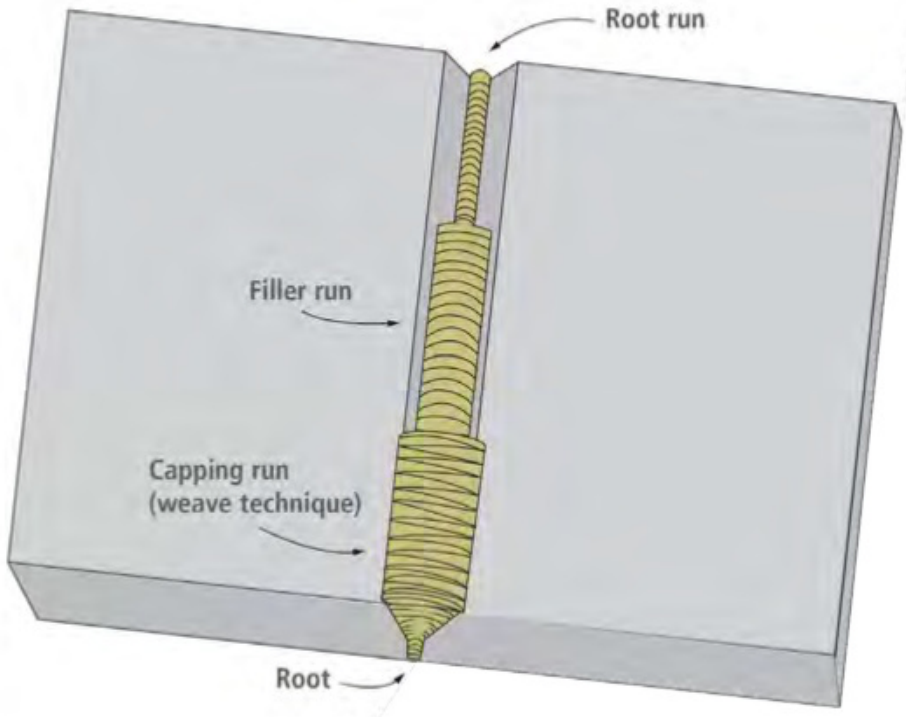
Welding heat will always tend to pull work in one way or another through heating and cooling of the weld metal. It is good practice to try to account for this. In thinner metals in particular, it is a good idea to allow for the contraction that can occur after the weld cools in right-angle fillets and set the adjoining piece slightly off square to allow for this. 'Sequence welding' is the most common distortion nullifier. Here the weld is done in short segments, alternating along the joint line. It is a good idea to apply a couple of good tack welds and clamp the work in position. Laying alternating welds on either side of the piece helps to combat distortion. Using this technique in conjunction with strong backs and/or stiffeners, you can counteract the effects of distortion.



Neat fillet weld, like a row of coins

Fillet weld terms

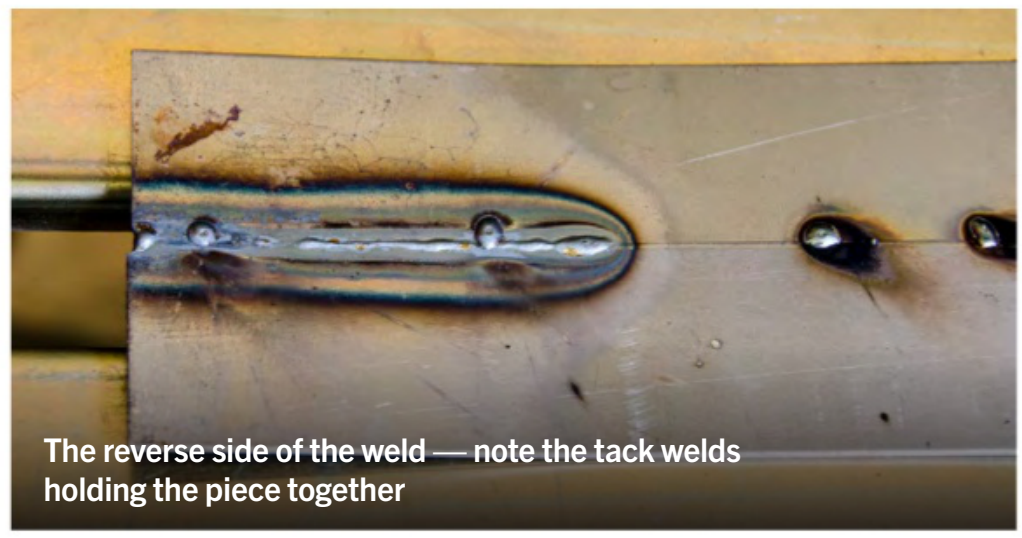




Multi pass groove weld

A weld on thin plate

Porosity (top) compared with the ideal weld bead



The reverse side of the weld — note the tack welds holding the piece together

A good weld

A good weld should look shiny, appear uniform, and be symmetrical in shape. There should be no weld metal or stray arcing outside the line of the weld. The result should look clean and even, not dull, pockmarked, or lumpy. The edges should also look fused.

Porosity

Porosity in welding is not a welcome sight but it can show up all too often in the welding shed. 'Porosity' is a contamination of the weld metal in the form of:

- trapped gases
- shielding gas problems
- gases released as a result of moisture, paint, rust, and impurities on the metal surface.

These are the impurities that we can think will disappear once we have welded over them. The gases, mainly hydrogen, are absorbed into the molten weld pool and released as solidification takes place. Or perhaps the shielding gas doesn't completely cover the weld pool and oxidization adversely affects it.

Using gasless wire with too many volts is another cause of porosity. The problem here is that the arc may seem super smooth and hot, but you may be cooking all the good stuff out of the flux core. So beware; make sure the arc has a little crackling sound to it and you should be all right. Porosity comes in the shape of rounded holes, called 'spherical porosity'. If you are lucky you will be able to see them. Often, though, they are under the surface. If the holes have an elongated appearance, they are called 'wormholes'. These wormholes are normally on the surface, which means there will be other gremlins underneath.

Other causes might be:

- a clogged nozzle in the gun
- wind blowing the gas away
- too little gas flow
- too much gas flow.

The first thing to do is to check and clean the gun nozzle. You should do this from time to time anyway, to clear weld metal splatters that tend to clog the gun. Keep your weld torches — whether they be MIG, TIG, or your stick welding handpiece — in mint condition. The same applies to your earth lead and connection. ▶

Cratering

'Cratering', or holes, on the end of the weld can also lead to failure or cracking. This is caused when the power ceases and the weld pool is still molten. If you pull away too quickly, you prevent the gas from shielding the cooling weld pool properly. This is preventable by pausing slightly at the end and either holding the arc for a second or so or, when MIG welding, going back partially over the weld pool briefly before releasing the trigger. These craters are like a tiny volcano. The hole will often go down to the toe of the weld. This is a great place for a crack to start once the stresses on your project start.

Cold lapping

Cold lapping occurs when the arc has not melted the base metal sufficiently and the weld filler metal has not fused properly with the unwelded parent metal or previous weld material. It can occur in arc welding, when the molten slag is allowed to roll in front of the weld pool, or from the preceding weld when the slag has not been removed properly. Wrong electrode angles and amperage that is too low are common faults. For MIG, one of the most common faults is having amperage too low for the amount of voltage dialled up. Also, when you are using flux-cored wire with MIG welding, the MIG torch must be dragged.

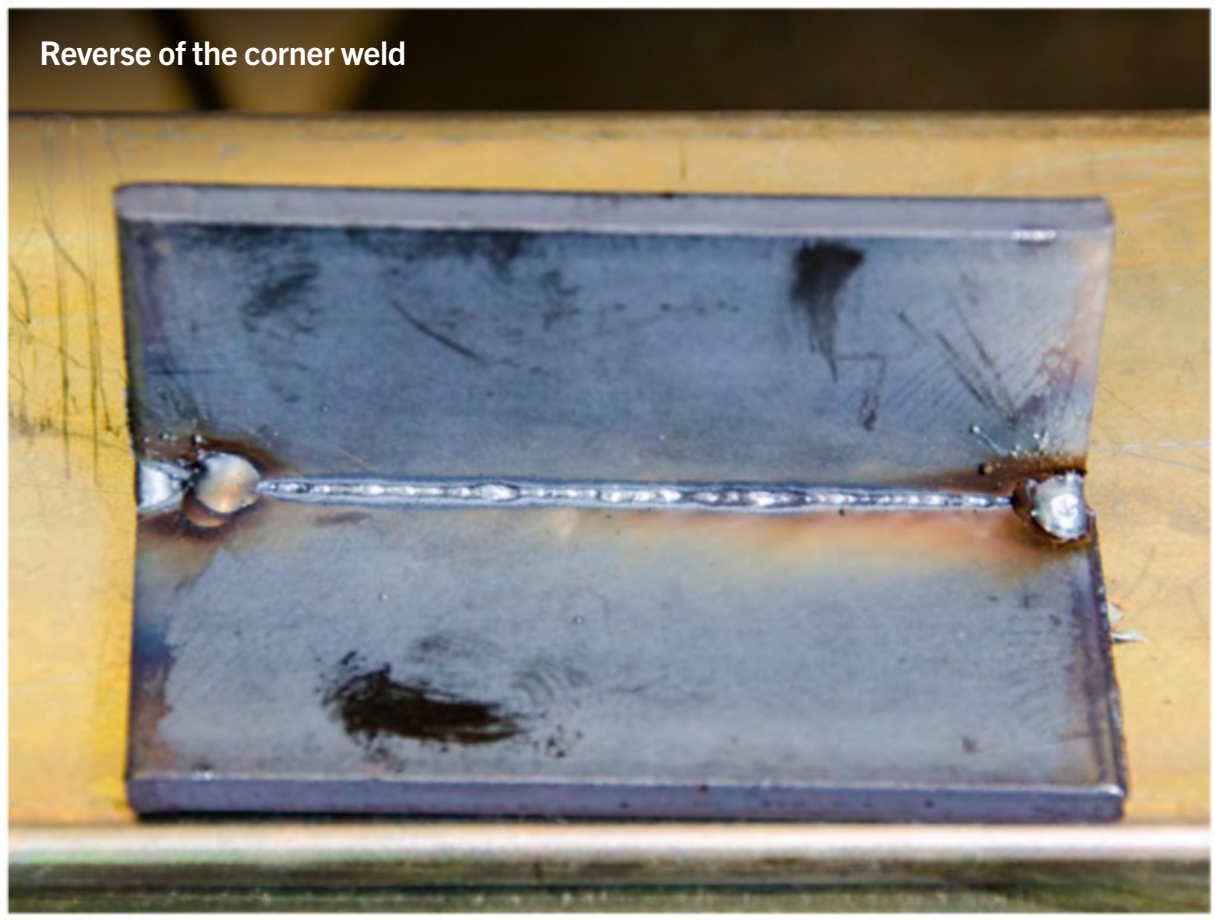
'If it has a slag, you drag.'

Pushing flux-cored wires, whether they be gas-assisted or gasless, is a common mistake. You are just inviting lack of fusion or cold lapping. An X-ray of the affected piece would confirm that the weld has not adhered. These inadequate welds have to be ground out.

Cold laps can also mean you are moving too fast or too slowly, causing the weld pool to float. If you are worried about cold lapping or lack of sidewall fusion, it might be helpful to dial your MIG welder up a bit or increase the amperage in a stick welder.


A corner joint prior to welding


Good corner weld


Reverse of the corner weld

Welding the corner joint

Practice

The best practice in any form of welding is to spend time just laying down weld beads, even on a flat piece of heavy-grade scrap. Many experts recommend laying down a solid pad of welding runs on a 6mm piece of scrap to develop your technique.

Try to keep the runs consistent in width and depth, but to see the effects that various changes make to the outcome:

- vary the angle of the gun or electrode
- vary the voltage
- vary the wire feed speed
- vary the distance of the arc, etc.

Once you feel you have the knack, you can try changing a few parameters: speed, welding vertically down or vertically up. A good setting and welding run after run will help to train your body to maintain the right position and work automatically at feeding the electrode in arc welding, or holding and maintaining a consistent arc in MIG.

Many experts recommend laying down a solid pad of welding runs on a 6mm piece of scrap to develop your technique

Laying a series of welds like this over a plate or other steel tool is a legitimate practice in industry, used to hard-face material subject to wear. If you are using an arc welder, be sure to remove the slag from the preceding run before adding another bead.

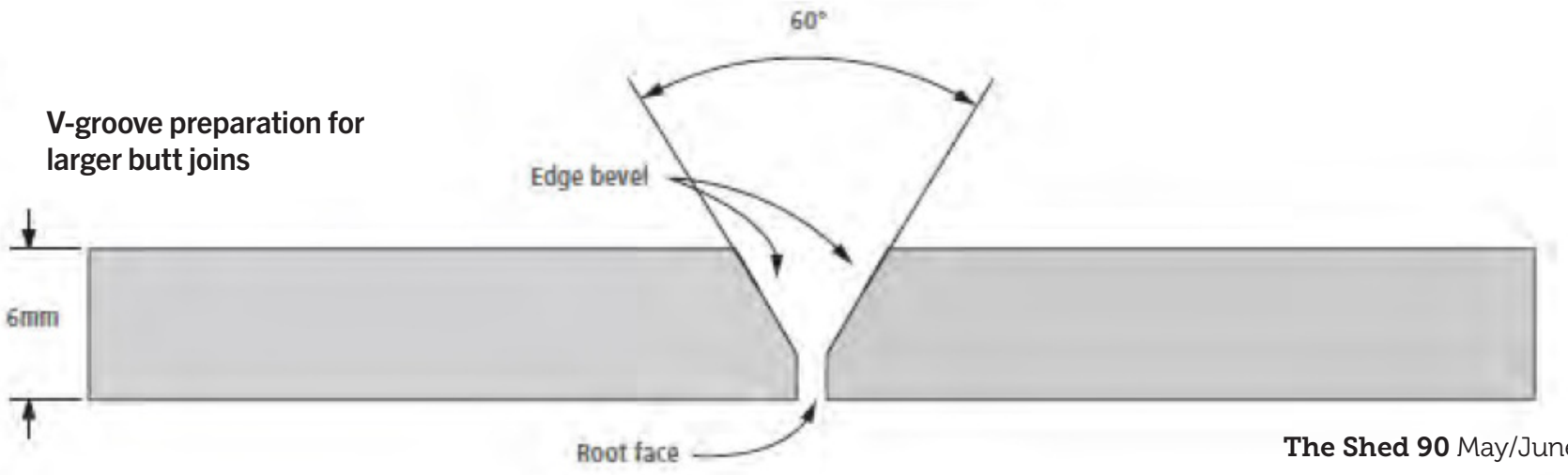
Ergonomics

Body position is all important in welding. It is important to be comfortable. You cannot expect to do good work when your body is under stress or you are unbalanced. The best advice in welding is to relax. Move the gun/handpiece from start to the position where you will finish, become comfortable there, then return to the start. This ensures that you progressively become more comfortable as you work.

If standing, stand with your feet slightly apart and firmly placed and with your knees slightly bent or relaxed. The torch or electrode should be held in a relaxed but firm manner in one hand and if needed supported by the other.

Make sure the cables are not twisted. Don't strangle the gun or handpiece. In stick welding, many welders use a gloved hand to help steady the rod when first struck, until the rod gets to a manageable length.

Good welders at work keep head and body still, with all the movement in the arm and hand. Keep your head where you can see the weld pool and ahead of the weld and always look slightly ahead of the torch. ▶



V-groove preparation for larger butt joins

Safety

All welding involves heat and molten metal. Spatter is underestimated. *Beware.* A badly set MIG welder can send spatter a long way. So keep flammables, rags, plastics, etc. well away from the spatter firing range. Oh, by the way, spatter sticks to glass windows.

Ideally, you should wear a leather apron, or at the very least a good set of coveralls in a tough cotton material; avoid polypropylene or nylon. Do up the top button of your shirt. Cover yourself well.

The light from arc machines is strong enough to cause sunburn and blistering of the skin. Make no mistake — the radiation from arc welders is very high, in the extreme ultraviolet ranges. This should be a given but you can never overstate it: don't ever look at an arc with the naked eye. Even from a distance, an arc light can permanently damage your retina. Be sure that the types of safety goggles you have are suitable and rated for the machine you use. Gas welding goggles are not suitable for MIG; MIG glasses are not always suitable for TIG.

Automatic helmets are a good investment. The ability to see your work right through from start to finish, instead of having to start blind, is a great bonus, especially to the beginner. Check the fine print on the helmets, as some are rated for TIG and you usually get what you pay for.

Gloves are also a must; good leather welding gloves will save your hands from burns and save you time fumbling for pliers to pick up a hot piece of metal

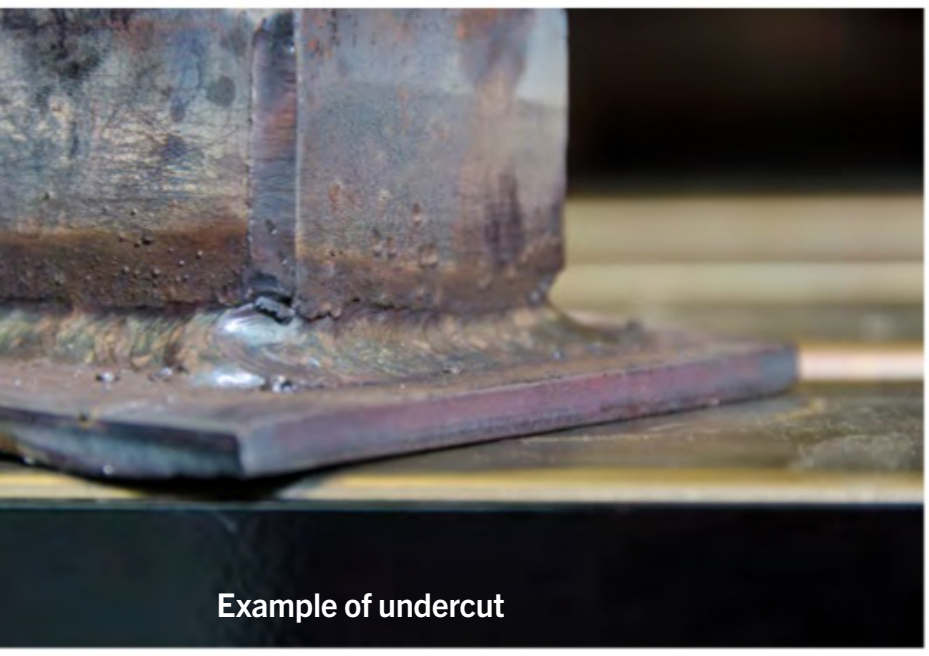
Gloves are also a must; good leather welding gloves will save your hands from burns and save you time fumbling for pliers to pick up a hot piece of metal. Make sure the gloves have a good lining. There is nothing worse than getting a spark or slag down your glove and not being able to flick the glove off because the lining has your hand stuck.

Always wear decent boots; welding in jandals or thongs is not to be recommended, and even trainers or sports shoes are often made from materials that will melt on contact with hot metal.

Fumes are a problem in welding. Some metals and electrodes can give off highly toxic fumes. Wherever possible, weld with plenty of ventilation and keep your face a reasonable distance from the work. Be careful about fumes becoming trapped in your helmet.

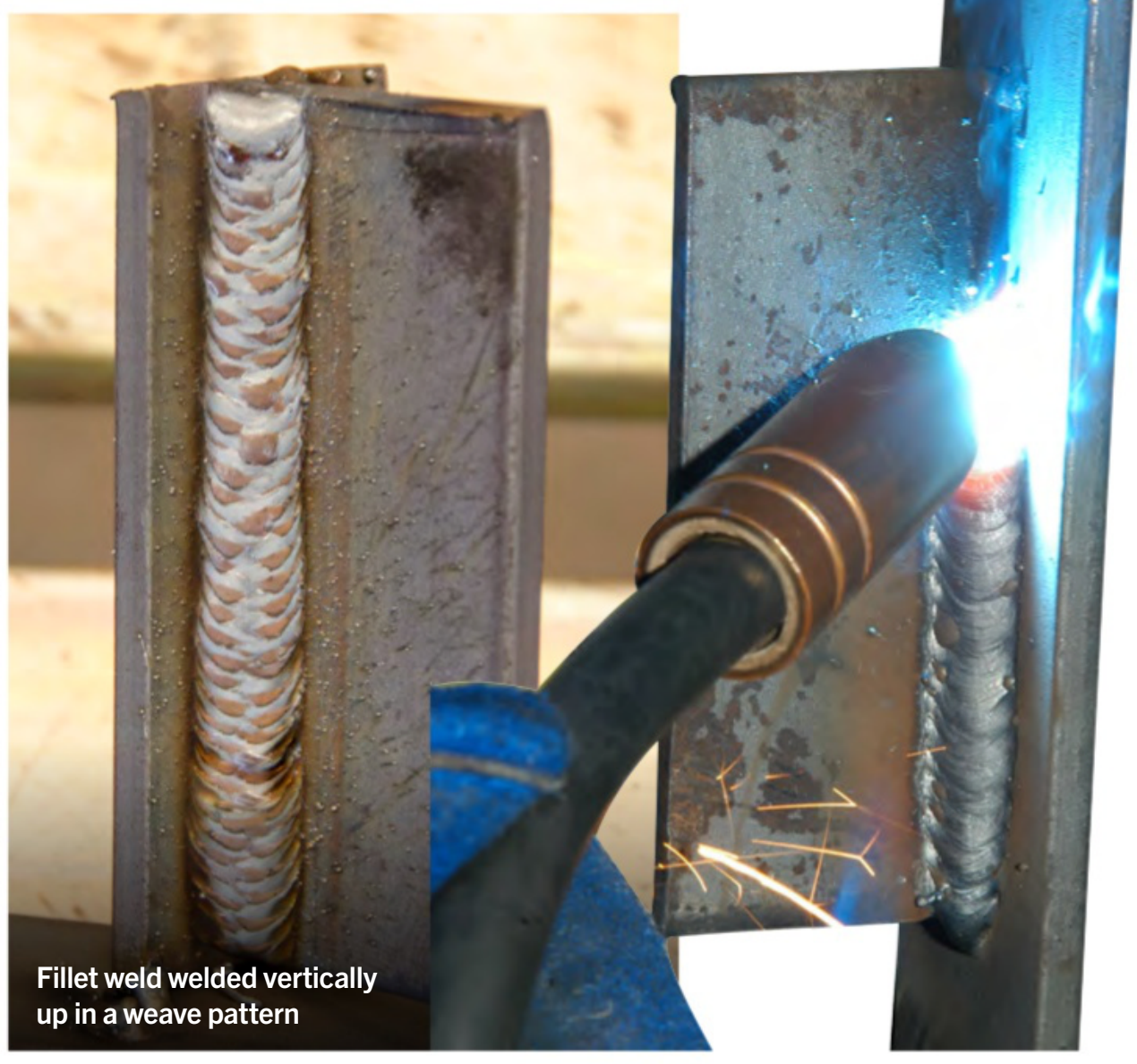
Finally ...

If in doubt, ask a specialist welding retailer about what welding machine to use. They often have DIY handymen asking the most basic questions about getting parts and advice for home welders bought at a general store without expert backup. These specialist welding retailers advertise their expertise, and their people, knowledgeable in the field, are more than happy to help. They are unlikely to steer you into a machine that won't suit your needs simply for a sale, because they can help you prosper with your welding by providing the right consumables and follow-up service. With so many choices of good machines in the market, it pays to get some sound advice.



Example of undercut

Too much penetration leading to burn through



Fillet weld welded vertically up in a weave pattern

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TRASH TO TREASURE

NIGEL YOUNG BUILDS A ROTARY SANDER FROM BITS HE FINDS LYING AROUND HIS SHED

By Nigel Young Photograph: Nigel Young and Juliet Nicholas

I love working with pallet wood as the colours are so amazing, and watching a YouTube video on making a small rotary sander inspired me to make one in order to facilitate preparation.

The basis of my sander was an old lathe headstock paired with an adjustable top from a home-made saw bench on a chassis of solid timber, with a one-third horsepower motor providing the power. The chance find of a water blaster that had been thrown out gave me the idea for mounting the motor in a way that was more portable — one-third horsepower motors are surprisingly heavy, and I needed a way to fix it in relation to the sander while keeping the whole thing transportable.

The motor was now self-contained, and moving the rotary sander became much easier

I removed the water blaster from its cradle — selling it for scrap — and replaced it with my electric motor. I used a piece of 12mm ply drilled for both the pattern of the cradle and the pattern of the motor to fix it.

Fitting required the removal of part of the motor's cast-aluminium stand, and I did that with a grinder. The motor was now self-contained, and moving the rotary sander became much easier because it was now in two parts. Only the drive belt and a removable base were common to them both. The addition of wooden feet and a switch finished it off nicely. I now had a handy self-contained one-third horsepower motor for use elsewhere should the need arise. That, then, was the power sorted. ▶

Spindle and faceplate

The spindle was machined from 13 150mm-diameter, 20mm-thick MDF discs, glued together with an M12 threaded rod down through the centre. One end was rebated so that the bolt holding it all together would be recessed in order to accommodate the faceplate to which it would be fastened. This was eventually done with three 100mm wood screws. The original welds on the faceplate which held the mounting thread had cracked, so these were redone. The faceplate was machined to plane the front face square, and then mounted to the MDF spindle. This was then refitted into the lathe in order to square them both together.

The unmounted end was wobbling quite noticeably

The reason for this was quite obvious when it was first spun, as the unmounted end was wobbling quite noticeably. By the time we had finished, the wobble was completely gone — the spindle and the faceplate were now good to go. The plan had been to mount the spindle at only one end, in order to accommodate larger pieces of timber as required. This had now been achieved.

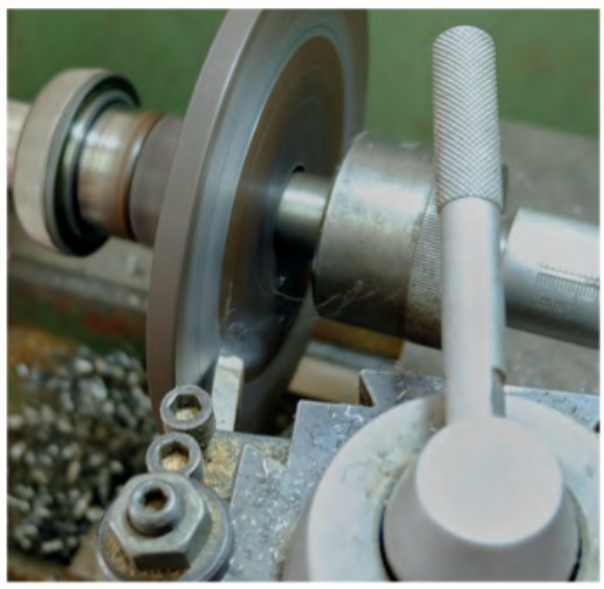
The MDF sander spindle showing the recessed M12 threaded rod

The MDF sander spindle getting a coat of polyurethane to seal it

The cracks in the original weld of the faceplate connector

the cracked headstock thread being re-welded

The planed faceplate being checked for accuracy



The faceplate being ‘planed’ in preparation for the MDF spindle

The completed spindle being mounted for machining to remove any wobble

Note the vacuum cleaner being used for dust control

Milling the spindle

The next stage was the preparation of the spindle itself. The first requirement was to give it a thick coat of polyurethane in order to seal it, and the second was to machine a groove along its length to enable the sandpaper to be replaced easily as required.

At first we had planned to router the groove, and a box was made to guide the router along its length. A chance comment regarding the available milling machine was made, so we switched to that. The result was a groove 20mm wide and 9mm deep, spec’d to take the ends of the paper held together by a piece of flat 16x4mm aluminium.

We had planned to lap the paper in order to give it maximum grip, but the paper we were using was an offcut from a commercial belt sander, and it wasn’t going to be folded for a lap!

The end result is a very tight and well-fixed piece of paper that can be replaced as needed

In the end we butted the two ends, and the screwed aluminium strip proved not only to be sufficient but also tightened up the paper as it was driven down.

The end result is a very tight and well-fixed piece of paper that can be replaced as needed. The edges of the aluminium strip were rounded back in order to eliminate any adverse wear, and four countersunk holes were drilled in it to take the final 50mm screws. The strip sits about 1mm below the surface of the spindle, so there is no risk of it interfering with the final sanding process.

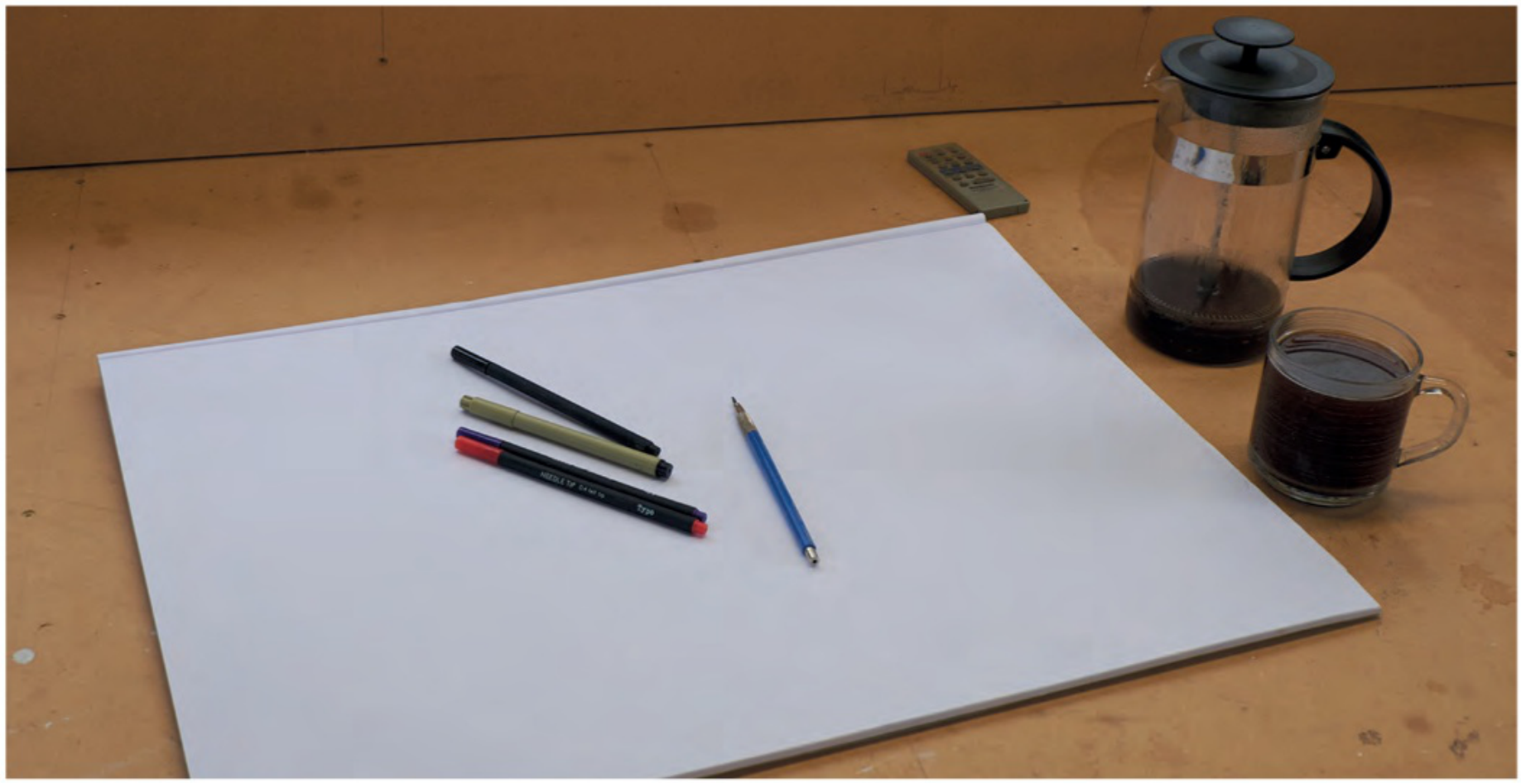
As a point of interest, we had a disc that had been previously experimented with in terms of fixing sandpaper, and for that a slot and drilled-hole approach had been tried. The method had been found to be unsatisfactory, as the dowel used to lock it together could not be maintained in the position required. (See photo next page.)

Next to receive our attention was the head stock itself. This proved to be very well built, with the arbor being mounted with tapered Timken roller bearings — the same sort of bearing as found in car-wheel hubs. These were cleaned with turps and then repacked with grease. Timken bearings allow for tightening in order to remove any slop, and are tightened with a locknut once this has been achieved. ▶

A previous attempt at joining; it was unsuccessful as the dowel used to lock it could not be contained in the right position, with the result that the end was loose

The spindle being grooved with a mill in order to provide the join for the sandpaper

The grooved spindle being 'fitted' with a piece of the recessed aluminium strip over some sandpaper offcuts, to see how well we had done



My favourite tools: an A2 desk pad, a decent pencil, some coloured pens, coffee, and music

The aluminium strip being drilled

The aluminium strip being countersunk

The aluminium strip being checked again by being screwed in place

Assembly

With each component finished, we assembled everything on the wooden chassis made from a piece of New Zealand Oregon. The final step was to mount a re-greased and tightened adjustable saw bench top as a work platform. The result was a well-balanced and smooth-running sander, with the ability for the platform to be raised and lowered depending on the thickness of the timber being prepared.

One other step will be to form a sanding disc that can be swapped out with the spindle as required. In that case the platform becomes a rest for the sanding operation.

Once it was all complete and assembled, it was time to try it out.

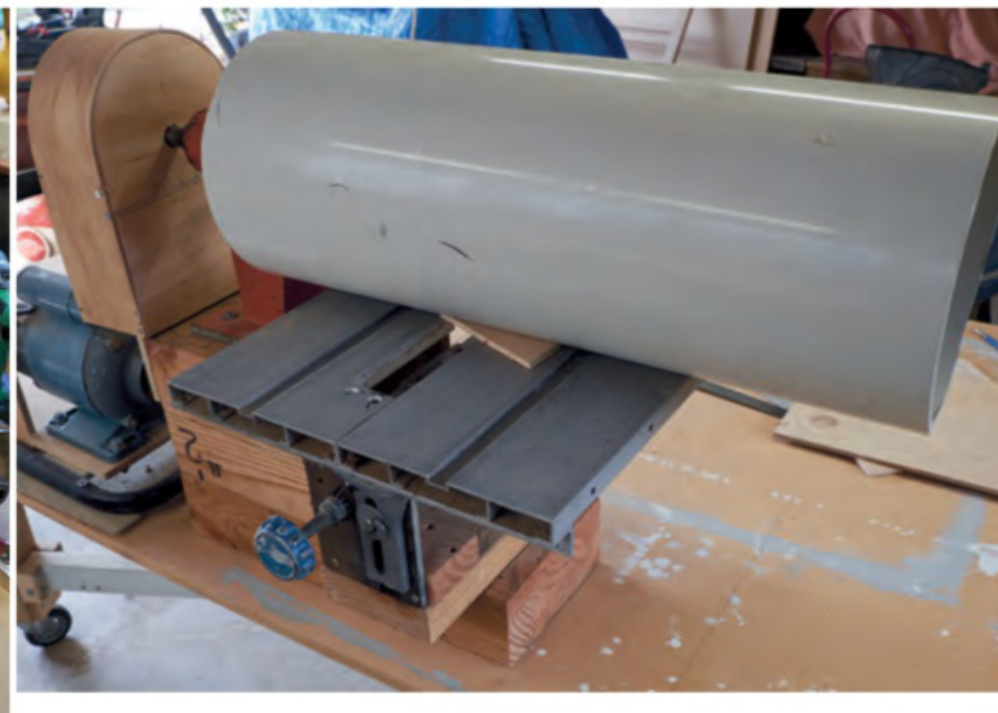
Two things became apparent almost immediately. First, it needed a guard over the driving belt, and, second, a way of fining-tuning the platform was needed. The first issue was resolved by steaming a piece of 3mm ply and bending it to form the shape required. As for the second, if the depth was determined by the piece of wood to be sanded, then it needed to be decreased by the amount required for the sanding — too much and it would just jam, too little and it would be ineffectual. The existing platform simply could not be raised or lowered to that degree of precision. What was needed was a spring-loaded interface.

Two things became apparent almost immediately. First, it needed a guard over the driving belt

After much consideration and looking at springs and hinges, I ended up forming a sheet of 3mm ply to the same size as the platform, which I could clamp at one end when it was needed. I could then place a stick of hardwood that was wider than the ply sheet under the ply and push it towards the sanding drum as needed. Simple, and it cost nothing. ▶

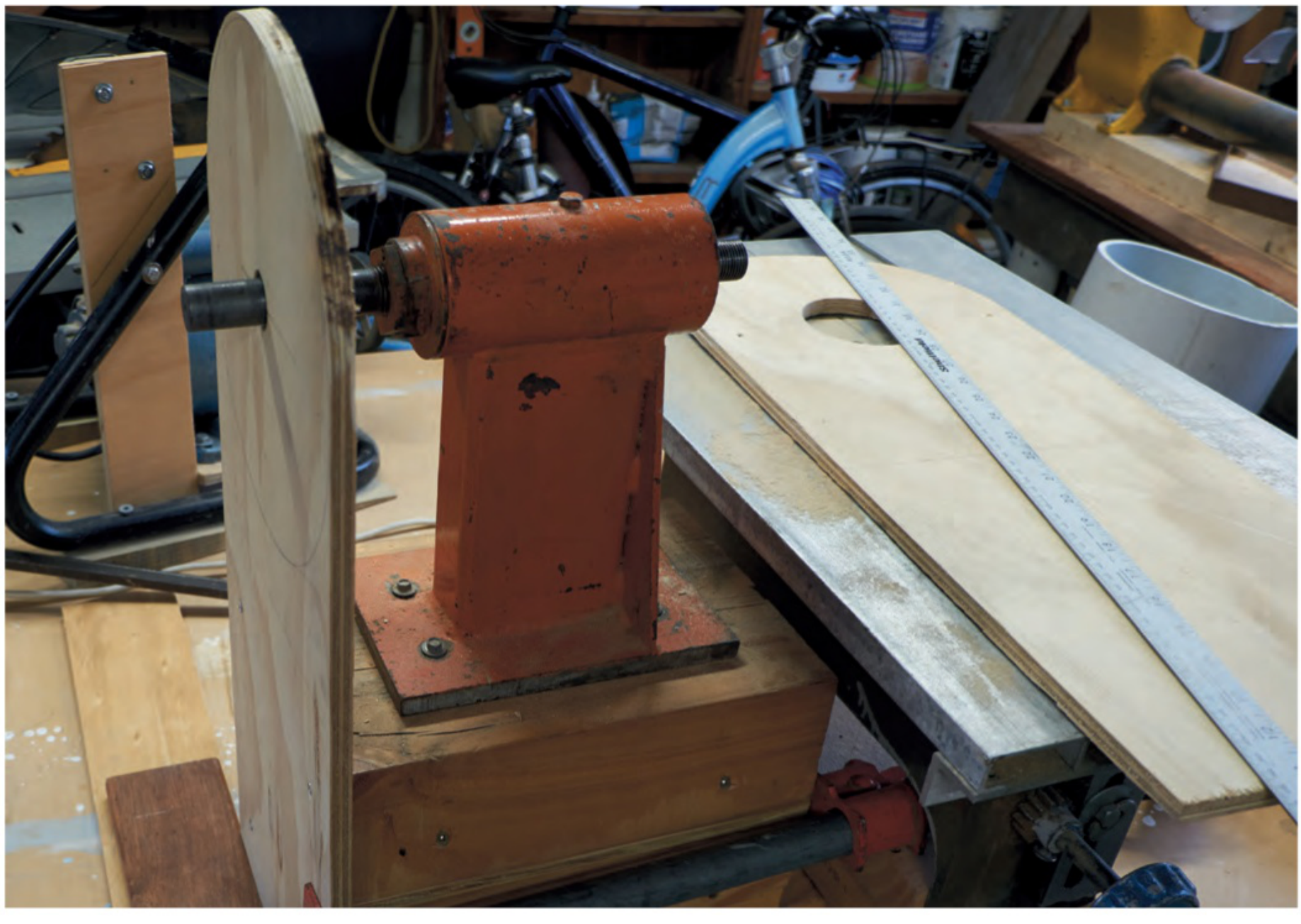
The individual components of the rotary sander

The beginning of the dust extractor and belt safety cover



Placing the pipe to get a sense of it — note the existing belt sander before I removed it

My hardwood-stick–driven adjustable platform



Clamping it to allow screw fixing

Unexpected wins

As for the dust extractor, a plumber friend gave me a piece of 250mm drainpipe, which I cut down the middle to form the cover. It turned out that it was just the right length to protect the belt drive guard, too, and the ply used to make the guard would also contribute to supporting the drainpipe.

I removed the original one and formed up the new solution, incorporating the pipe — overall, a very neat solution. I fitted the swivel junction from an old vacuum cleaner head to the top to take a hose, and that was another job sorted.

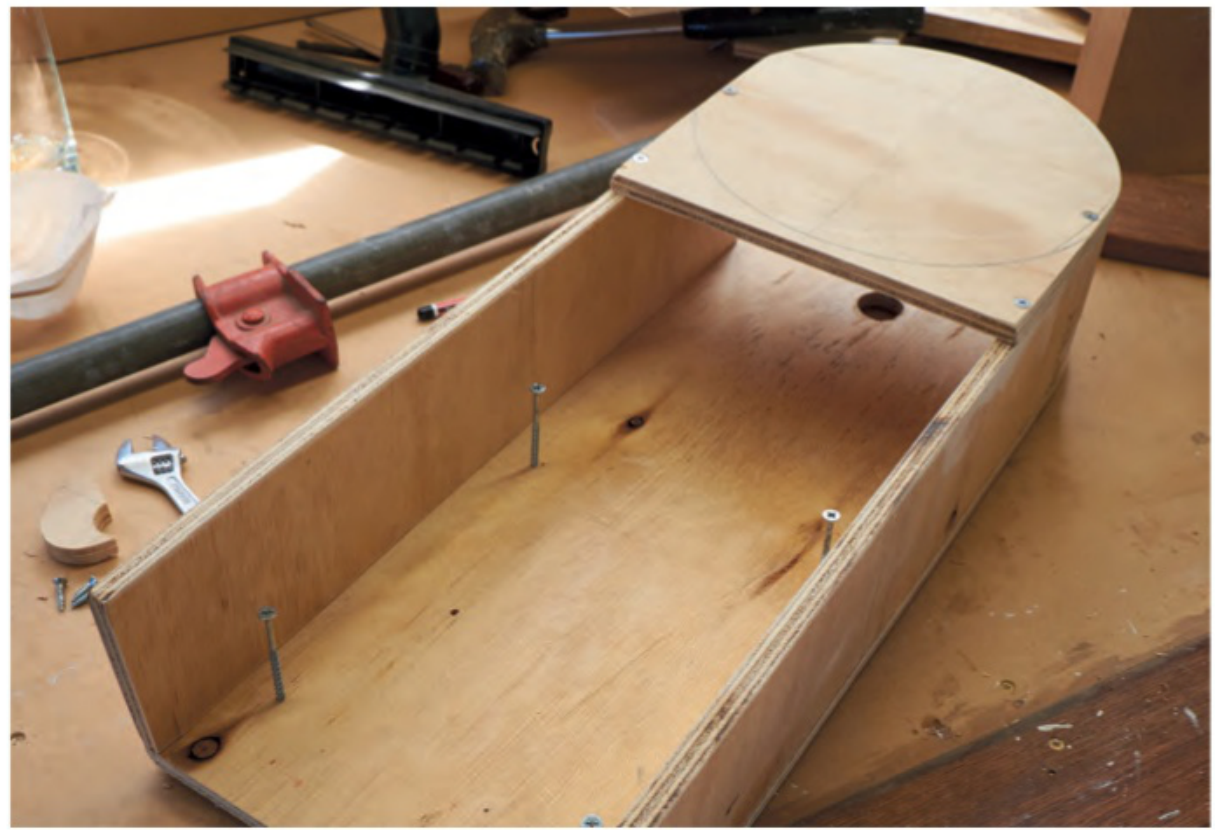
It goes to show how things change over the course of a project. Plus, forming the original guard reintroduced me to the possibilities of steaming and bending — and that is a whole new world.

Another benefit of the new belt guard was that it was able to locate the portable motor in relation to the sander, necessary because of the positioning of the belt. I was aware I had to address this, so it was two birds and one stone. Excellent.

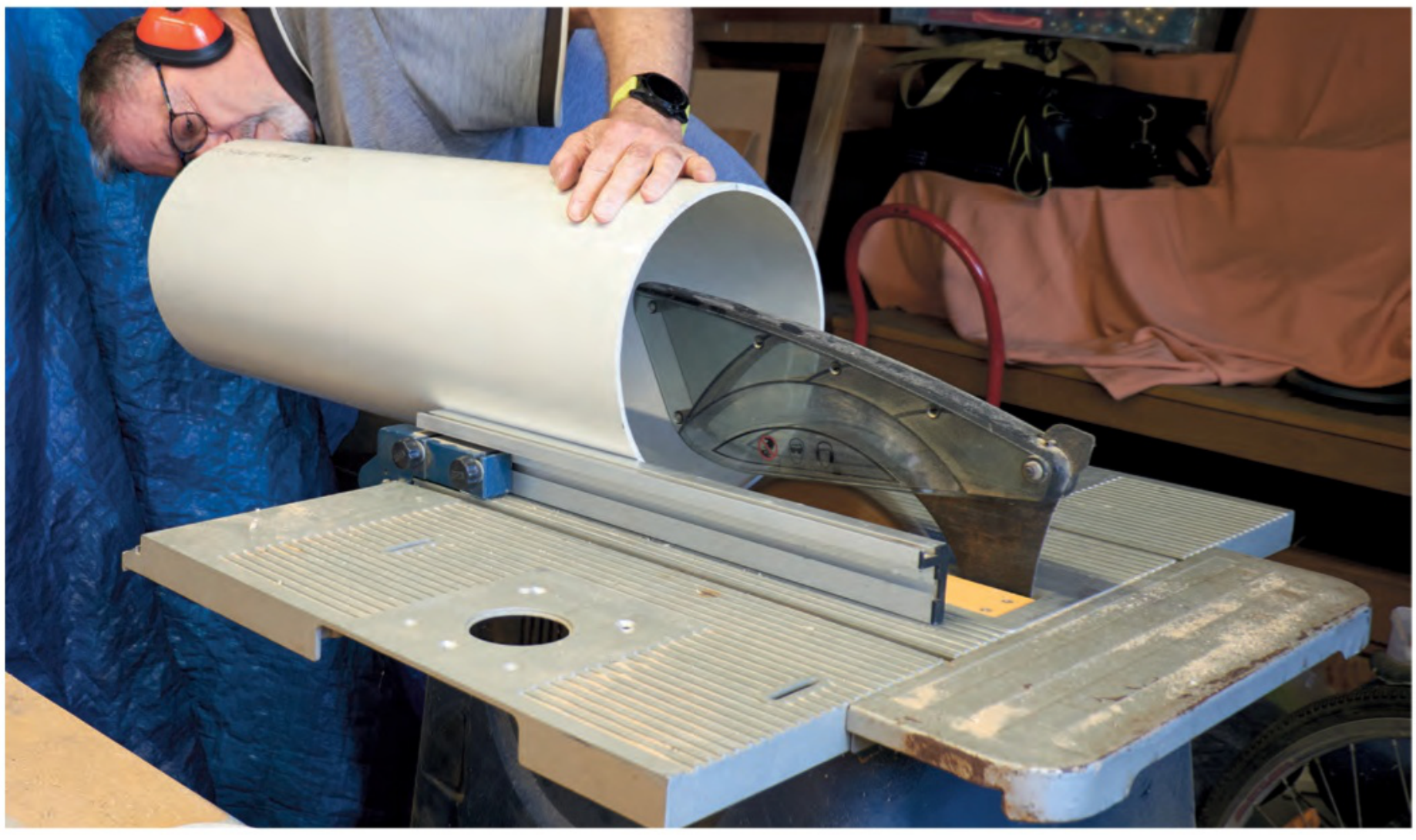
I'm sure that there are rotary sanders out there that are more compact than ours, but this was built completely from parts lying around, so there was no cost involved. There is also the possibility of modifying it for other purposes as the need arises.

this was built completely from parts lying around, so there was no cost involved

The bonus is the portable electric motor, should it be required elsewhere. Then there was the fun — probably the biggest component of any job. We enjoyed the project, solving problems as they arose and then standing back and seeing the sander being used. A great solution to a need. Now all I have to do is sort out the heap of old pallets at the back of the house that I've been getting into trouble over.



The belt sander cover completed and ready to be installed



Cutting the PVC pipe — even with ear protectors it was loud

Toggle clamps

When it comes to clamping, lever-action toggle clamps offer excellent power from a quick and easy motion and they are simple to install for ready access. Toggle clamps have a multitude of uses in engineering, metal fabrication, and woodworking.

Hi-Q Components stocks a wide range of high-quality Turkish-made Kukamet toggle clamps including horizontal and vertical action, latching, or push–pull configurations with different mounting options and even pneumatic versions.

See the Hi-Q Components website or for more information, email sales@hiq.co.nz, or call 0800 800 293.

No more dust

Unless you enjoy the taste and feel of dust grit against your teeth and the sting of dust in your eyes, there really is a better way to do it! The CT Midi Compact M Class Extractor is packed with innovative features such as touch control for ease of use, an internal hose garage for quick storage, and tidy cable management. The main filter is housed in a convenient external slot for cleaning and the conical suction hose with smooth surface ensures maximum suction power. The extractor's compact and ergonomic design makes it perfect for mobile work and a level storage area allows for temporary storage of work materials.

For more information, see hml.co.nz.

Get ya scoot on

Walking? That's a thing of the past. Zip down to the bakery for smoko on a Mini Bopper Electric Scooter (PE9980) instead! Reaching up to 30kph and with a range of up to 25km — based on the rider's weight and riding habits — the scooter also features a dual electrical and mechanical brake system. It's IP54 water-resistant rated so it won't matter if you get caught in an unexpected downpour and it has a built-in front LED light for those late-night adventures. Travelling on bumpy ground? The front and rear shock absorbers ensure a smooth ride. With a charge time of just three to four hours and selectable three-speed technology to cater for all levels of rider, this is the ideal local commuter when you've been slogging it out all day.

For more info, visit isl.nz.

Drive it home

Everyone has their must-have tool in their toolbox, but we can all agree that no toolbox is complete without a good impact driver. The Bosch GDX 18V-200 C Professional is the most powerful cordless impact driver/wrench with brushless motor in the 18V category, punching out 200Nm of torque, which makes it extremely powerful for high-demand performance. It features a two-in-one bit holder with a quarter-inch internal hex and a half-inch square drive that makes it flexible for a wide range of applications, and offers Bluetooth connectivity that provides active tool feedback and servicing information via a mobile device. It is also compatible with all Bosch Professional 18 V batteries and chargers (Professional 18V System).

Head to bosch-pt.co.nz for more details.

Goodbye mould and mildew

Selleys No Mould prevents mould and mildew build-up in usually damp areas of your home, like the bathroom and shower. It's an ideal solution to use when renovating your bathroom or when you're replacing old mouldy silicone. All you need to do is follow four easy steps. Remove any old silicone from the surface, spray the area with Selleys Rapid Mould Killer to make sure the area is hygienically clean and remove soap residue, rinse the surface and dry thoroughly, then apply Selleys No Mould, making sure you push the sealant into the joint. Wait for one hour and you're ready to go. You'll have a waterproof seal and mould will no longer grow.

Selleys No Mould is priced at $19.80 and more info can be found at selleys.co.nz.

25 years of robotic mowers

Back in 1995, Husqvarna took the first step into a new product segment with the launch of the world's first robotic lawn mower, the Husqvarna Solar mower. Now, 25 years later, Husqvarna hasn't ceased to innovate, with 2019 seeing the launch of the first all-wheel-drive robotic mowers. The Automower 435X AWD for residential customers and Husqvarna Automower 535 AWD for professional customers makes light work of lawns up to 3500m² and navigates obstacles, rough terrain, and slopes of up to an impressive 70 per cent. The mowers feature X-line design with LED headlights, remote object detection, and intuitive interaction, and are equipped with Automower Connect, including GPS theft tracking.

To celebrate 25 years of pioneering in the robotic mower industry, Husqvarna is giving away a special limited-edition anniversary version of the Husqvarna Automower 315X, featuring a unique colour and worth $4099. For more information, visit husqvarna.com/nz.

Multi-feature industrial router

You've got the batteries, now add the skin that will change the way you work for the better. DeWalt's XR Lithium-Ion Brushless Laminate Trimmer Router Skin Only with Plunge Base is designed with industrial applications in mind, making it strong and durable. Speed variable for a better surface finish, it also features twin LEDS to offer greater visibility in dark conditions. To increase user control, the soft-start mechanism avoids any undue movement. The spindle lock mechanism makes accessory changing easy and quick, while the BL51 brushless motor offers a runtime of 20 minutes. Multi-slit collets increase the bit contact to minimize slipping and make tightening and loosening easier. An electronic brake enhances cutting accuracy and reduces torque twisting when starting and stopping.

The XR Lithium-Ion Brushless Laminate Trimmer Router Skin Only with Plunge Base has many more features — for further details visit bunnings.co.nz.

RINGING IN THE CHANGES — PART TWO

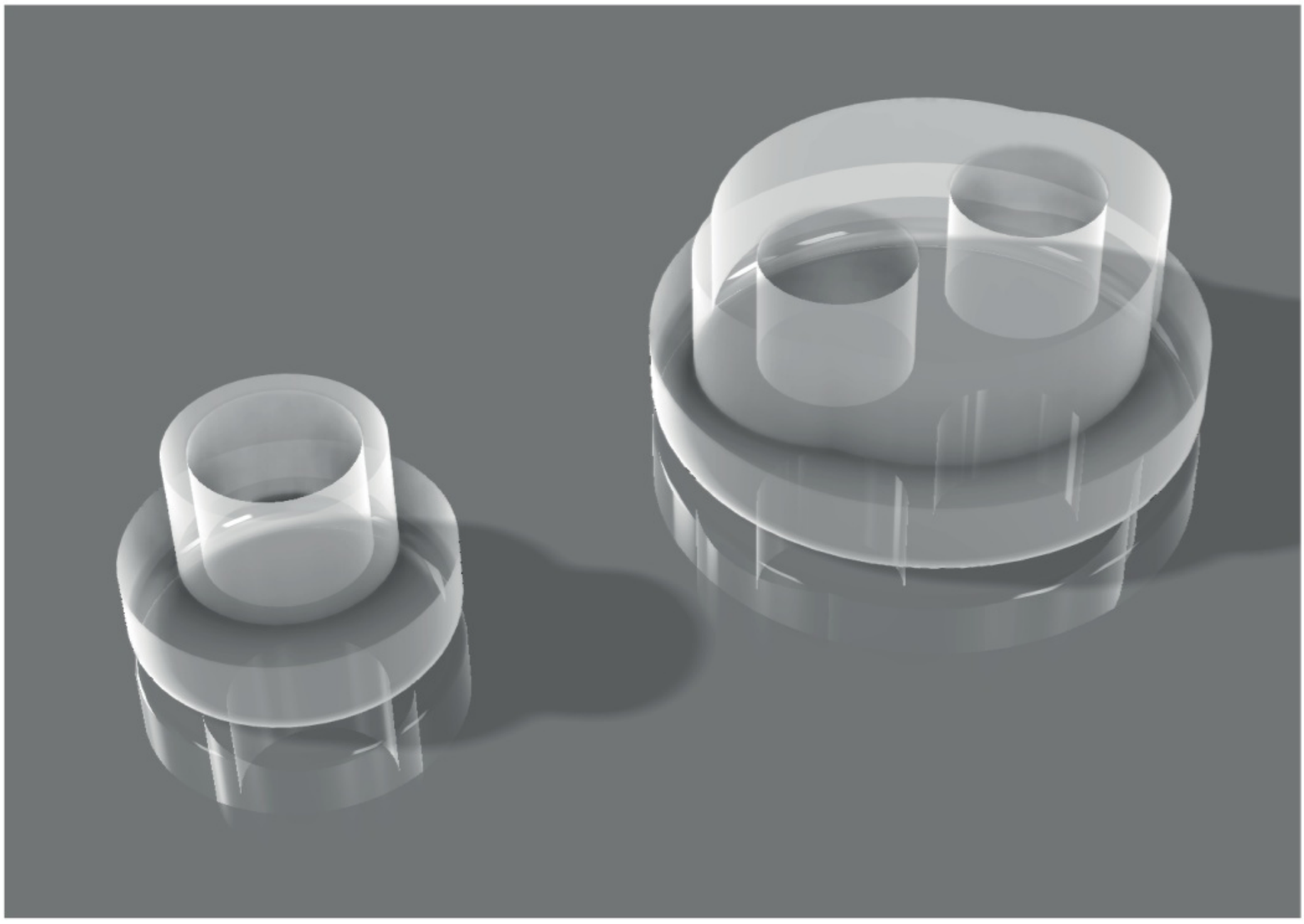
TAKE A 50-YEAR-OLD PHONE — IT'S NOT ABOUT WHAT IT IS BUT WHAT IT CAN BECOME

By Enrico Miglino Photography by Enrico Miglino

In the first part of this series, which appeared in Issue No. 89, we saw the principles to be followed to upcycle an old rotary telephone. The simple circuit connected on the Raspberry Pi general-purpose input/output (GPIO) to control the amplifier buttons worked fine, as did the three LEDs used to provide some essential visual notification to the user.

Making the hardware and adapting the internal design of the phone to include a Raspberry Pi (with the circuit), the amplifier, and the batteries was a challenging task — at least, that's what I thought until I faced the real challenge of making all the elements actually work together.

The Pi rotary project completed and fully assembled. The three LED notifications — red, yellow, blue — are assembled in two 3D-printed transparent supports. The bigger one (to the left in the image) includes the red and yellow LEDs; the red LED activates when the dialler can accept a numeric command, while the yellow LED flashes with every dialled number. The blue LED is enabled when the user hangs up the microphone and stays on while the microphone is off the hook



In this rendering of the LED holders the two parts are 3D printed with an LCD printer in transparent resin

Things became more complex when I tried to accomplish the task on a Linux machine

I made this upcycling project battery operated, as the circuit of the amplifier was already equipped with a Li-ion USB-rechargeable battery. I decided to add a PiJuice board to run the Raspberry Pi on battery as well.

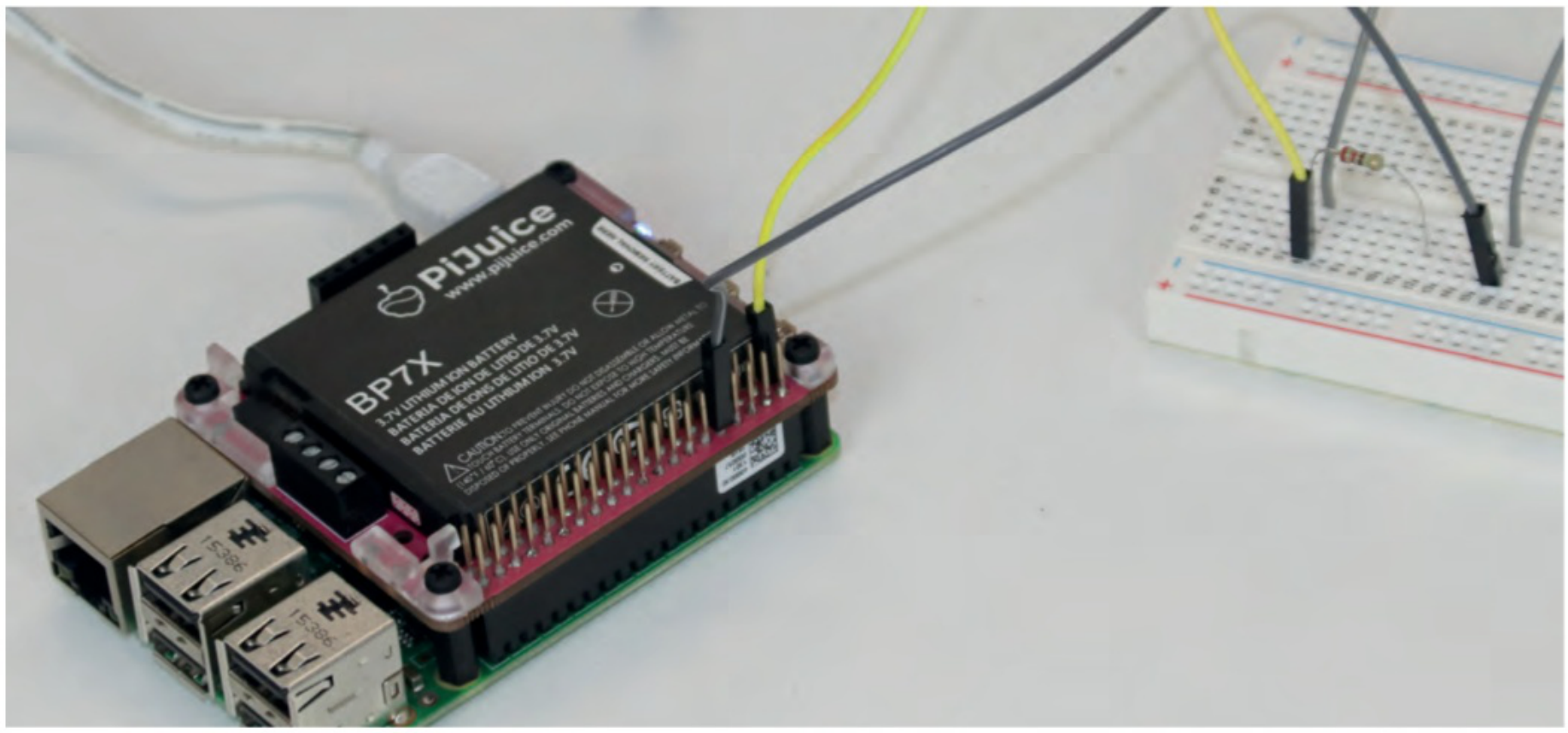
Changing pulses to numbers

It is an easy circuit, aimed at enabling the rotary dial to get numbers. If you search online you will find plenty of working examples of how to count the pulses generated by the rotary dial and convert them into the corresponding numbers.

Unfortunately, the projects and documentation, as well as the source code, for managing this task are based on the Arduino board, and things became more complex when I tried to accomplish the task on a Linux machine such as the Raspberry Pi.

The Pi rotary in action — the blue LED indicates that the system is ready and working, while the red LED indicates that the system can accept numeric commands

Arduino is a microcontroller that runs a programme continuously and, as the dialler signal goes high, it starts counting the pulses generated by the rotary dial. The generated pulses can be detected by connecting a pin from the board GPIO to one of the two wires of the rotary dialler while the other wire is connected to the power line; when the signal goes high, a pulse is generated for about 10ms. ▶



The PiJuice HAT installed on top of the Raspberry Pi; the board includes its own microcontroller and power supply circuit, and communicates with the Raspberry Pi through the I2C protocol. This solution makes it possible to expose all the Raspberry Pi GPIO pins without interfering with other hardware

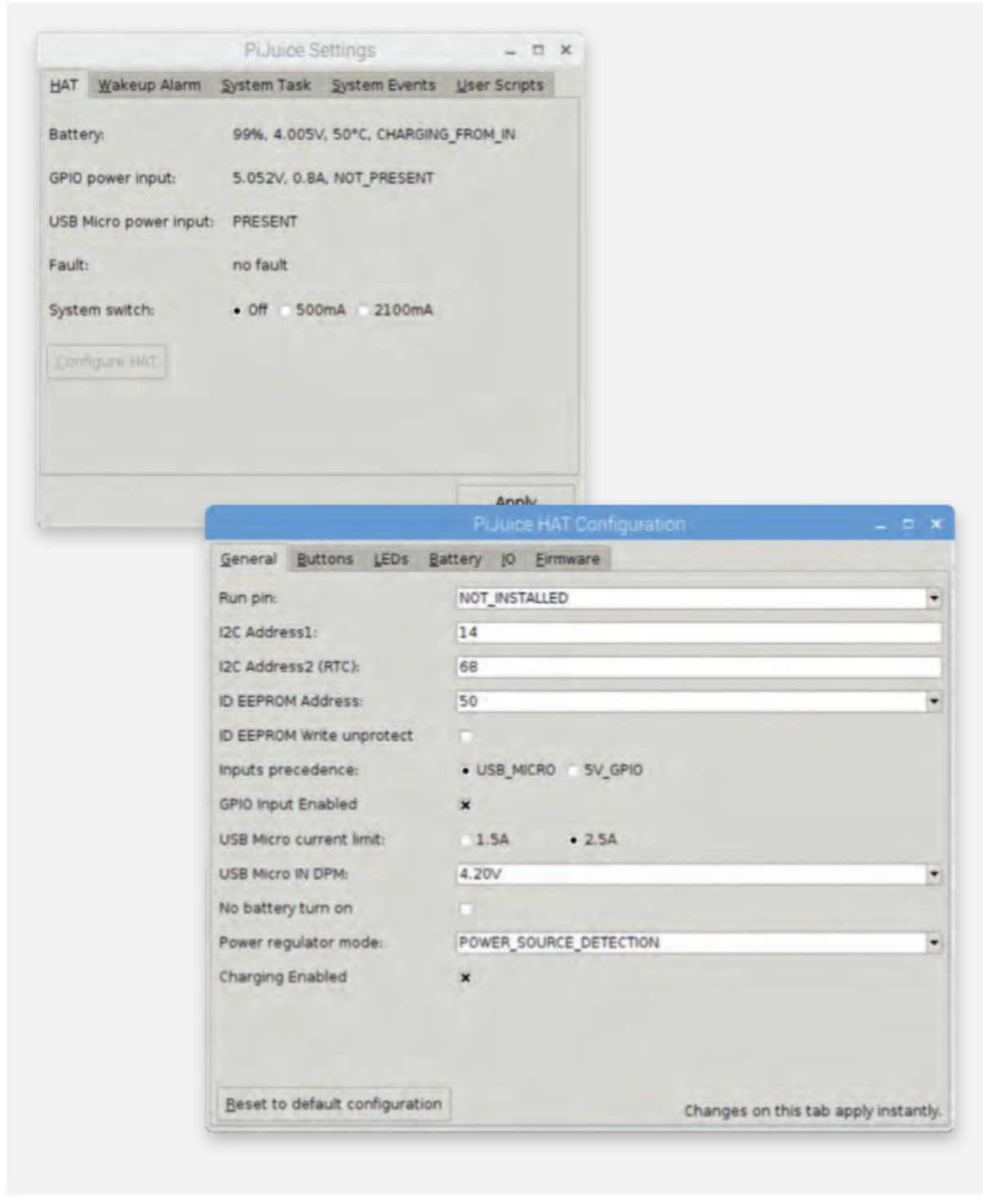
Frustration

The circuitry for achieving the same result on the Raspberry Pi using Python is identical to that on Arduino. The issue lies in the behaviour of the Linux operating system. When an event happens, such as a pulse being received from a GPIO pin on the Raspberry Pi, it is not certain whether the operating system allocates all its resources to this specific task in a timely manner — at least not in the normal way we can expect using the GPIO library for Python and the Python source.

This issue made me crazy for a week

This issue made me crazy for a week, as regardless of my approach, I always missed detecting some pulses. The correspondence between the number of pulses and the dialled number is direct: 1 = one pulse, 2 = two pulses, 3 = three pulses, and so on up to 0 = 10 pulses.

The use of the rotary dialler is essential in this project, as it is the main interface between the user and the device. The problem was partially resolved by the adoption of the use of interrupts in the Python source. The first resulting programme was a state



This screenshot of the Raspberry Pi desktop shows the PiJuice control software. PiJuice can be set up to put the Raspberry Pi in sleep mode and to wake it up at a specified time, and it can generate signals relating to conditions such as low battery and charging status

machine that waited indefinitely for a dialled number to start counting. Every command was represented by a three-cipher sequence, parsed when the third cipher was dialled.

The list following shows the commands available as talk by the Pi rotary when the number 111 is dialled:

- Wait for the red light before dialling a command
- Dial 1 2 3: play all the playlist in order
- Dial 1 2 4: list all the playlist titles"
- Dial 3 2 1: play the next track in the playlist
- Dial numbers from 4 0 1 to play the corresponding track in the playlist
- Dial 6 6 6: hot reset the Pi Rotary
- Dial 9 9 9: cold reset the Pi Rotary
- Dial 1 0 0: hear last weather report
- Dial 1 1 1: these help notes ▶

PiJuice

There are many cases in which the use of the small and powerful single-board computer (SBC) Raspberry Pi equipped with a full Linux operating system — including the graphical desktop — can fit in real-world solutions. However, there are some indoor and outdoor applications that are almost impossible if you cannot use the system without a battery supply.

Developed by the UK-based Pi-Supply company (https://uk.pi-supply.com/), PiJuice is a powerful Raspberry Pi 'HAT'. 'HAT' stands for 'hardware on top', and PiJuice is the Raspberry Pi add-on board corresponding to Arduino Shields — designed to back up the power supply.

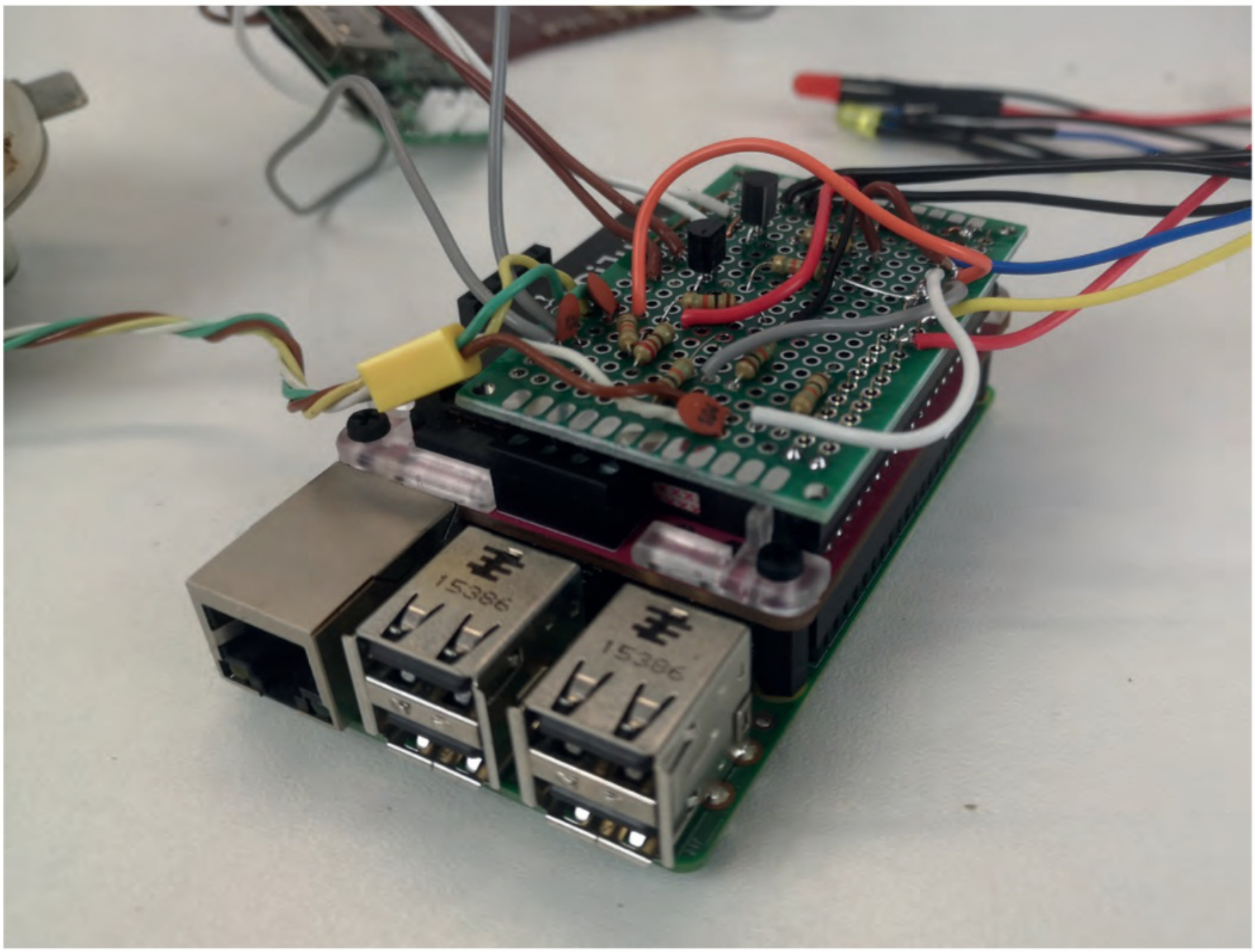
Many projects that are created with Raspberry Pi, such as outdoor weather stations or automatic shooting to catch animals in their natural habitat, need the battery for this device to be powered for hours or days. The PiJuice HAT is perfect for that purpose, so I used it in this project.

The standard version of the PiJuice (https://uk.pi-supply.com/products/pijuice-standard) is provided with a 5000mAh battery but it can support several kinds of power supply: several batteries up to 12000mAh and a solar panel. Another interesting aspect of this device is its ability to be controlled and set up through an interface installed on the Raspberry Pi. This makes it possible to control the battery level directly from the user application.

The software installation is easy, just use the following command:

```
$> sudo apt-get install pijuice-gui
```

After the software has been installed, the PiJuice programme can be set up from the accessory menu on the desktop.



The PiJuice battery HAT has a thin profile and exposes the 40 pins of the Raspberry Pi GPIO by a pass-through. If the PiJuice is not used, the prototype HAT board can fit directly on top of the GPIO connector

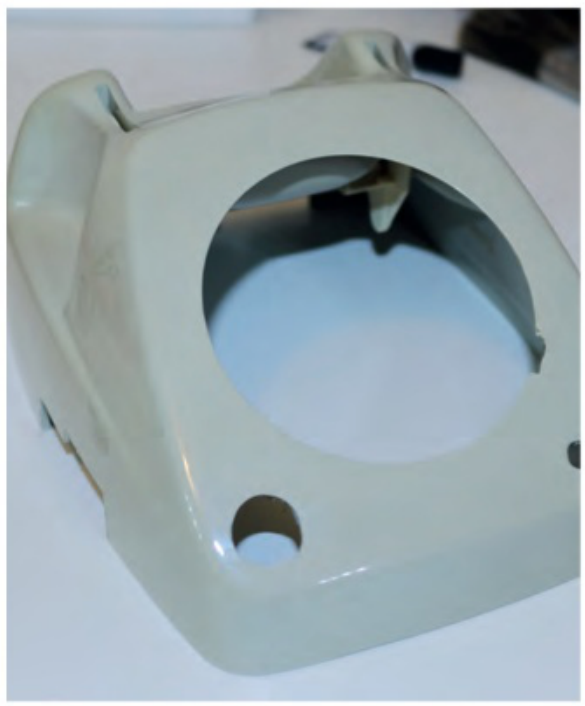
A complex task solved

Note that all the textual information, the messages, and the song track titles are defined in the two JSON files: playlist.json and comments.json.

When working as a pure state machine — no main programme running after the start-up initialization — there were still cases when the programme was not able to process the pulse count correctly.

What I needed was a GPIO reading engine in Python that was able to take control of the main process of reading all the events during the dialling. I also needed a Python library interfacing the GPIO hardware events in a more accurate way. After trying several GPIO libraries for Python, I finally adopted the PiGPIO library (http://abyz.me.uk/rpi/pigpio/python.html), which is perfect for solving problems like this.

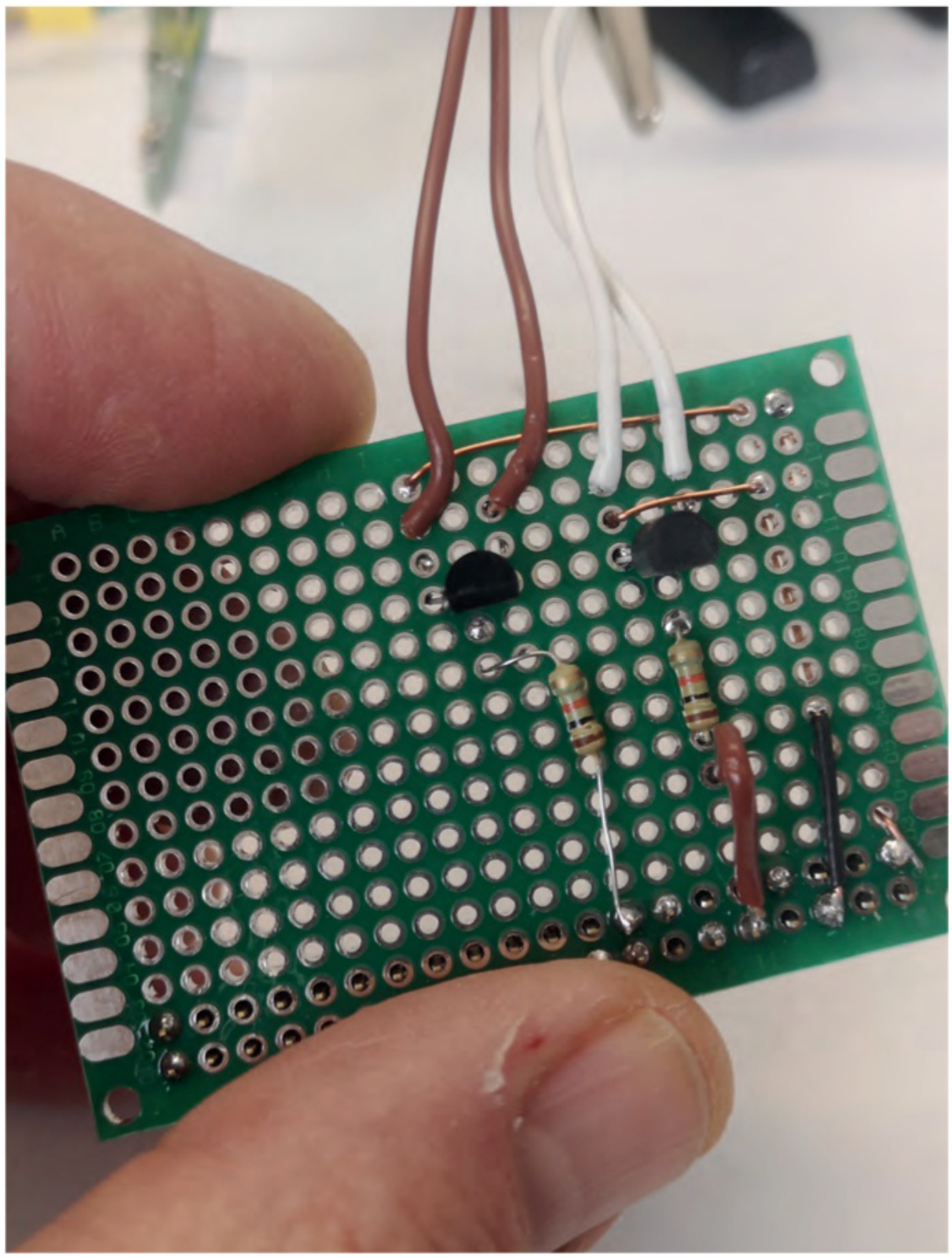
Notably, this multiplatform library is a C-component that can be compiled in the Windows, Mac, and Linux environments, including the Raspberry Pi Linux operating system. The advantage of the library is that it uses a 'daemon' — a programme that runs at a lower level than the other common processors, such as the Python interpreter, and can read any GPIO pin status change at a high frequency. An interface available for Python makes it easy to include the features inside the application.



The cover of the telephone after the modification; the two holes will host the 3D-printed LED light supports to complete the assembly with the desired aesthetics

```
def check_number():
    '''
    Check if the current number corresponds to a valid command:
    '''
    global dialed_number
    global track_position
    global pi

    debug_message(str(dialed_number))

    # Numeric commands and related functions
    if dialed_number is not '':
        if int(dialed_number) == 666:
            # Restart the application to initial conditions
            dialed_number = ''
            reinit()

        # Play the next track
        elif int(dialed_number) == 321:
            # Disable the interrupts until finished
            release_callbacks()
            # Start playing the next track
            play_track()
            # Enable the interrupts
            cb_set_hangout()
            # If the hangout is still active, enable the dialer too
            if pi.read(pin_hangout_led) is PI_HIGH:
                cb_set_rotary()

    # Play all tracks in sequence
    elif int(dialed_number) == 123:
        # Disable the interrupts until finished
        release_callbacks()
        # Play the entire playlist
        play_all_tracks()
        # Enable the interrupts
        cb_set_hangout()
        # If the hangout is still active, enable the dialer too
        if pi.read(pin_hangout_led) is PI_HIGH:
            cb_set_rotary()

    # Tell the playlist titles
    elif int(dialed_number) == 124:
        # Disable the interrupts until finished
        release_callbacks()
        # Tell the playlist titles
        list_all_tracks()
        # Enable the interrupts
        cb_set_hangout()
        # If the hangout is still active, enable the dialer too
        if pi.read(pin_hangout_led) is PI_HIGH:
            cb_set_rotary()

    # Play the desired track
    elif (int(dialed_number) <= tracks + 400) and (int(dialed_
number) > 400):
        track_position = int(dialed_number) - 401
        # Disable the interrupts until finished
        release_callbacks()
        # Start playing the next track
        play_track()
        # Enable the interrupts
        cb_set_hangout()
        # If the hangout is still active, enable the dialer too
        if pi.read(pin_hangout_led) is PI_HIGH:
            cb_set_rotary()

    # Tell the help notes
    elif int(dialed_number) == 111:
        # Disable the interrupts until finished
        release_callbacks()
        # Tell the help messages
        say_help()
```

```
        # Enable the interrupts
        cb_set_hangout()
        # If the hangout is still active, enable the dialer too
        if pi.read(pin_hangout_led) is PI_HIGH:
            cb_set_rotary()

    elif int(dialed_number) == 999:
        # Reboot the system
        runCmd([REBOOT[0], REBOOT[1], REBOOT[2]])

    # Tell the weather
    elif int(dialed_number) == 100:
        # Disable the interrupts until finished
        release_callbacks()
        # Retrieve and say the weather message
        get_weather()
        # Enable the interrupts
        cb_set_hangout()
        # If the hangout is still active, enable the dialer too
        if pi.read(pin_hangout_led) is PI_HIGH:
            cb_set_rotary()

    elif int(dialed_number) == 999:
        # Reboot the system
        runCmd([REBOOT[0], REBOOT[1], REBOOT[2]])
```



The Raspberry Pi prototype board with the NPN transistors simulating the buttons to control the audio amplifier

Turning numbers into words

A second important feature of the upcycled vintage telephone is the ability to answer the user with natural language sentences. The programme can also be localized easily, simply by changing the language of the JSON files.

To make this device speak, I used 'trans', a simple terminal shell script that accepts a text string as input and plays the generated audio file using Google Translate.

The MP3 tracks are stored in the Music folder of the system, and the MP3 player uses the terminal command 'mplayer'. The block of Python code following shows how the commands are processed by the simple parser.

I also needed a Python library interfacing the GPIO hardware events in a more accurate way

Getting good audio

Once a dialled number has been recognized as the command, the programme stops the interrupts in order to avoid any interferences until the command execution has been completed.

I had to adopt this solution, including the use of the red LED as a 'ready' signal when the programme is able to accept a new command, because when also using the PiGPIO library I experienced some problems when the programme started other tasks, such as activating the MP3 player, while speaking.

As a matter of fact, the audio output is played by a Linux streaming command that takes control of the system in order to avoid interruptions by other tasks, which may result in a poor audio sound. The programme worked perfectly after the change was made. However, the limiting factor of the solution is that it is now not possible for the programme to accept any command while a task is in execution. ▶

Weather report function

A last upgrade to the programme before I considered the project completed was the addition of the command '100'. I used the Linux terminal command 'weather' after installing the Weather Utilities (maketecheasier.com/weather-forecasts-raspberry-pi/) with the simple terminal command:

```
$>sudo apt-get install weather-util
```

I made the command available to be called as an external process from the Python programme.

The right function 'get_weather()' is the Python function of the programme that processes the weather forecast information provided by the terminal command 'weather'.

The right function 'get_weather()' is the Python function of the programme that processes the weather forecast

The forecast data is audio spoken, but the data generated by the command are not suitable to be spoken as it is. As shown in the example following, the function extracts the information from the generated string of the command and converts it to comprehensible text.

An example of the weather command forecast:

Last updated 29 Feb 2020 – 11:20 AM EST / 2020.02.29 1620 UTC

Temperature: 46F (8C)

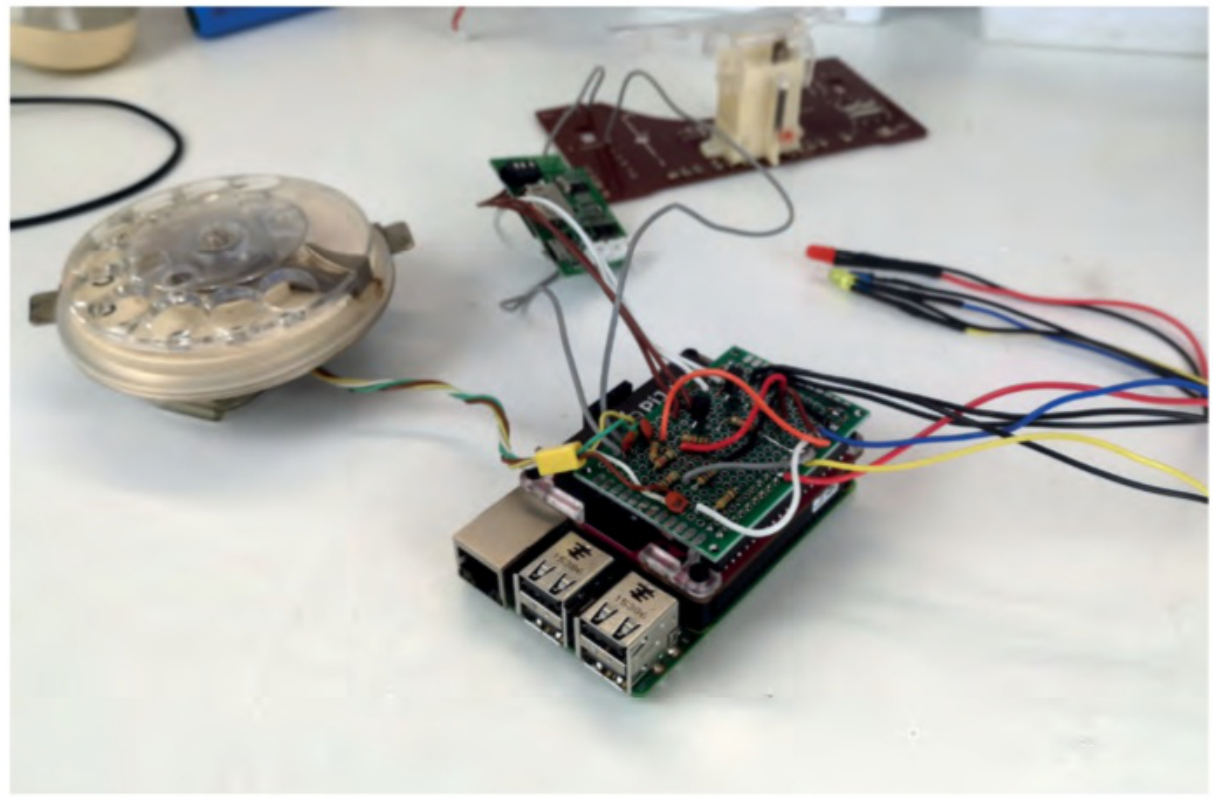
Relative Humidity: 65 per cent

Wind: from WSW (240 degrees) at 18 mph (16 KT)

Sky conditions: mostly clear

The command 'weather forecast' can be configured in several ways, but to get the fastest response you have to specify the International Civil Aviation Organization (ICAO) four-character airport code. Using this method, it is possible to localize the weather forecast command depending on the desired location. ▶

```
def get_weather():
    '''
    To retrieve the weather from the nearest airport, the desired
international airport weather station ICAO four-character code should
be set in the comments.json file.
    The command speaks the weather data returned from the call.
    '''
    global is_playing
    global weather_airport
    global weather_ICAO

    # Enable the amplifier and set the playing flag:
    is_playing = True
    ampli_on_off()

    # Announce the weather retrieval:
    runCmd([TTS[0], TTS[1], weather_airport])

    # Execute the weather command:
    cmd = [WEATHER[0], weather_ICAO]

    proc = subprocess.Popen(cmd,
                            stdout=subprocess.PIPE,
                            stderr=subprocess.PIPE,
                            )
    stdout, stderr = proc.communicate()
    # Divide the weather message in a list of single lines
    # removing the newline characters
    forecast = stdout.splitlines()

    w = 4   # First useful line of the weather forecast

    # Say the forecast meaningful strings (starting from 4)
    # Note that forecast is a list of bytes so every text line
    # should be decoded to the corresponding ASCII string
    while w < len(forecast):
        text = forecast[w].decode('ascii')
        runCmd([TTS[0], TTS[1], text])
        w += 1

    # Disable the amplifier, if it has not yet disabled by the user
    if is_playing is True:
        ampli_on_off()
        is_playing = False
```



The Raspberry Pi with the prototype HAT circuit assembled. All the components — LEDs, rotary dial, pick-up switch, and amplifier buttons — are soldered on the Raspberry Pi HAT circuit ready to fit inside the modified telephone body

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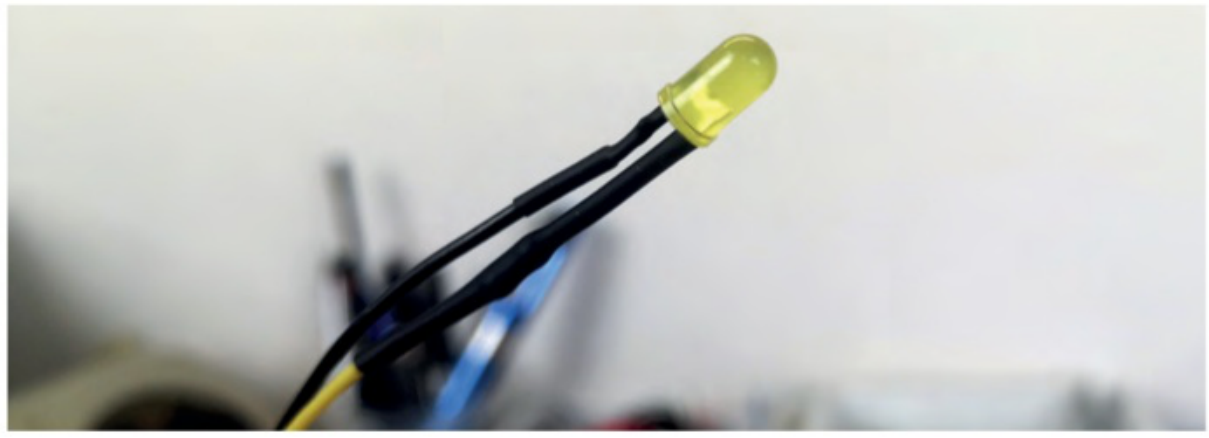
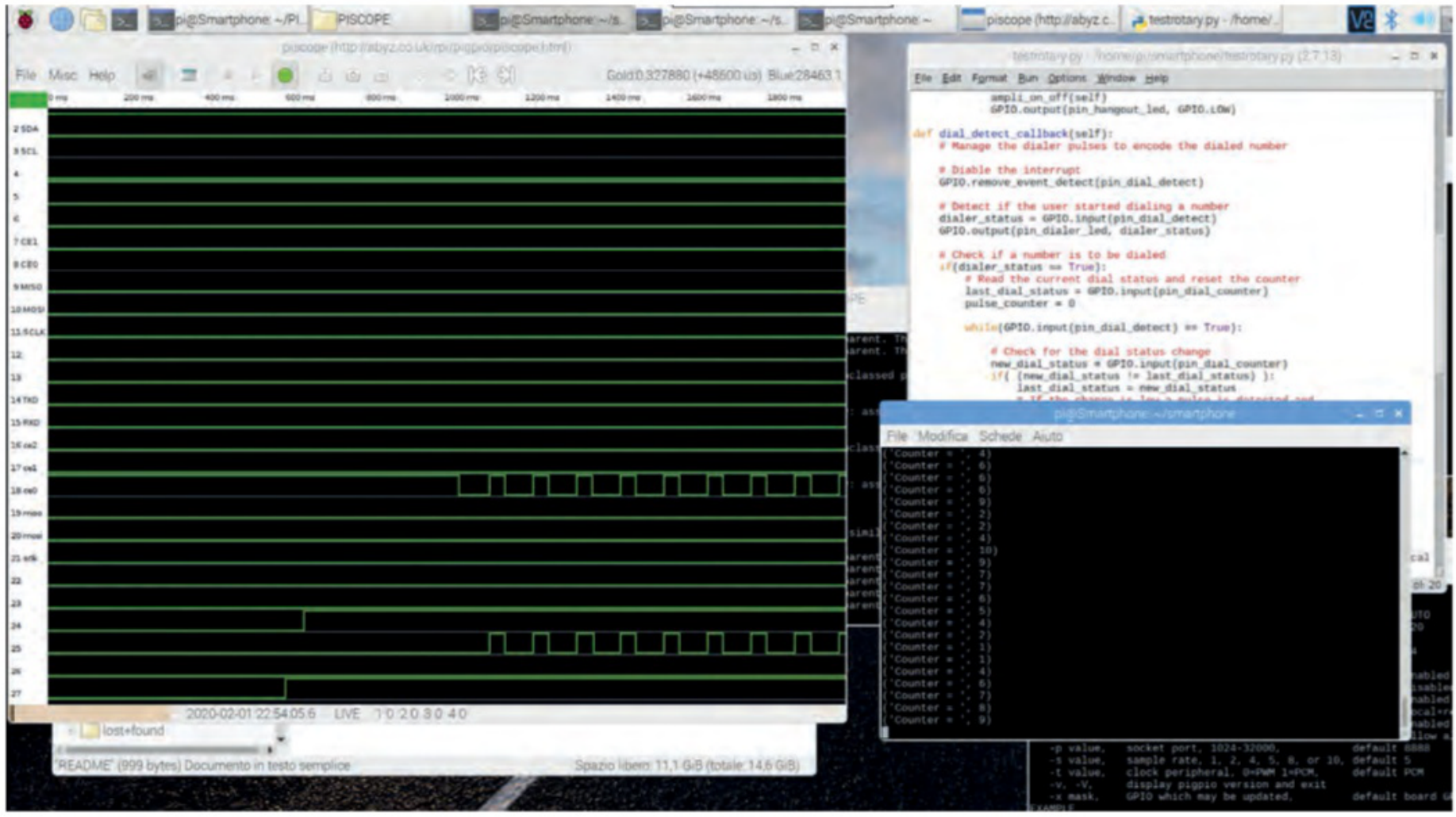


One of the three LEDs assembled ready to be glued inside the transparent support. To save space on the prototype Raspberry Pi circuit, the resistor is soldered directly to the pin of the LED

The sources and Python library of the project, as well as the STL files for the LED covers and the circuit design, are available under open source licence at the GitHub repository: https://github.com/alicemirror/PiRotary.



Screenshot of the Raspberry Pi desktop showing a Python test programme. The terminal window shows the counter of the rotary dial while the left window shows the generated pulses to the corresponding GPIO pins. With the interrupt-driven programme and the PiGPIO library interfacing the software daemon, the pulse count works as expected.

Do you remember the first part of the upcycling project published in Issue No. 87 of *The Shed*? Here it is again, activated by the Pi Rotary while playing an MP3 music track

Completed shed

CAN HE BUILD IT? YES HE CAN

BUT YOU CAN'T TAKE THE ENGINEER OUT OF THE MAN — BOB HULME BRINGS HIS FASTIDIOUS ATTENTION TO DETAIL TO BUILDING A KITSET SHED

By Bob Hulme Photographs: Bob Hulme

Downsizing is almost a swear word to us sheddies, but when the later stages of life arrive there are practicalities that are difficult to fight. A casualty of this horrible but necessary downsizing is the loss of that shed space. Selling up in Auckland and moving into what was our weekend beach bolthole has been — and still is — a tricky exercise in reducing the stuff that my wife and I have accumulated.

The other side of this has been creating more storage within the beach house so we can keep the essential stuff and items we're not ready to let go just yet. A significant part of the solution to this problem was to build a 10m² shed/workshop in the backyard.

Now, I may be an engineer but I am no builder

The choices

Why 10m²? Well, that's as big as I have room for and it is the maximum size that can be built in most council areas without the need for a building permit, with the associated costs and red tape. It's not big enough to drive a car into, but if it was I would be building another garage, wouldn't I?

Another choice that needed to be made early on was whether to buy a kitset building, pay a builder to do it, or build it from scratch myself. Now, I may be an engineer but I am no builder, so building from scratch wasn't my favourite option. Even though you can see how to do almost anything on the internet, it's no substitute for proper trade training. Builders are currently enjoying high demand for their services and this means high rates. Paying over the odds doesn't sit well with me, so kitset it was! I became Bob the builder. Can he do it? Yes he can! ▶

Bare site

Decisions, decisions

Next decision was which kitset. There's plenty of choice and I initially narrowed it down to timber construction rather than metal. A beach location is tough on anything metal. Even coastal-rated Colorsteel has a limited life compared with wood.

I chose a kitset made by EcoSheds in Auckland's Browns Bay. Now I don't know if they are necessarily the best, but we were able to look inside a finished example, rather than rely on a brochure, and the price seemed reasonable.

Other decisions that are best made earlier on are matters such as power supply, drainage, water supply, lining, and lighting. I decided to put mains power to the shed because I still use several mains power tools and have little faith in the battery ones. This lack of faith may seem backward and I can only say in my defence that it's brought on by the number of them that I've thrown away because the batteries have died and new batteries were going to cost more than another complete drill — that is, if they were even available.

I did buy a battery drill back in 2019 when it was on special at the Mystery Creek Fieldays. It might yet change my opinion, but I'm not ready to get a battery angle grinder, Skilsaw, jigsaw, and planer just yet. My mains-powered ones just keep going and going.

It's good to get ahead of things and reduce the time that the kit is lying around out in the weather

Provision for power wasn't an option in the kitset, but you would be well advised to consider this. Talk to an electrician about where the power will connect to and how your site location will affect that.

And more decisions

I don't need a water supply in my shed for the sort of things I do, so no issues there.

The kit didn't include lining, but I wanted to have plywood lining to effectively brace the structure. The lining needed to be thick enough for me to mount anything anywhere without reaching for a stud finder.

Lighting is a two-pronged issue, as natural daylight is just as important as artificial lighting. EcoSheds had options for windows, which meant I could include a side window on the sunny side as well as have windows in the double doors.

An option I did add to the standard kitset was extra height. It's only another 150mm, but I reckon it makes best use of the floor area and gives a wee bit more storage capacity. The only amount of extra height available was 150mm, so I guess there are structural reasons for that.

The soil here at Waihi Beach is very sandy so the natural drainage is amazing. For that reason, I opted to do away with guttering and allow the rainwater to simply drop off the roof edges. Stone pebbles laid on the drip line will prevent scouring.

Another decision was whether to plonk the shed directly on the ground, put it on rails or a concrete pad, or go for full foundation piles. I went for piles because I wanted to be sure that the shed — and contents — would stay dry.

Bob in his element

Well, as you read this article you will begin to realize that I am a bit anal about things

The foundations

If you're going to build your shed directly on the ground or on rails then the only preparation will be to make the ground flat and perhaps put down a layer of gravel to help drainage. A concrete pad will need a little more work and could be made a bit bigger than the shed to allow for an edging.

In my case I needed to place the piles so they would line up with cross members that the shed would sit on. All cross members had to be the same height and level. Happily, I got a prompt reply from EcoSheds to my request for extra information about the correct positioning of the cross bars. I'd ordered but not received the kit at that stage so didn't have the benefit of the instruction leaflet.

In the end I succeeded in getting a copy of the relevant page emailed. It's good to get ahead of things and reduce the time that the kit is lying around out in the weather.

My chosen spot had some smallish trees on it so I had to clear those. A neighbour had already put up a storage shed at the boundary so I had to locate my shed just a little in from the boundary so I could access the back wall for building work as well as painting. I made the gap big enough to store the wheelbarrow — another storage issue solved! ▶

Wheelbarrow space

The piles

For the piles, I set 100mm square appropriately tanalized posts in concrete.

The holes had to be dug at the right spacing and depth, although the depth wasn't too critical for the method I used. After digging the holes I put some concrete in the bottom of each one to make sure that there was a full patch of concrete under every pile to stop the piles from sinking into the sandy soil. Concrete pavers could also have been used for this.

Next, two piles were cut to set in at opposite ends of the first cross member, and position it level at the right height. The middle two piles under that cross member were then cut about 30mm shorter than they needed to be and fixed to the cross member so that they dangled into their holes. The 30mm is meant to allow the concrete enough room to flow under the pile post to give it full support. The same process was used with all the piles with reference to being level with the first cross member. With everything held in place many bags of Readycrete were mixed up in the wheelbarrow and carefully shovelled down each hole.

Now, I know some readers will be thinking, *Why didn't he use that post-setting ready-bagged concrete that you pour in dry then hose?*

Well, as you read this article you will begin to realize that I am a bit anal about things. The talk about cordless tools might've given a clue. It doesn't stop there. I have used the post mix 'tip-it-in-dry' stuff and I didn't feel as if the strength was all that it should be. So for my piles I used the slow-setting, high-strength mix, which I could be sure was mixed well with the water and would be consistent in strength. Keep reading for more of my quirks.

Pile holes dug

Levelling the piles


Kitset on trailer

The kit

I turned up at EcoShed's workshops in Browns Bay just as the rain started and the staff were good enough to do most of the loading while I did the tying down. We all got soaked. Delivery cost to our beach location was going to be prohibitive so I had opted to pick up the kit with my race car trailer. In hindsight it would've been better to hire a large box trailer as it would have been much easier and less stressful than worrying about the load shifting and dropping through the hole in the middle of my trailer. Securing everything was a challenge. If I'd used a box trailer, most components would've simply sat inside with just a few long pieces of timber to tie on top.

I felt that they were probably written by someone who was well skilled in the building trade

Anyway, we made it to the beach and it was time to start construction on top of the cross members that were secured on top of the piles with pieces of gang nail to stop sideways movement. The instructions that came with the kit were really bare minimum and the photos weren't printed clearly. I felt that they were probably written by someone who was well skilled in the building trade and assumed that kit purchasers would have more than a basic knowledge of which end of a hammer to hold. In my case I found it harder than I felt it should've been and I lost quite a lot of time figuring things out. Yes, I did get there in the end without any catastrophe, but I wouldn't encourage an accountant to give this a go. ▶


Support structure on piles

The floor

The first part of the kit to assemble was the floor frame. Photos here show this placed onto the cross members. It was nailed together with very grunty nails that took some solid hammering to send them home.

Then some nails to hold the frame onto the cross members. Nearly everything else is screwed together, which pleases me as I much prefer screws to nails. There's the analness showing again. The tricky part to this was making sure that the frame was square before fixing it down. Measuring the diagonals and adjusting the frame until both diagonals were the same length was the best way to achieve this.

Next, the sheets of plywood for the floor were to be fixed to the frame. The plywood doesn't extend right to the outer edges of the frame so there is a ledge that the wall frames sit on and the floor plywood then buts up to the walls. A tip here is to put pencil marks on the edges of the frame to show where cross members are, as they will be hidden once the plywood is in place and it'll be necessary to know where to put the screws in. After putting a mountain of screws through the plywood into the floor frame, my next step was to paint the floor and the exposed parts of the frame.

> ***Nearly everything else is screwed together, which pleases me as I much prefer screws to nails***

Once the walls go up the edges will be covered and there will be no way to paint the edges of the plywood and the frame ledges. I wanted to make sure that if any water found its way in there it wouldn't be able to soak into the plywood.

Now if that sounds a bit anal — I used oil-based primer/undercoat. I don't like water-based paints for undercoating and believe that oil-type paints are better for the wood and bond to it better. Paint experts may be typing letters to the editor as I speak and I welcome their comments. I just have my own experience and thoughts to go by. (Write in if you agree with me.)

Painting the ledge where the walls will sit

Floor on and undercoated

Storage in the shed

The boards are New Zealand–grown Oregon pine

Wall panels are stood up on the edge of the floor frame and screwed to each other

Wall panels up

The walls

The EcoShed kit has walls that are pre-made in tongue-and-groove panels on the outside over a relatively light frame. The boards are New Zealand–grown Oregon pine and, being just short lengths due to the width of the wall panels, the manufacturers probably have very little waste. They are quite knotty, though — more knots than a Boy Scout manual.

The wall panels are stood up on the edge of the floor frame and screwed to each other, as well as to the floor frame itself. I chose to pre-drill the screw holes, as I was sure the timber would have split if I didn't and this also meant that the screwing together was easier.

Salt spray in the air might make short work of these thin steel staples — another reason to get plenty of oil-based paint over them

To start off this part of the construction, I laid out the panels to make sure I had them in the right order, with the right ones on the ends and the one with the side window in the right place. Before standing them up I painted the lower edges with — you guessed it — oil-based primer/undercoat. The boards on these wall panels extend past the bottom edge of their framing so that when in place they overlap the floor frame, making it difficult for water to find its way into the shed.

Probably for economic reasons, the wall panels are put together with staples rather than screws or nails. This was an issue for me due to the coastal location. Salt spray in the air might make short work of these thin steel staples — another reason to get plenty of oil-based paint over them.

In part two (*The Shed*, Issue No. 92), we will progress with construction and add a few items to the kit to improve strength, water tightness, and security.

Don Spence and Rooster Rutter in their American plains gear

THE MOUNTAIN MEN GATHER

DANIEL BOONE RIDES AGAIN — IN THE KING COUNTRY

By Geoff Lewis Photographs: Geoff Lewis

One of the weekend's many activities is a group shoot

For a week after Christmas, the big hills of the central King Country echoed to the cracks and booms of old-style musketry as members of the New Zealand Black Powder Shooters Federation (NZBPSF) came together for their annual Mountain Man event.

Around 50 members and their families arrived from around the country to enjoy a week of activities based around their common interest in the era of black powder firearms and the dress styles of the time.

The spot chosen for their rustic camping experience was a sheltered valley surrounded by steep sun-baked hills on one side and a cool area of deep totara forest on the other — a venue made available by the generosity of the landowners. The shooting activities, including targets, were created and set up by the 'booshway', or event organizer, Rex Morris and his family.

While a competitive spirit was definitely in evidence, this gathering and the local club events that take place during the year are an important social activity for participants. The group operates like a large family and terse words will be exchanged if someone goes through another member's town without stopping for a cuppa. Annual events and get-togethers are like family reunions.

The group operates like a large family and terse words will be exchanged if someone goes through another member's town without stopping for a cuppa

Frontier inspiration

Black powder shooting has a long history in New Zealand, with many of the aficionados drawing inspiration from US history and great tales of the American frontier and the Wild West. Throughout the world, re-enactments, particularly those based around the English Civil War (1642–'51), the American Civil War (1861–'65), and that earlier frontier era, have a huge following, especially in the US; New Zealand also has its own colonial history to draw on.

Black powder shooting maintains a worldwide following and the reproduction of antique firearms has been a viable industry for decades, with specialist manufacturers in the US, Europe, and New Zealand.

The firearms used in black powder shooting range from smooth-bore flintlock muskets similar to those used 250 years ago, to cap-lock rifles used for military, hunting, and sporting purposes in the mid 19th century.

Challenges galore

Activities during the Mountain Man week included trail walks, which allowed shooting at a variety of set-up targets in bush and hill country, along with group shoots, long-range events out to 265m, and even a shoot for the kids using antique falling-block .22s. With exception of the long-range event, cartridge gun events, and shotgun events, Mountain Man used 'patched' round balls and iron sights.

The annual tomahawk and knife–throwing competition, which involves throwing axes and Bowie knives, is ▶

always contested at all levels.

Evening entertainment included a fire-lighting competition using old-time (flint) spark and tinder. Competitors were teamed in pairs to create a fire and heat a sealed tin containing a small quantity of water. The winners were the first pair to blow the lid off their tin.

The Mountain Man trophy, competed for by many during the multi-day event, is the culmination of results in four shooting challenges: Running Boar — half of an old gas tank was the moving target; Renegade — a timed shoot allowing just one minute to reload between shots and a three-second exposure for each of five shots; Save Your Mate — how to hit a boar and not the man carrying it; and a plains game.

There was also the main Mountain Man award plus a senior award for shooters over 65, a Mountain Woman award, and a junior award.

The Mountain Man trophy … is the culmination of results in four shooting challenges

Safety paramount

The Mountain Man event had its beginning in the early ’80s as an informal gathering of a small number of passionate followers on military land at Waiouru. They later transferred to a property at Ohinewai and more recently to this current site off the Taumarunui road.

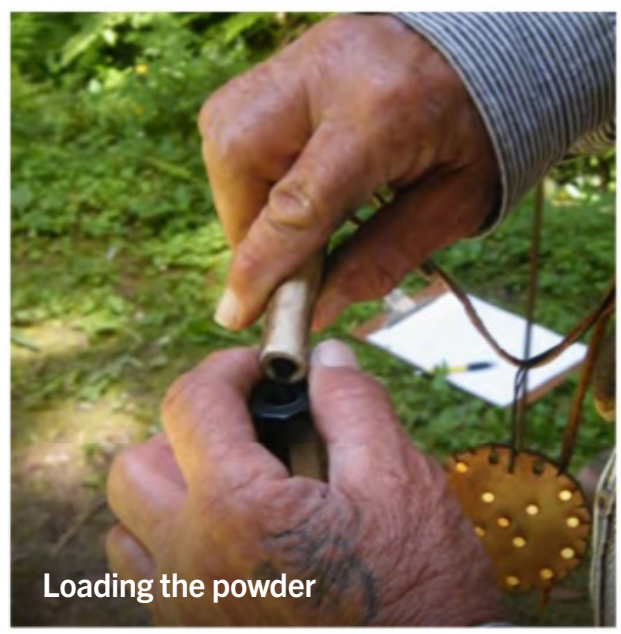
Loading muzzle-loaders with black powder and either ball or ‘slug’ (Minié ball) shot is a time-consuming process. NZBPSF committee member Grant Smeaton says safety is paramount and there is a set drill intended to ensure accidents don’t happen.

Even then, in the heat of competition, shooters can still manage mishaps such as loading a shot before putting the powder into the barrel or firing the ramrod.

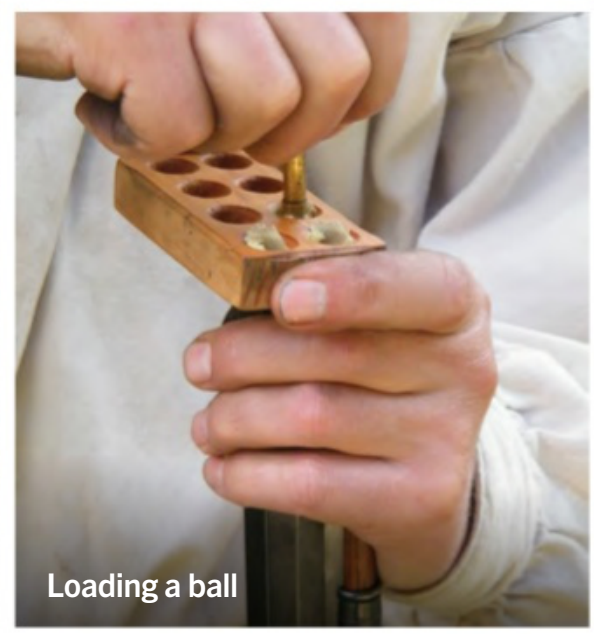
The annual tomahawk and knife throwing competition … is always contested at all levels

Graeme Baker takes part in the axe and knife–throwing competition

The spot chosen for their rustic camping experience was a sheltered valley



Loading the powder



Loading a ball

Two old cobbers, Don Spence and Dennis 'Rooster' Rutter, hail from the south of the South and have been hunting together for decades

"Everyone attends a briefing in the morning before we get into that day's competition. We have qualified range officers in attendance but the idea is that everyone is a safety monitor. If anyone sees someone doing something that could be dangerous, they'll have a quiet word with them. We need to know people are competent with their firearms," he says.

The frontier lifestyle

Many of the people involved in black powder shooting have a general interest in firearms. Some have been, and continue to be, active hunters.

Two old cobbers, Don Spence and Dennis 'Rooster' Rutter, hail from the south of the South and have been hunting together for decades. Now 70, Rooster shot in helicopter meat hunting and live capture in the early days of the venison industry. He got into black powder club shoots on the West Coast with an active muzzle-loading shooting community.

Both love the American frontier–style equipment and leather gear and Rooster makes his own guns using imported American barrels.

"There's such a lot of history. I'm always reading and learning, It's a whole lifestyle," he tells us.

Black powder shooter and Auckland cabinetmaker 'Steven' spent 14 months making his own cap-lock muzzle-loader in the style of a Southern Mountain rifle. The result is an elegant and functional firearm.

Steven has shot with black powder for 40 years and the .40-calibre smooth-bore is his first home-made gun. For information and research he used the internet and hints and tips from the American Longrifle Association.

Gunpowder has had its day

Also known as 'gunpowder', black powder is regarded as a low explosive. It was developed in China in the ninth century for medicinal purposes and was first used in warfare about 1000 years ago. By the end of the 13th century its use had spread throughout Eurasia and it was widely used as a propellant in firearms, artillery, rockets, and fireworks along with being used in quarrying and civil construction.

Black powder is no longer used in modern weapons, nor is it used for industrial purposes, due to its relatively inefficient cost compared with newer alternatives. Today gunpowder firearms are limited primarily to hunting, target shooting, and historical re-enactments.

How the weapons work

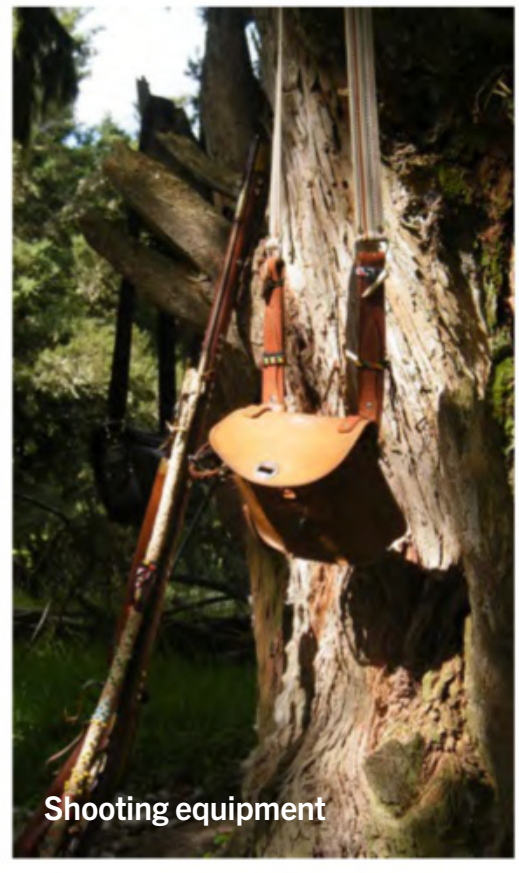
Muzzle-loaders are nowhere near as easy to use as modern firearms. The preparation of powder with ball or projectile as ammunition, the loading and shooting, and finally the cleaning and maintenance of these firearms involve a science and acquired knowledge base that is never complete.

Shooters prepare a supply of 'ball', or 'slug' (cast lead projectile), ammunition particular to their firearm. Cast projectiles or slugs have grease grooves cast into the projectile and are pre-lubricated before use with a preparation often made up to a shooter's own recipe, which can include a blend of beeswax, animal fat, and Chefade, or other such ingredients.

Muzzle-loaders are nowhere near as easy to use as modern firearms

With round ball ammunition, a sized, lubricated cotton patch of a specific thickness appropriate to the difference between the ball diameter and the ▶

A Martini–Henry musket, introduced in 1871 by the British Army as its first purpose-built breech-loader



Shooting equipment

bore dimension of the firearm is placed on the muzzle. Then the ball (not pre-lubed) is centred on the patch and driven a few inches down the bore with a short starter rod before the full-length ramrod is used to drive the load home.

The starter rod avoids the potential of snapping the ramrod due to too much side load at full stretch. In a round ball gun the lubricated patch is necessary to achieve a gas seal during the firing phase and flutters aside when the shot is discharged.

Shooters who use guns employing a percussion or cap-lock mechanism begin a day's shooting by wiping out all residue from bore and breech. Then, in a process called 'capping off', they fit a copper percussion cap containing a layer of mercury fulminate to the 'nipple' and discharge the cap with no powder or bullet in the gun. This is to confirm the flame path to the charge (when loaded) and ensure that the barrel is clear.

In serious competition it is usual to follow capping off with an unaimed fouling shot into a safe area, as experience shows that a first shot from a clean barrel will have a different point of impact to subsequent shots fired from a fouled barrel.

Choose your calibre

In black powder, there is a plethora of calibres, from quite small — around .30 of an inch — to measurements such as the .577 and larger sizes used in the mid 19th century. In the early days barrels were made in a wide variety of sizes, so much so that often home-made ammunition was cast specifically for the weapon.

Often home-made ammunition was cast specifically for the weapon

Some members of the NZBPSF use brass-cased rounds loaded with black powder in popular calibres, including the original .44-40 lever-action round. Some shooters use the 1880s-era Martini–Henry, one of the early breech-loading rifles, which uses the .577/450 round. These will hit supersonic speeds of around 1300 feet per second (396 metres per second). The powder load is carefully measured depending on the requirement of the round.

As black powder is highly corrosive, diligent cleaning is necessary to prevent damage inside the barrel. Many antique weapons are unusable due to barrel damage caused by corrosion. After firing, barrels are often sluiced out with boiling water and then treated with a preservative oil, wax, or grease. This has to be cleaned out before the gun can be reloaded and fired.

Sound like you?

Like most organizations, the NZBPSF would love to have more members. Anyone interested should contact NZBPSF through its website — sporty.co.nz/nzbpsf — or check for a black powder club in their area.

Note: Original, muzzle-loading, black powder firearms are classed as antiques and no firearm licence is required to own one. However, the majority of black powder shooters today use modern reproduction firearms, or those they have built themselves, so a current A Category firearms licence is required.


Brian Large


Graeme Baker


Steven spent 14 months making his own cap-lock muzzle-loader

Multitool INTERNATIONAL

Belt & Disc Grinding Attachments

The Multitool is a Australian designed belt grinding attachment which can be used on most bench grinders*. The technology replaces the grinding wheel and converts a traditional grinder into a sophisticated work station ideal for sanding, grinding, sharpening, shaping, polishing and refinishing.

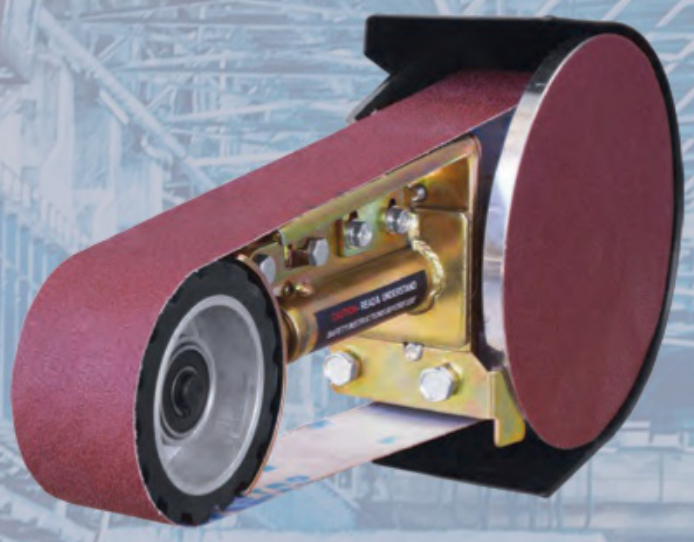
VERSATILITY
Grinding, sanding or polishing in 4 positions on rubber contact wheel, platen, disc or free strapping. The unit can also be swivelled vertically or any position in between.

ACCURATE TRACKING
The running position of the belt is simple to adjust and it stays there, allowing for finishing into sharp corners

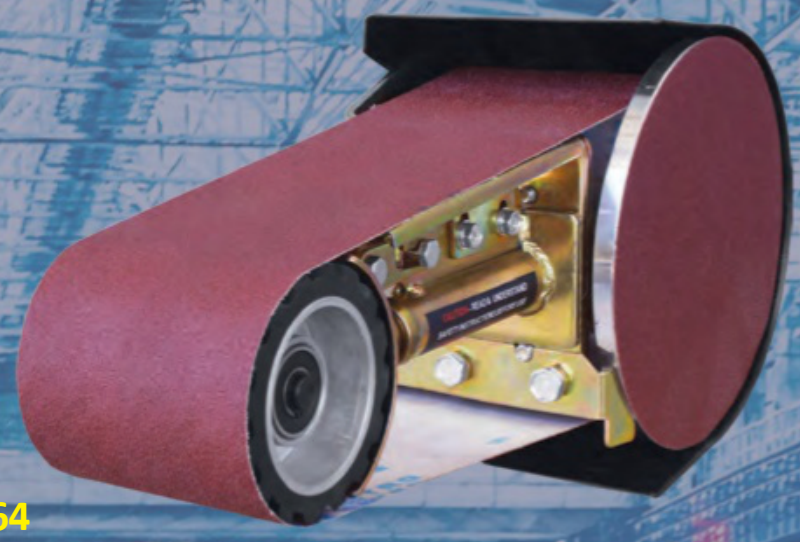
QUALITY CONSTRUCTION
Robust, maintenance free with sealed ball bearings, hardened and ground essential components and zinc plating

SPECIFICATIONS:
- 178mm Diameter Disc
- 3 1/2" (89mm) diameter rubber contact wheel
- Suits grinder shaft sizes of 5/8" and 1/2".
- 5 1/2" (140mm) diameter drive wheel
- Fitting Kit supplied

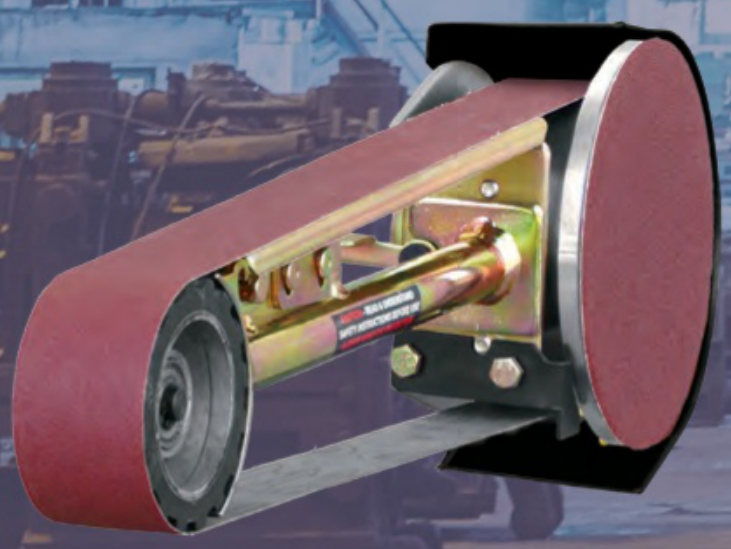
*Bench Grinder not included



Part# PO362
- 915 x 50mm Belt
- Suits most popular 6" or 8" bench grinders with a screw mounted wheel guard and a minimum of 1/3 HP



Part# PO364
- 915 x 100mm Belt
- The 364 suits most popular 8" bench grinders with a screw mounted wheel guard and a minimum of 1/2 HP, though 3/4 HP is recommended.



Part# PO482
- 1220 x 50mm Belt
- The 482 suits most popular 8" bench grinders with a screw mounted wheel guard and a minimum of 1/2 HP, though 3/4 HP is recommended.

Part# PO484
- 1220 x 100mm Belt
- The 484 suits most popular 8" bench grinders with a screw mounted wheel guard and a minimum of 3/4 HP.

Email sales@isl.nz for your nearest stockist or visit www.isl.nz

Green hops are used to make fresh green-hopped beers that have a distinctive green or grassy taste to them

GREEN-HOPPED BEER

FOR A BRIEF MOMENT EACH YEAR, LUCKY BREWERS CAN GET THEIR HANDS ON A VERY SPECIAL INGREDIENT

By Bryan Livingston — Photographs: Chris Carter

We all know hops are a plant, so of course they are green. However, the term 'green' is also used to describe fresh hops that have just been picked and have not been dried or made into hop pellets.

These green hops are used to make fresh green-hopped beers that have a distinctive green or grassy taste to them as well as having the citrus or fruit component from that hop variety.

So, what is all the buzz about these beers?

Put quite simply, we brewers have one shot each year to make these unique beers. When hop growers say the hops are ready, we need to start brewing immediately to get these amazing beers made before the hops spoil.

Green hop party time

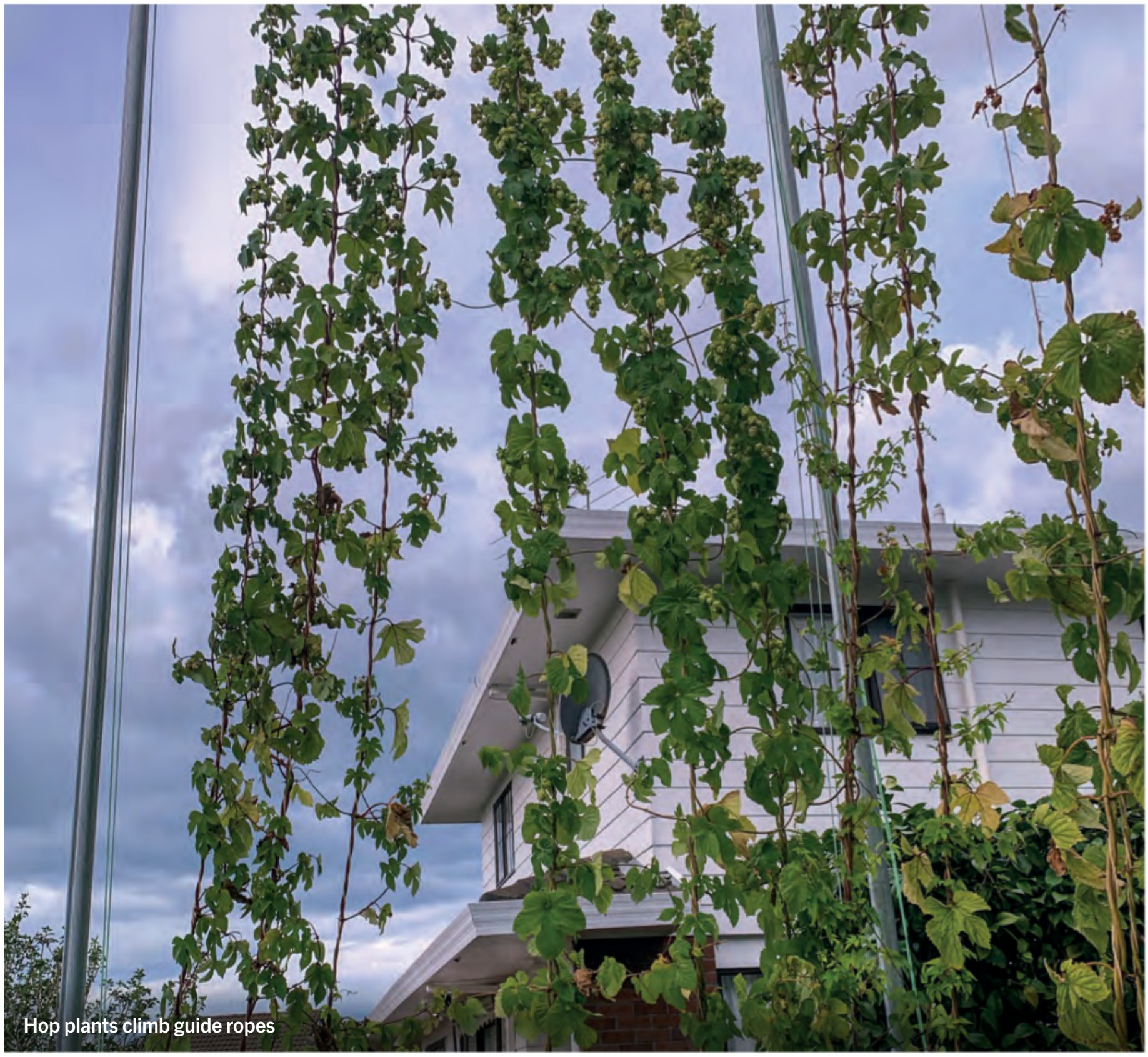
For commercial breweries, these seasonal beers form part of the Green Hop Festivals around New Zealand. Many craft bars and pubs join in hosting events to coincide with green hop beer releases.

It's not just the commercial breweries that have all the fun. Home brewers are now jumping on the green hop bandwagon and making batches of these beers. Some are even growing their own hops in their backyards and harvesting them moments before adding them to their favourite brew.

The term 'green' is also used to describe fresh hops that have just been picked and have not been dried

Those who haven't got their own hop plants might be lucky enough to source some from Brewers Coop or other home-brewing shops, which arrange for a once-a-year delivery of green hops direct from the hop farms. You usually have to pre-order the hops from your favourite home-brewing shop and collect them the same day they arrive. ▶

Hop Cones ready to harvest



Hop plants climb guide ropes

Home brewers are now jumping on the green hop bandwagon

How hops grow

Hops love sun and need plenty of water in free-draining soil. In New Zealand hops are typically grown in the Nelson region, as conditions there are perfect for growing hops. The hop growers work closely with research and development teams to develop hops that have become highly sought after around the world. Nelson Sauvin and Riwaka hops are just two of the many varieties that are sold around the world to international breweries.

If you are lucky enough to be in Nelson in summer you may see some of the hop farms on the outskirts of the city. Some say they look like a vineyard only two storeys taller!

Hops grow from rhizomes from a parent plant — similar to the way strawberries grow. The rhizomes are planted in rows and along each of these rows are wooden posts that sit 6–8m above ground. At the top, wires are strung between the posts, and climbing ropes descend from these wires down to the planted rhizome.

Just like climbing beans, hops are climbers and they climb up the ropes. They love climbing straight up but don't like growing sideways.

Brewers' gold

In summer the plants develop 'hop cones', or flowers. These are like gold to brewers, as they are what are used to make our beers.

In late February to late March — the time differs for each hop variety — the cones mature and the whole long length of the hop plants is cut at the base and taken away for the process of removing the cones from the vines. Most of the cones are dried and processed into pellets but a few of us are lucky enough to secure a few crates of the freshly harvested green hops for our green-hopped beers.

This harvesting process is largely done by machines now, but in years gone by families of workers used

A few of us are lucky enough to secure a few crates of the freshly harvested green hops for our green-hopped beers

Brewers Coop Green Hopped Pale Ale

Volume: 23 litres
Est. alcohol by volume: 5.7 per cent

MALT

5kg New Zealand pale malt
660g Munich malt
450g Dark Cara malt
200g wheat

HOPS

8g Nelson Sauvin pellets, boiled for 60 minutes
1kg green Nelson Sauvin hops steeped at whirlpool for 15 minutes — stirred continuously, then removed. Wort cooled immediately

YEAST

Safale 05 American Ale or Mangrove Jacks M44 West Coast Ale

EXTRACT BREWERS

Replace the 5kg New Zealand pale malt with two cans of light liquid malt extract.

Steep the other grains in 4–5 litres of 65°C water before removing.

Bring liquid to the boil for hop additions then add this along with liquid malts to your fermenter, stir well, and top up to 23 litres before pitching yeast.

to pick the cones by hand from the vines. Those interested can check out the pictures of the hop harvests in the UK between 1900 and 1945 at mashable.com/2017/06/03/hop-pickers/.

Growing hops at home

Home brewers follow the same process as the commercial hop farms only on a smaller scale. The hops can be planted directly in the ground or grown in pots. Some home growers let the hops climb up long lengths of bamboo while others rig up their own post and wire system. The photos used in this article come from the backyard of keen brewer Chris in Auckland. Chris kindly took the photos for Brewers Coop before he harvested his hops.

Unfortunately, most home brewers don't have the machinery to pick the cones, so this is still done by hand.

Brewing with green hops

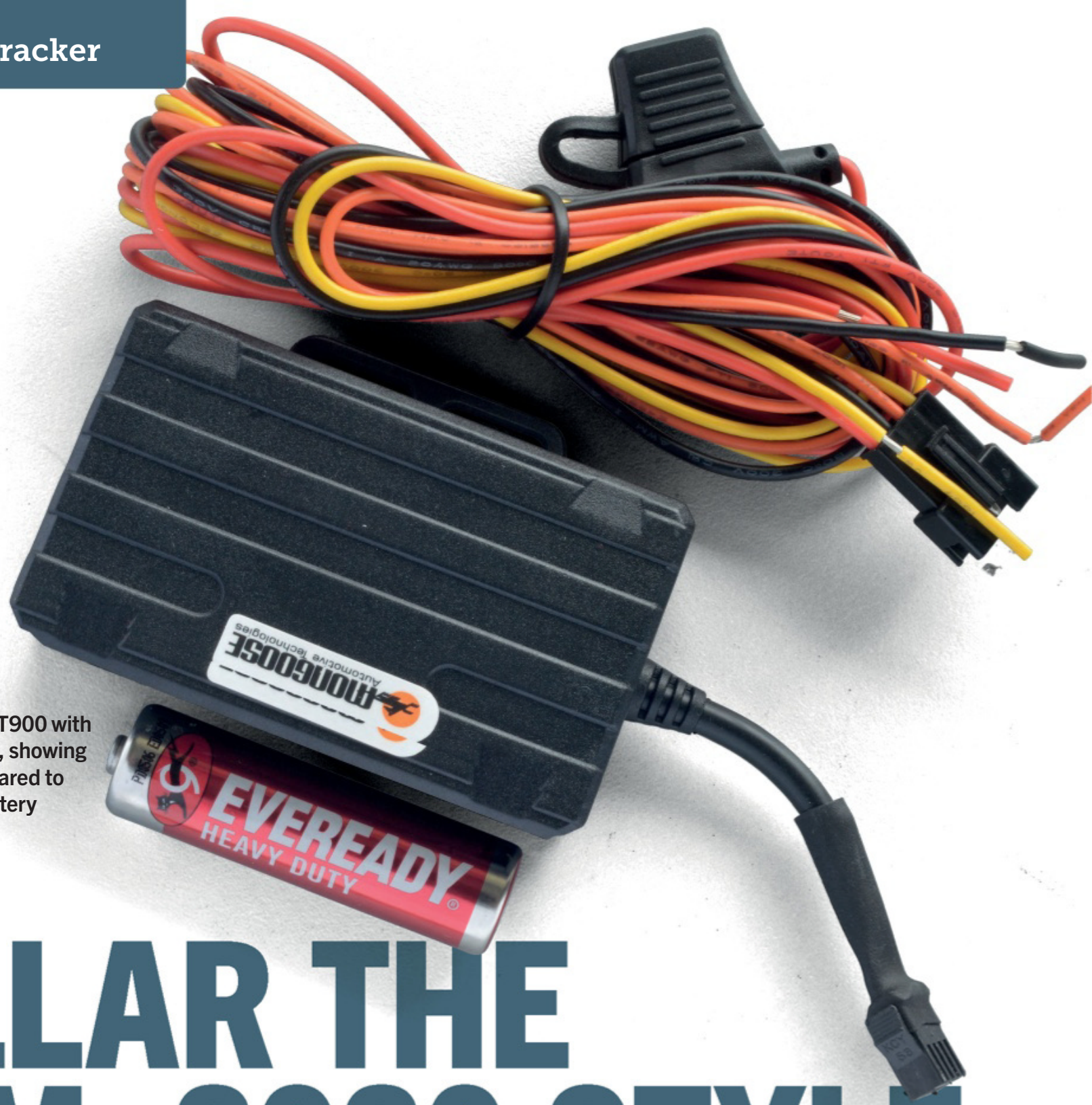
The malt recipe doesn't really change much from recipes using pellets or dried cones. However, the way the hops are treated is quite different. In my opinion, there are three key areas to note.

First, the freshness of the hop — this is what you want to come through in your beer. The lovely tropical fruit and citrus flavours are volatile so you don't want to boil green hops for long — if at all — or these aromas and flavours will be lost.

More important is the bitterness. You need five times the weight of green hops to get the same bitterness as hop pellets; that is, 1kg of fresh green hops is equal to 200g of pellets of the same hop variety. With this amount of green hops they cannot be left in too long or the beer will become too bitter — it's a balancing act to get the bitterness right while retaining the hop flavour and aroma.

Finally, infection risk — you get one shot a year at brewing green hop beers so you don't want to have your beer spoil. A couple of years ago, while packaging the green hops into our own 1kg bags, we had insects climbing up our arms. These insects lived in or on the hops and if we to dry hopped these cones into a brew there was a chance that the insects would introduce an infection into our brew and it would be spoilt. Instead, we chose to add the green hops at the end of the boil as a 'hop stand', or 'whirlpool', for a short period before cold crashing the beer for fermentation. That way the hot beer sterilized the hops and any insects that made their way into our brew!

Delicious looking, West Auckland homegrown hops



Mongoose VT900 with power cable, showing size compared to AA battery

COLLAR THE CRIM, 2020 STYLE

A GPS TRACKER CAN REDUCE THE ODDS OF LOSING YOUR PRECIOUS VEHICLE TO THIEVES — OR AT LEAST HELP YOU GET IT BACK

By Mark Beckett Photographs: Mark Beckett

There was a time when people respected other people's property. Locking houses and hiding keys wasn't normal, but at some point that all changed. As criminals started targeting other people's property, they chose the easy targets; alarms and sensor lights were enough to make them try somewhere else.

Sadly it seems we are living in an age when your property is deemed to be 'waiting for collection' by someone who will sell it for the next fix or to repay a debt, and the criminals involved are getting bolder. Day or night, residents home or not — it doesn't seem to matter to the thieves.

Alarms

We covered domestic alarms in Issue No. 74 of *The Shed*, and while these provide a deterrent to an opportunist, they are no match for someone who has your property on their shopping list.

It's likely you'll simply see your prized possession disappearing down the road

The same is true for vehicle alarms. They might make some noise for a short while but unless you are right there — and quick — it's likely you'll simply see your prized possession disappearing down the road, or a trailer that you suspect contains your vehicle heading somewhere.

GPS trackers 101

A GPS tracker consists of a GPS receiver, a movement detector, and a cellular data connection. It provides GPS coordinate information to a data collection point using the cellular connection in real time or as a text message when requested.

These have been around on commercial vehicles for a while and provide the business's dispatch centre with information about delays or other events. Like G-force recorders, they can help in accidents or if a complaint is made by enforcement agencies or other road users.

Vehicle trackers can have a range of features to provide an update on status: parked, ignition, movement or vibration detection, speed detection, excess G-force, geo-fencing, parking mode, power loss, audio, and remote engine stop. The power loss feature requires an internal battery. If you receive this alert it's a clue that someone has disconnected the vehicle battery, which is usually done to disable an alarm.

Data

Similar to the data connection on your mobile phone, the tracker sends GPS coordinates and speed information to a data collection point at set intervals. Alarms can be set to send a text message, a phone call, or both.

Some manufacturers provide a data collection point that you can access via a phone app or a web page. There is very little to set up and it is intuitive to use.

I was surprised at how low the cost of data was. Over a weekend recently, we attended a car event totalling 118km and the cost was 5c, while on another recent weekend away we travelled 290km over five days and it cost 16c. Mine is set to 10-second updates, so your figures may vary but it is very cheap.

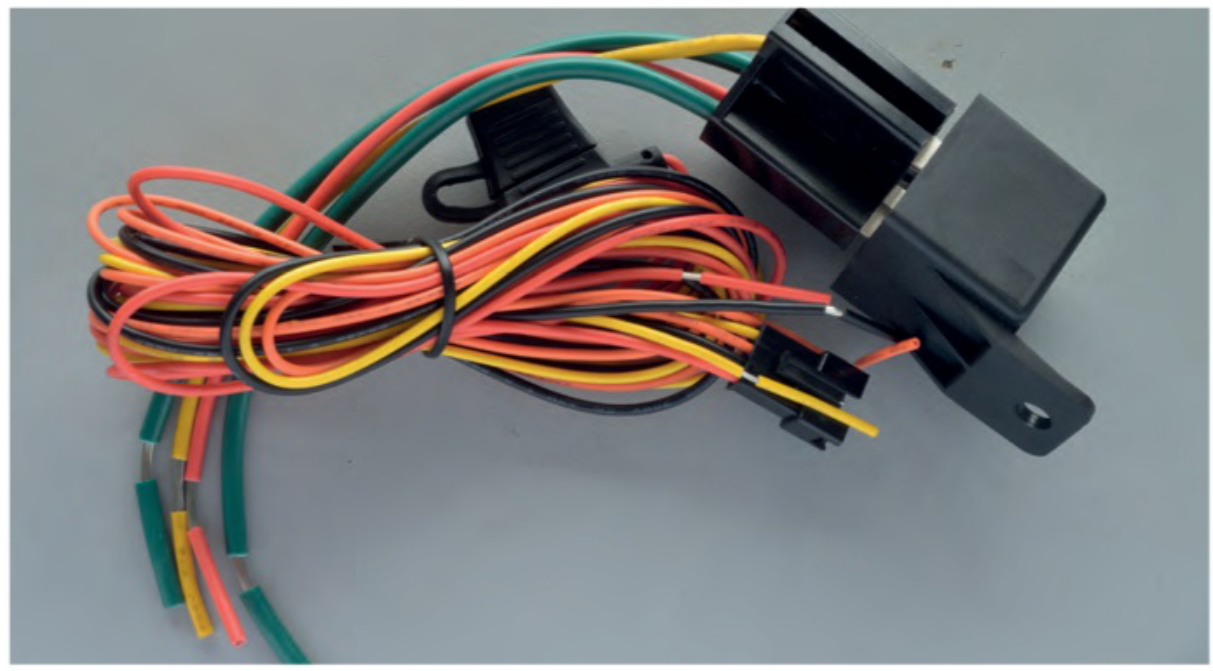
Health and safety regulations play a big part in our world today, so the evidence that a driver has taken appropriate rest breaks could be one reason a business may use the data. Another is that the data can be broken into time chunks, so mileage can be easily seen and charged to jobs.

If you receive this alert it's a clue that someone has disconnected the vehicle battery

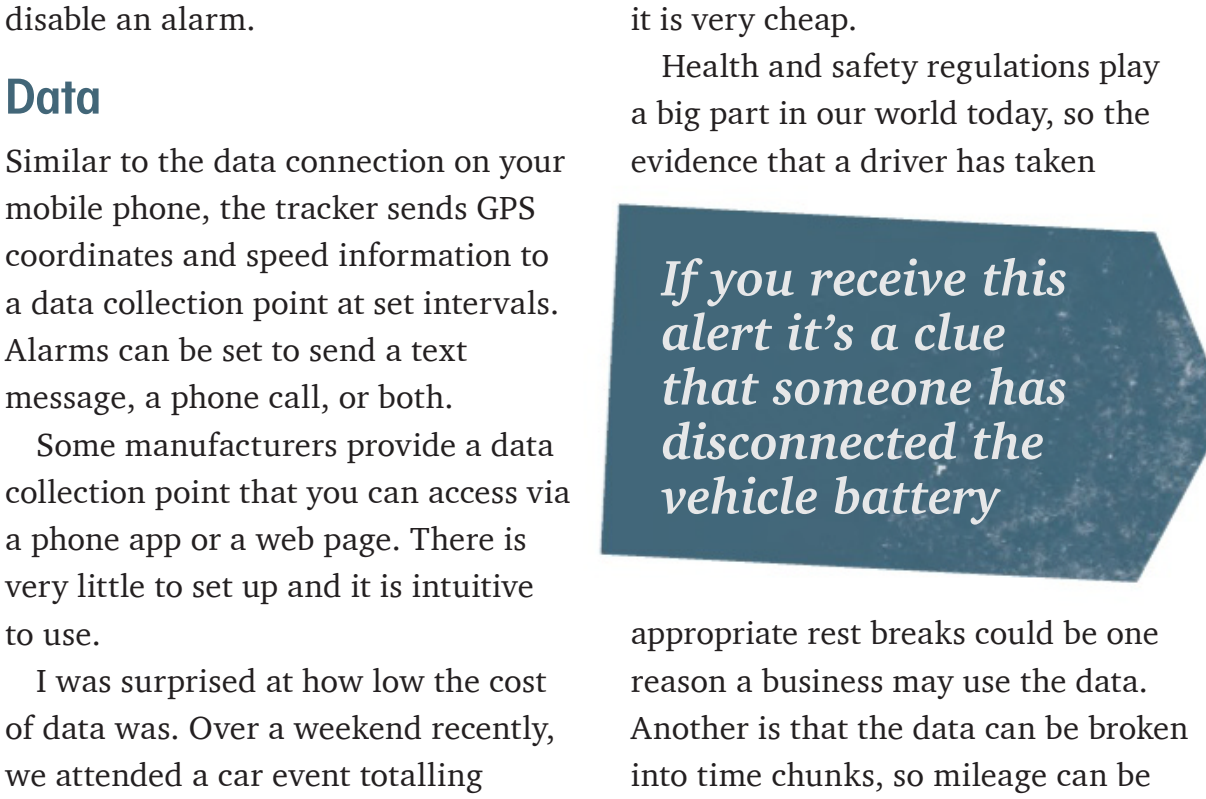
Storage on my collection point is only six months, but it does give the option of downloading the data into a spreadsheet for longer storage.

There is open-source software available that will provide many of the features required. Obviously this requires a permanent internet connection and a public IP address. Two examples are opengts.org/ (the right side provides a direct link to the latest release) and https://n0where.net/open-source-gps-tracking-system-traccar (this software is used by some sites that charge a monthly fee).

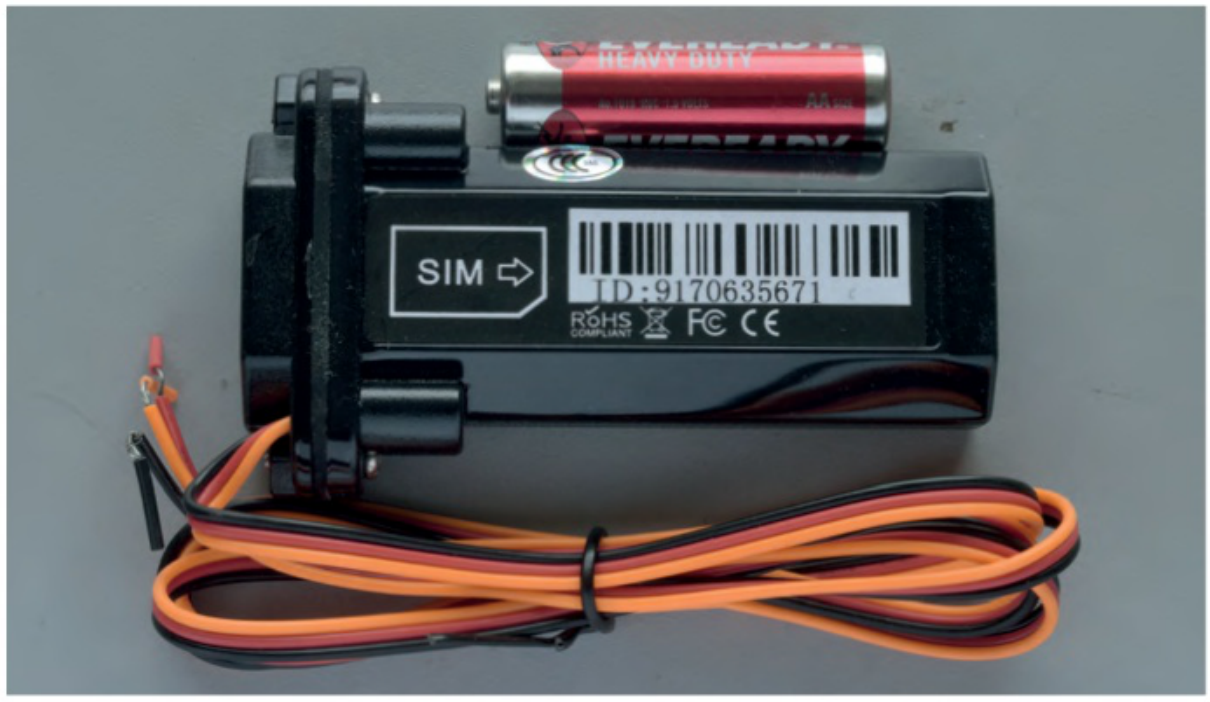
Most units will respond to a text asking where they are by providing ▶



Supplied relay, base, and wiring



Online-sourced tracker (left) versus Mongoose tracker



Online-sourced tracker showing size compared with AA battery

a GPS location. On a smartphone this opens your preferred map and pinpoints its location. If you don't want to use the data collection service, you can just text the unit when you want to know where you parked the car.

The hardware

I chose a Mongoose VT900 and the feature list is more than I need. It has an internal battery and a free data collection service, which is linked to the IMEI number of the cellular module, and cost under $300.

There are cheap online-sourced models available that have many of the features that other models have. Most are still using 2G, which in New Zealand is only supported by Vodafone. As long as there is coverage they will work, but Vodafone has threatened the end of the service one day — 2024 is one date. The size is much more suited to motorcycles and it is waterproof. It would have been useful when my son's motorcycle was stolen.

I followed this link — osnz.co.nz/gps — and purchased one of its referenced devices for another vehicle: (dx.com/p/mini-waterproof-gsm-gps-tracker-built-in-battery-2006298.html). The total cost was $39 — $34 plus a $5 SIM card.

Here is the link for the manual, which also provides information about using the manufacturer's data collection service at no cost:

Location within the vehicle is critical — it mustn't be able to be accessed easily

drive.google.com/open?id=0B2s4P7cCZcFDb3BKM01wT1NpTE0.

This product might suit someone who simply wants to know where the vehicle is when it is no longer in the place they left it.

Installation

Installation is easier than with most car alarms. It requires battery, ignition, and ground to be connected.

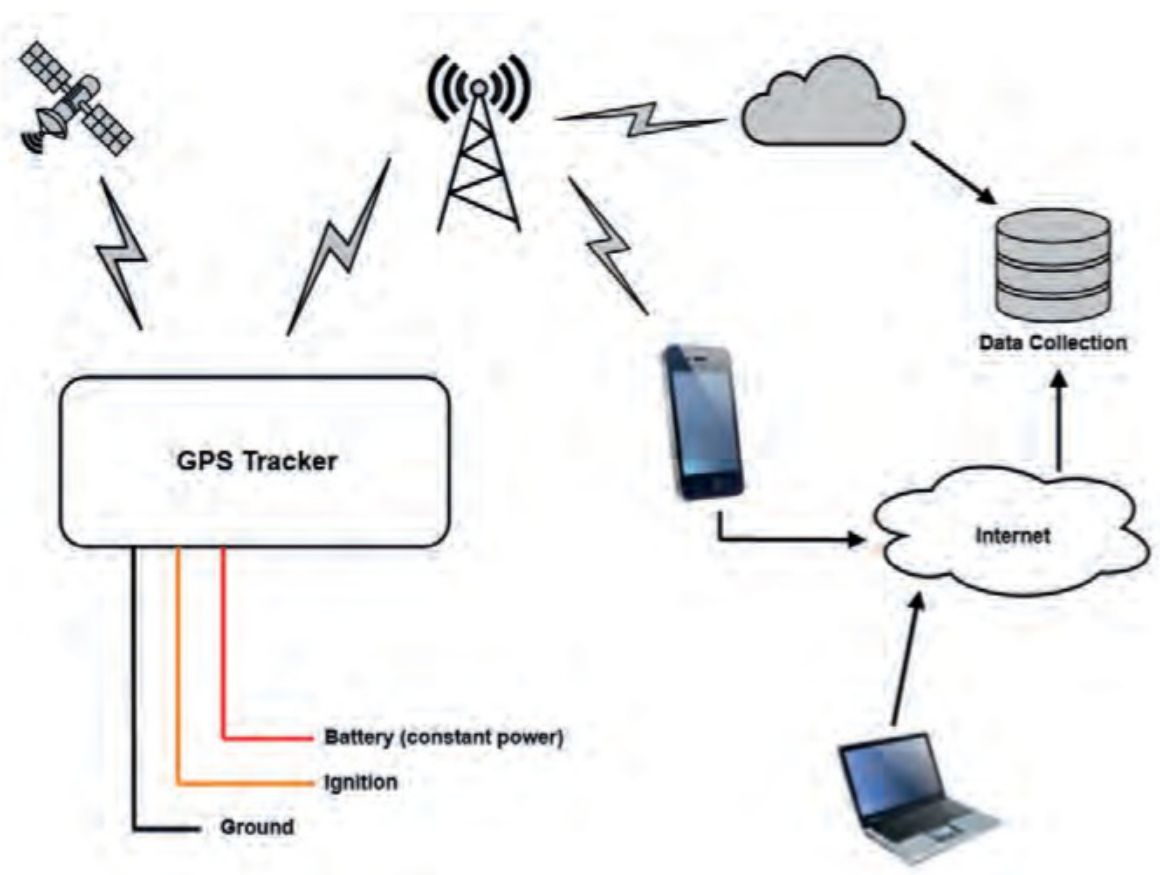
The GPS needs to be able to receive a signal, so it cannot be placed below a metal surface.

Modern vehicles usually have plastic dashboards and rear parcel shelves, and the sensitivity is good enough for mine to work reliably inside a metal garage.

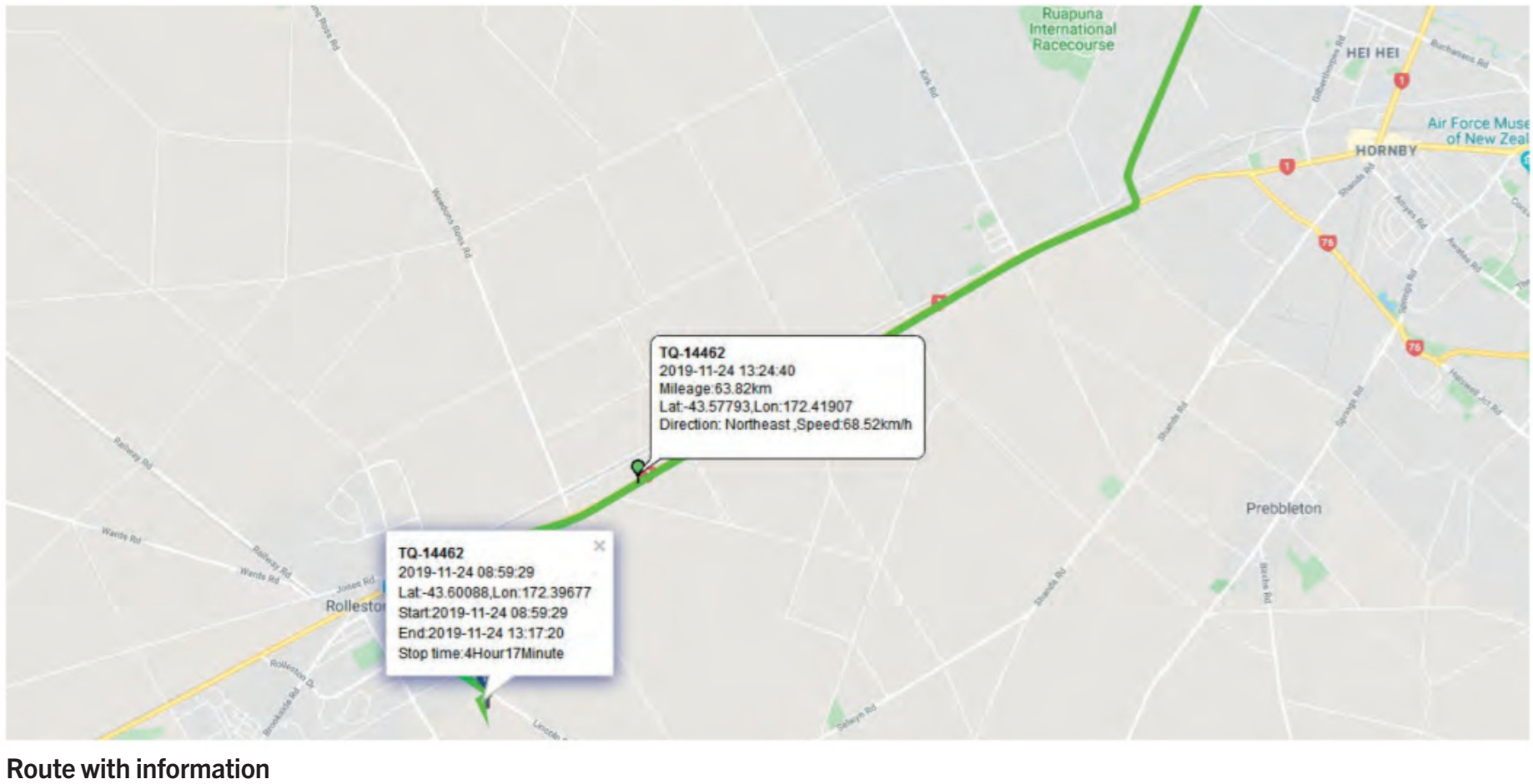
Location within the vehicle is critical — it mustn't be able to be accessed easily. To have the best chance of recovering the vehicle, you want the unit to still be in the vehicle to update you on its location.

A search on the internet should provide details on how to remove the trim on modern vehicles. This took the longest time of the installation, but it is simple enough for most owners to do. Some units have an option to send a text and operate the supplied relay. Mongoose does not recommend fitting it to the ignition circuit, and suggests interrupting power to the fuel pump. However, this only suits vehicles with an electric fuel pump, so the choice is yours.

The manufacturer warns that it is essential to ensure the SIM is set up, is registered with the provider, and can receive and send texts. It forgot to mention that you should link it to an account so you can check the balance. The Vodafone helpdesk was very helpful and saved me dismantling my car to remove the SIM. So, my advice is to ensure you have full access to the



Sample showing location detail available and info



Route with information

Date & Time	Number	Usage type	MINs / data	Cost $
25 Nov 2019		Data	0.13MB	0.03
24 Nov 2019		Data	0.22MB	0.05
23 Nov 2019		Data	0.17MB	0.04
22 Nov 2019		Data	0.11MB	0.02
21 Nov 2019		Data	0.17MB	0.03
20 Nov 2019		Data	0.14MB	0.03
19 Nov 2019		Data	0.19MB	0.04
18 Nov 2019		Data	0.12MB	0.02
17 Nov 2019		Data	0.19MB	0.03
16 Nov 2019		Data	0.24MB	0.05
15 Nov 2019		Data	0.18MB	0.03
14 Nov 2019		Data	0.17MB	0.03
13 Nov 2019		Data	0.09MB	0.02
12 Nov 2019		Data	0.27MB	0.06
11 Nov 2019		Data	0.03MB	0.01
10 Nov 2019		Data	0.15MB	0.03
09 Nov 2019		Data	0.25MB	0.04
08 Nov 2019		Data	0.18MB	0.04

Running costs from Vodafone

SIM before inserting it into the unit.

Depending on the hardware, you may need to link the tracker to your phone for texts and the data collection point setting, so be prepared to use a dollar or two on confirmation texts back from the unit.

Once you're happy everything is working the way you want, replace the trim you removed.

Hopefully, this article has provided you with enough information on what is available to help you locate your prized possession without signing up for expensive monthly fees.

Off to a flying start — Jennie gets a crash course in beekeeping

WHAT A BUZZ

UNEXPECTED GUESTS PROVIDE FOOD FOR THOUGHT

By Murray Grimwood Photographs: Murray Grimwood

They arrived after a big southerly blow. I suspect someone's hive blew over but, given that they weren't sporting airframe numbers, it was a case of finders beekeepers.

They coalesced on a branch of one of our fruit trees, hanging in an ever-changing shape. A beekeeper we contacted said nobody would be interested; another said they would die of cold. *Well, heck with that,* we thought.

My better half had swapped three chickens for a part-build top-bar beehive some years back. It was still part-built, but a crash production line on a temporary template saw enough frames assembled to get us started. With a strip of mesh tacked across the base and a piece of plywood to serve as a temporary roof, we were ready to go get 'em.

Bee-gathering 101

I approached the tree in ordinary overalls, with loppers and hive in hand. I slipped the hive under the branch. Lopped the outer part of the branch off, and lopped the swarm into the hive. Then I ran — only later did I learn that swarming bees are not prone to anger.

An hour later I was able to remove the branch because they'd crawled into the frames. Yee-hah! They liked their new home and it was obviously worth finishing off the remaining frames. These are made of macrocarpa — as is the box itself — and what looks like recycled kahikatea.

The top bars extend either side and the extensions are what the frames hang on. Each top bar had a circular-saw slot along the underside, the purpose of which I assumed was honeycomb alignment. Pre-drilling is a good idea with seasoned macro and I double-nailed each joint, but only because of a lack of suitably sized screws to hand. A few back and forths of lacing wire gave some rigidity for the comb. Fabricating a permanent roof of macrocarpa skinned with galvanized iron finished off the build.

The bee's knees

A phone call to yet another beekeeper friend resulted in two varroa strips being inserted and some protective gear borrowed. Since then it has been an intense learning curve. We learned that I should have laid strips of beeswax in those grooves along the bottom of the top bars; it tells the bees where to start. We learned that they would benefit from an energy hit in the form of honey, so three old jars of the stuff followed each other into the hive. To save the bees from drowning we stuffed macrocarpa fronds into the honey as a ladder; they emptied all three in short order.

A beekeeper we contacted said nobody would be interested; another said they would die of cold

We have also learned that you can move a hive about one metre a day, so it hasn't moved very far from the fruit tree where it started. We've learned that if they had not had a queen, they would have been much louder — more of a roar. Queened bees are happy bees and happy bees are quiet bees. We organized a landing platform just outside their entrance holes, and never tire of watching their comings and goings. They need that platform, too; some of them come in seriously overloaded and their landings are not pretty. They seem to know us, and put up with us getting quite close. ▶

Varroa strip in evidence. Lacing wire is to assist with comb alignment

A crash production line saw enough frames assembled to get us started

We organized a landing platform

Entrance hole should be small enough to defend

To save the bees from drowning we stuffed macrocarpa fronds into the honey as a ladder

Filling up the frames — bees busy generating comb

They emptied all three jars of honey in short order

The road to a happy hive

There is a legal requirement to register your hive, for a small fee, and there are a couple of things to watch out for: varroa mite and American foul brood (AFB). Varroa needs hitting a couple of times a season or you won't have a hive before very long. AFB requires yearly inspections by a qualified person — you can do a course yourself.

There is also colony collapse disorder (CCD), which may be wiping out about 10 per cent of New Zealand hives each year. Links have been suggested between CCD and an agricultural spray component that may knock out their homing capability; collapsed hives are empty except for the queen and a few juveniles. Hives do best in a sunny, sheltered spot, and entrance holes should be small enough to defend.

There are 32 species of native bee, and a host of other pollinators

There are some moral issues to consider. Honeybees were introduced into New Zealand, as were bumblebees. Besides those two there are 32 species of native bee, and a host of other pollinators. None of the latter needs hives and none of them has been weakened by human theft — they don't have the honey we steal. Just how many of the native bees and other pollinators have been displaced by commercial hives, though, and how much biodiverse acreage has succumbed to mono-cropping are questions with no good answers.

To bee or not to bee

It was easy for us to decide not to extract the honey — it's the bees' winter food — but not so easy to be sure we were doing the right thing in keeping bees at all. On one hand there is concern at plummeting global bee numbers. On the other, New Zealand has more hives per square metre than any other nation — the only greater density is achieved artificially once a year among the almond orchards of California — and there are all those others that were here first. We'll keep ours because we like them and because we have more than enough mixed growth to host a dozen hives.

We might start a conversation with our neighbours about planting bee corridors, past non-flowering paddocks to connect up with other bee-food areas. We also like the fact that we're helping pollination along.

I've learned that top-bar hives are fine for non-commercial or one-offs, and that they better emulate a naturally hanging hive. I've learned that traditional boxes stack and travel better. I've learned that bees don't like cold, so before winter I'm going to build an insulated lid, mount the hive a little further off the ground, and shroud it from the cold downhill (katabatic) evening air.

If nothing else, this experience has made us appreciate the amazing bee work that went into the honey we spread so casually on our toast. Beehive building would be a great community fundraiser or local production-run project — dare I suggest a working bee? — besides being fun as a one-off.

Plans are available as free downloads, well within sheddie range, and there are plenty of enthusiasts happy to mentor beginners.

Helpful sites

afb.org.nz/beekeeping-and-the-law

apinz.org.nz/new-to-beekeeping

biobees.com/build-a-beehive-free-plans.php

nzbees.net

nzbees.net/forums/topic/144-north-otago-bee-corridor

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BRING BACK THE CANE

WHETHER IT'S TO BE A GIFT FOR AN INFIRM FRIEND OR AN INDISPENSABLE AID IN NEGOTIATING A TRICKY TRACK, CREATING A WALKING STICK CAN BE A REWARDING PROJECT

By Coen Smit Photographs: Coen Smit

I've heard the refrain "Bring back the cane!" more than once from colleagues at our school during the Friday afternoon debrief, after yet another arduous week of attempting to impart our collective wisdom to the current generation. However, should you be outraged at the prospect of bringing back the cane, rest assured that is not the sort of cane that is the focus of this article.

Brought up on a diet of black-and-white television showing the exploits of Robin Hood and his band of merry men, I developed an early appreciation of the tall walking stick (staff) so deftly deployed by Friar Tuck at the expense of the Sheriff of Nottingham and his evil henchmen.

I developed an early appreciation of the tall walking stick (staff) so deftly deployed by Friar Tuck

During my teenage years my entertainment tastes expanded to include the TV series *The Avengers*. Who can ever forget the incomparable John Steed stepping down from his three-litre 1928 Bentley, complete with bowler hat and folded brolly, to come to the rescue of the delectable Emma Peel?

Turning the myrtle cane on the wood lathe

Varied uses

In the intervening years, walking sticks, hiking sticks, and the like have continued to draw my interest. At first glance it is tempting to see them as merely supports for the infirm in their declining years or those venturing into inhospitable environments where the extra support is warranted. I believe however that they are more than that. Apart possibly from a rock, they would likely have been the first and simplest survival-assistance device — that is probably a more accurate description of a stick's potential functions than the word 'weapon' — co-opted by our ancestors.

The Australian Aborigines relied heavily on message sticks in communicating with different tribes

The history of ancient and modern civilizations is littered with examples of sticks being used for a variety of endeavours. For example, until the advent of calculators, our own civilization relied heavily on a pair of carefully graduated sliding sticks called a 'slide rule' to undertake precise mathematical calculations. Even today, many hand tools are examples of modified sticks designed to fulfil a particular function. We take sticks for granted and underappreciate them dreadfully!

More than just a stick

An early example in my possession is the club that my grandfather brought back from Africa at the beginning of the 20th century. As you can see in the photograph (page 89), it handily extends the reach of the wielder and has the ability to deliver a solid hit from the knobbed end. Most likely it would have been used in the hunt, where its relatively light weight would also have been a bonus as its owner roamed the African plains in search of food.

The Incas used message sticks, called *quipus*, which had knotted lengths of string attached. These ▶

could be easily transported across the mountainous terrain of their empire and were used to convey vast amounts of detailed information for those conversant with the codes embedded in the strings.

The Australian Aborigines relied heavily on message sticks in communicating with different tribes across the continent and to provide safe passage through territories held by competing tribes. They are also known the world over for their development of the curved throwing stick, the boomerang.

Today, if you go to any cattle or sheep sale, or building site, you will soon appreciate that, even in our modern world, the stick in its various guises is still an integral and basic piece of equipment relied on by many of us to carry out our daily tasks.

The stick becomes a tool

When sticks are crafted for any of these varied purposes it somehow lifts them out of their simple designation as sticks. They become tools imbued with the sense of purpose and they go on to acquire a history and character of their own, as they accompany their owners on their daily adventures and fulfil the purposes for which they were created.

I decided it was time to pay homage to these simple but important devices — first, by building a lightweight gentleman's walking cane.

As a start, I purchased an art-deco brass cane handle from India via the internet. For the stem I opted to use a piece of Tasmanian myrtle.

I purchased an art-deco brass cane handle from India via the internet

Slide ruler

The timber dilemma

When choosing the best timber for your cane or hiking stick it becomes a trade-off between lightness and the ability to absorb uneven loads. Softwoods with larger profile grains such as macrocarpa and radiata pine are lighter but less durable. Hardwoods such as eucalyptus or Tasmanian oak are heavier but, as long as the grain is straight, will withstand more abuse. As suggested, laminating strips of softwood and hardwood can give the best of both worlds.

It has a nice reddish-brown colour and when I have used it in the past, my Lichtenberg burner (see *The Shed*, Issue No. 80) has made some lovely, delicate patterns on it. Although Tasmanian myrtle is not particularly renowned for its strength, this cane will be mainly a decorative item and subject to only light use, so that is not a drawback.

Making my cane

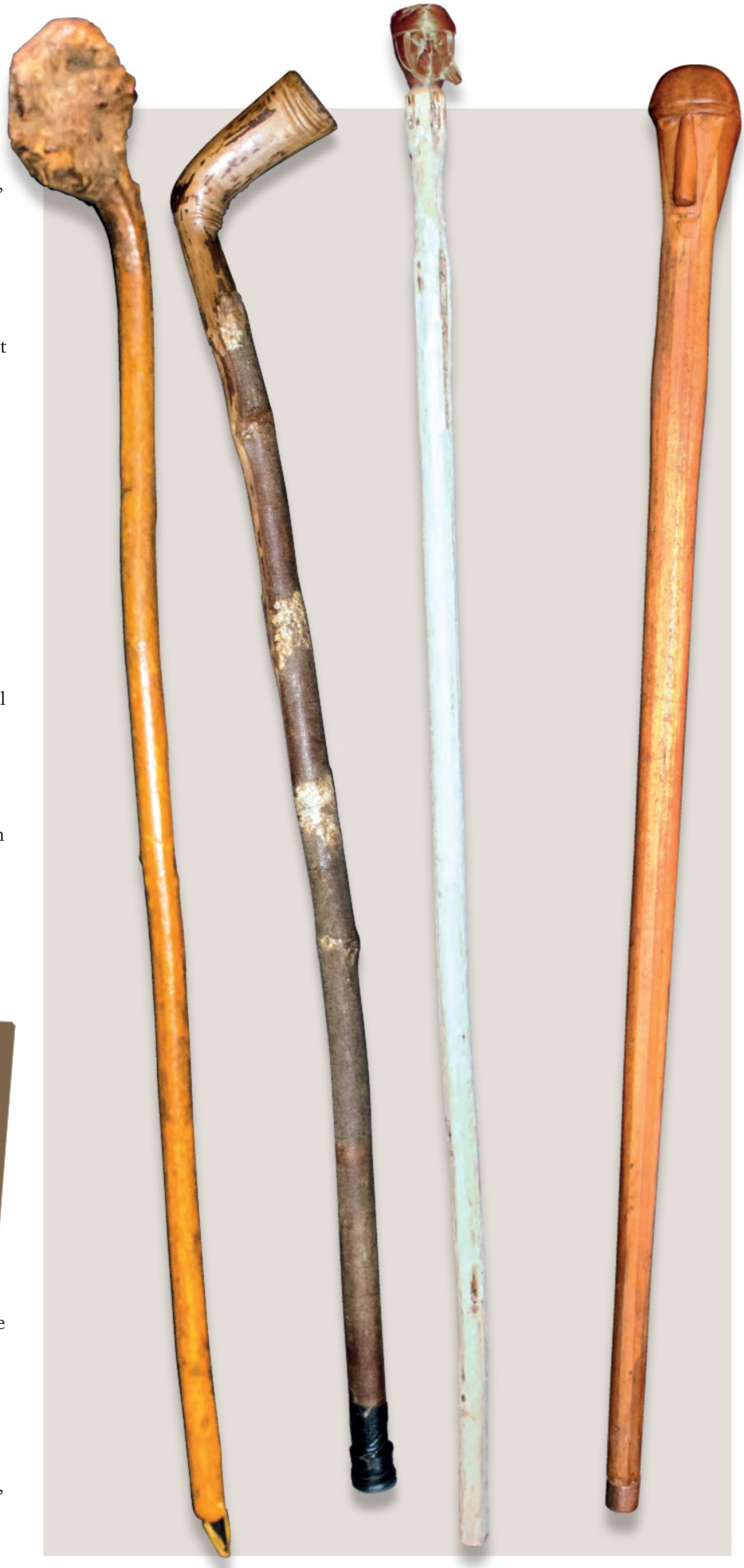
Taking a thin square piece of timber approximately 800mm long and turning it in a wood lathe does present some challenges, especially as you move towards the centre of the job.

To avoid breaking the timber and to minimize the flexing as the cutting chisel is applied, I planed the sharp corners off first and then made several gentle passes with the cutting chisel along the entire length of the stem to bring it down gradually. Once it was approximately round I used a flat file to further round off the stem and then ran 80-, 180-, and 320-grit sandpaper over it as it spun in the lathe. The result, although not a factory-perfect finish, was in keeping with the handmade look I like in my projects.

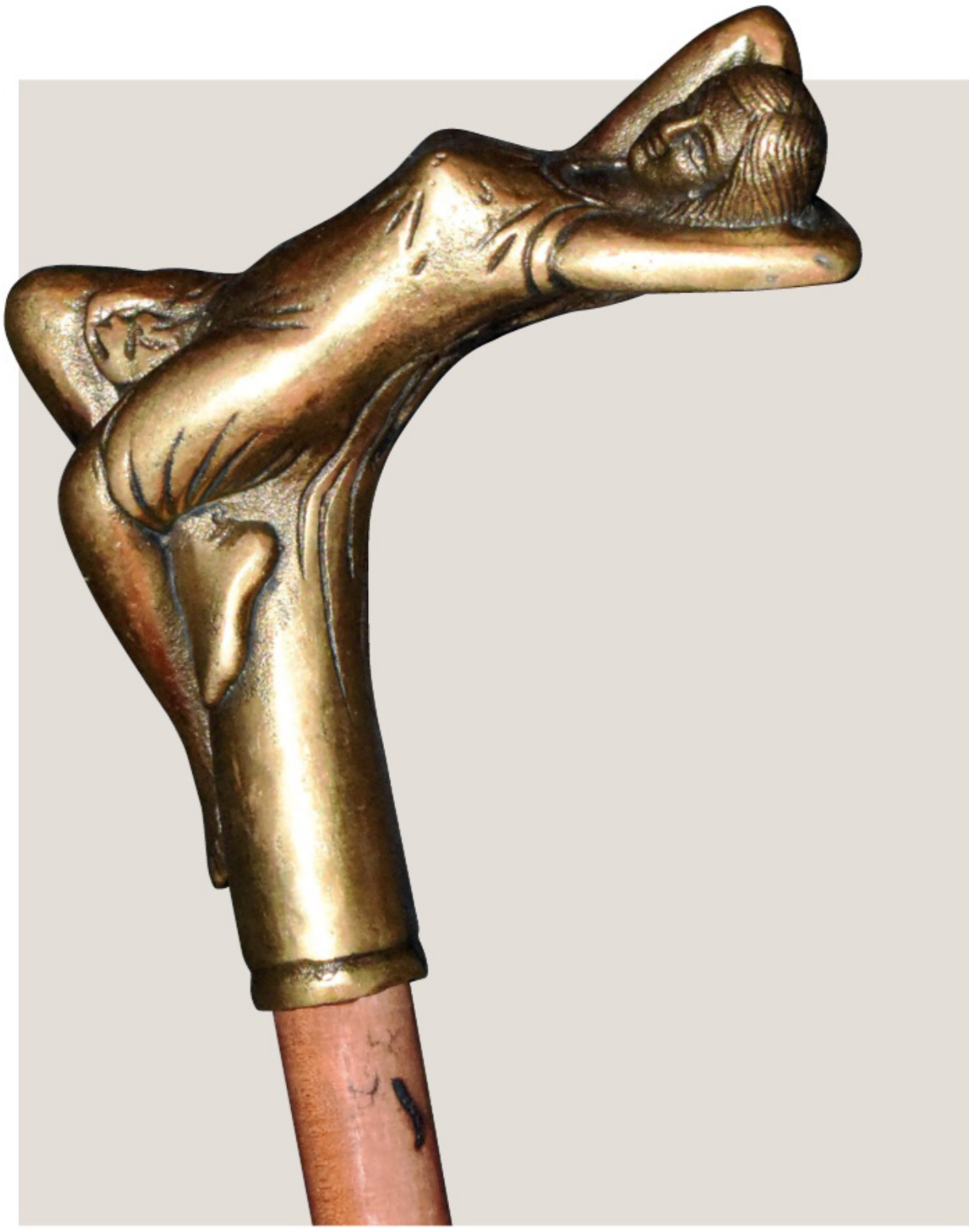
The result, although not a factory-perfect finish, was in keeping with the handmade look I like in my projects

Next, I brushed the stem with a diluted mixture of sodium bicarbonate for the Lichtenburg burn. I moved the probes part way along the stem and turned it around to create burns visible from whichever angle the cane is viewed. After another quick sand with 320-grit paper in the wood lathe, I mounted the handle and glued it on with Araldite.

As the cane may see duty on hard, polished floors I fitted a small rubber stopper to the base to provide grip. ▶



(From left to right) The African survival-assistance device souvenired by my grandfather, a simple walking stick made from horizontal scrub timber, hiking stick, and eco pine and myrtle laminated hiking stick



Close up of gentleman's cane

Brass handle with Tasmanian myrtle

My next project, I decided, should be a simple hiking stick

Personalize your cane

A home-made walking stick can make a wonderful present for an infirm friend; the commercially available versions are so bland and usually made from some nondescript timber or timber composite. A quick search online will reveal a great variety of tops, enabling you to choose something that will appeal to the recipient.

You can choose from a variety of timbers out of which to fashion the shaft or you could laminate thin strips of different species together. If you do not have access to a wood lathe, a good hand plane, a rasp, and files will also produce a nicely rounded shaft.

My next project, I decided, should be a simple hiking stick. This stick is expected to cope with rough tracks, and act as a support when crossing boulder-infested streams or climbing over and around rocks. It may be

Best size for hiking?

The overall dimensions of a cane or hiking stick should be guided by the user. As a general rule a hiking stick should be just a little shorter than the person using it. These sticks are not so much for direct support and will mostly be held with the arm outstretched and used in a lever action, therefore the hand grip can be lower than its top — around shoulder height.

Given the intended purpose of the stick, the diameter needs to be a little larger, around 25–30mm, than the gentleman's cane, which can be trimmed down to 20–25mm. The cane should be fitted, like a good shoe, so that it falls easily to hand. Allow a bit of extra length in construction so that it can be cut to the required height.

required to act as tent pole, to prod wood into an open fire, or even to flick away the odd reptile that might be lurking in my path. Therefore, it needs to be taller and sturdier than the gentleman's walking stick.

An important compromise must be taken into account. The hiking stick will spend long hours being held and carried; if it is too heavy and becomes a burden, the temptation will grow to discard it or leave it at home in the first place. However, if it is too light it won't be up to the job. These two competing factors must be weighed carefully when selecting a suitable material for the stick.

Light and strong

One choice is to select a straight sapling to build the hiking stick. A tall sapling will have spent time being subjected to wind stress while it grew, making the grain of the timber able to flex, thereby giving added strength when it is subjected to different loads. However, even a small sapling can be fairly heavy and feel cumbersome as well as be prone to splitting as it dries out.

I chose to use a small sapling of the species *Pomaderris elliptica*, more commonly known as 'dogwood'. It's abundant in my area and relatively light. However, it is prone to splitting as it dries and I would have preferred to submerge it in a stream for some months to let the sap leach out before using it.

This particular piece had already been lying on the forest floor for a while so I took a chance on it. However, within a day of my debarking it, long splits emerged, which I filled with a mixture of PVA glue, wood shavings, and sawdust in the hope that it will stop the splitting. Time will tell whether this is effective.

An alternative is to take a number of thin lengths of dried timber and construct a laminated beam that is then planed to the desired diameter. Not only will the laminations give strength, but by carefully selecting the way the grain runs in each length it is possible to build in extra strength. This method allows you to combine different types of timber to balance strength and weight, as well as visual appeal. I have previously made a hiking stick using this method and it has proved to be very robust.

Both types of hiking sticks will spend most of their active lives prodding muddy and rocky ground. To minimize damage to their bases I glued a 25mm section of steel pipe to the base. This protects the stick, and in the case of the stick made from the sapling should further reduce the likelihood of the timber splitting.

An alternative is to take a number of thin lengths of dried timber and construct a laminated beam

My unique finishing touch

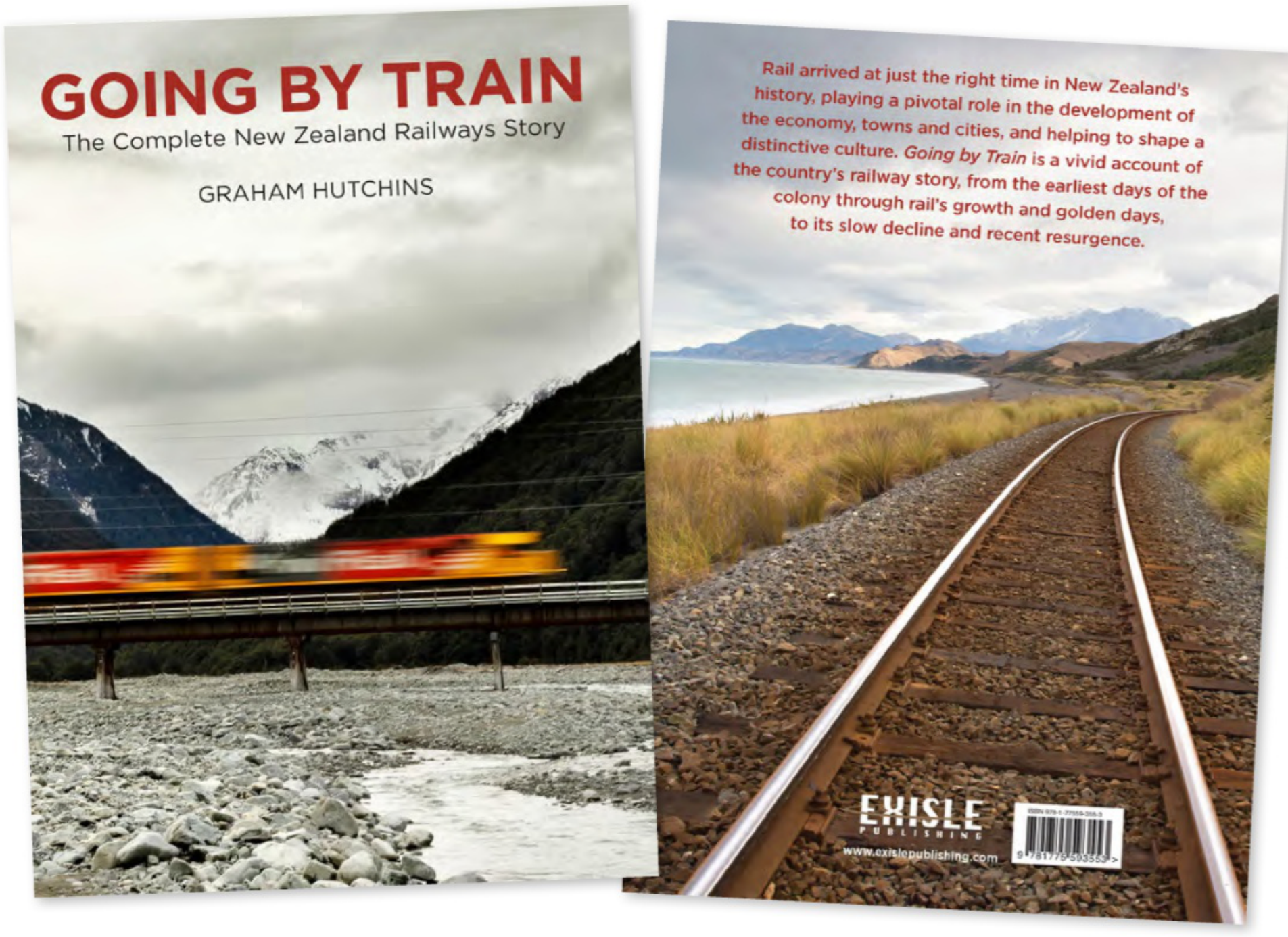
Of course, although an unembellished hiking stick is perfectly up to the task required of it, the enjoyment in constructing a hiking stick is in the details that can be carved or grafted on to it. Having recently delved into the realm of 3D printing, I decided to adorn my hiking stick with a suitable 3D-printed head.

Using PLA filament and searching the extensive archives of the Thingiverse website, I found a couple of nice alternatives. The 'desert head' I eventually settled on is compact, lightweight, and tough, making it ideal for adorning the top of the hiking stick. Unlike a cane, the hiking stick will not normally be held by its top. Therefore, the head can be ornate without its practicality being hindered. I then spent time with a hand plane, a file, and an orbital sander to trim the shaft to the desired diameter and reduce its overall weight.

At this stage my desert head hiking stick remains a work in progress, as I'm cautious about investing too much effort in it if it continues to split further as it dries. As mentioned before, allowing the wood to leach its sap in running water for some time is preferable although not always feasible. My wood glue and sawdust concoction appears to have done the trick so far, but it has detracted from the overall appearance of the stick.

Whichever route you choose to make a walking stick, you will find it a relatively simple project, requiring a minimum of tools, that will reward you with years of practical use.

The final gentleman's walking stick



GOING BY TRAIN: THE COMPLETE NEW ZEALAND RAILWAYS STORY

BY GRAHAM HUTCHINS

Review by Ritchie Wilson

Going by Train traces the development of the New Zealand railway system, from the first short lines servicing mines or running between cities and their ports, such as Dunedin to Port Chalmers, to the recent focus on rail as one way of reducing the country's greenhouse gas emissions.

The book traverses the difficulties of building railways through often extremely challenging country. For many years the longest sections of track were on the relatively flat Canterbury Plains.

The first section of track built south of Auckland was intended to supply troops if a new war with Waikato Māori broke out

The influence of Māori on the progress of the North Island Main Trunk (NIMT) railway is thought provoking; for instance, the first section of track built south of Auckland was intended to supply troops if a new war with Waikato Māori broke out.

A practical method of travel

A major focus is on the glory days of rail — the time between the opening of the NIMT line in 1909 and the 1950s, when competition from road transport began to bite. For many years, rail was the only practical method of travel in much of the country. Everyone went by train — from royalty on official visits to soldiers heading off to war.

It was surprising to read that shortages of suitable coal to fire steam locomotives was a major problem in the 1940s and early 1950s, causing trains to be cancelled and coal to be imported. Oil-fired locomotives, using imported oil, and the change from steam to diesel power in the 1960s and early 1970s removed the dependency on local coal as well as making the job of a locomotive fireman much easier.

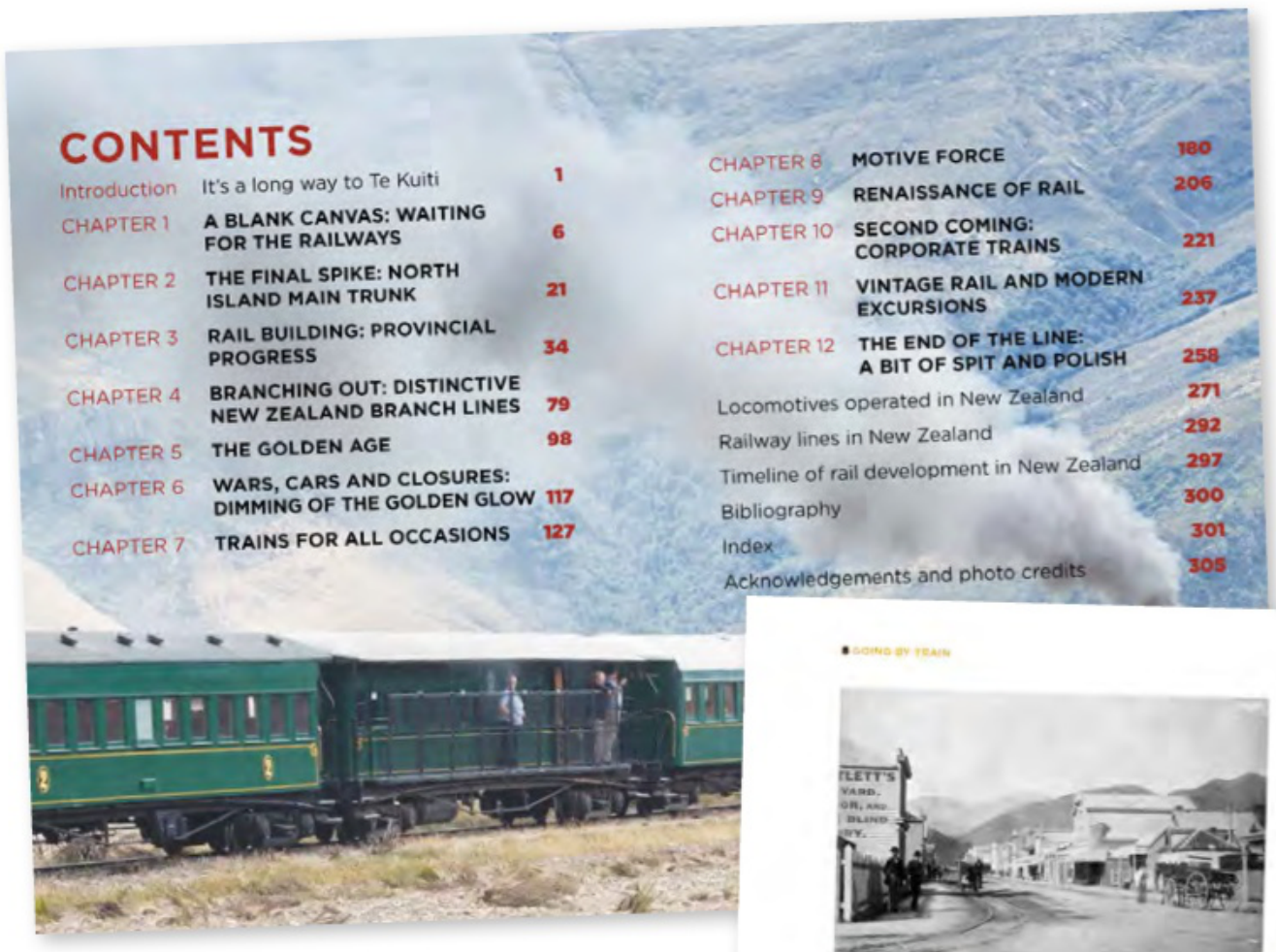
A 'railhead' is the furthest point reached by a railway under construction. I hadn't realized before that towns such as Graham Hutchins' hometown of Te Kuiti were once railheads and so enjoyed temporary eminence. Springfield in Canterbury was for more than 20 years the terminus of the line planned from Christchurch to Greymouth and enjoyed an importance that today is hard to visualize.

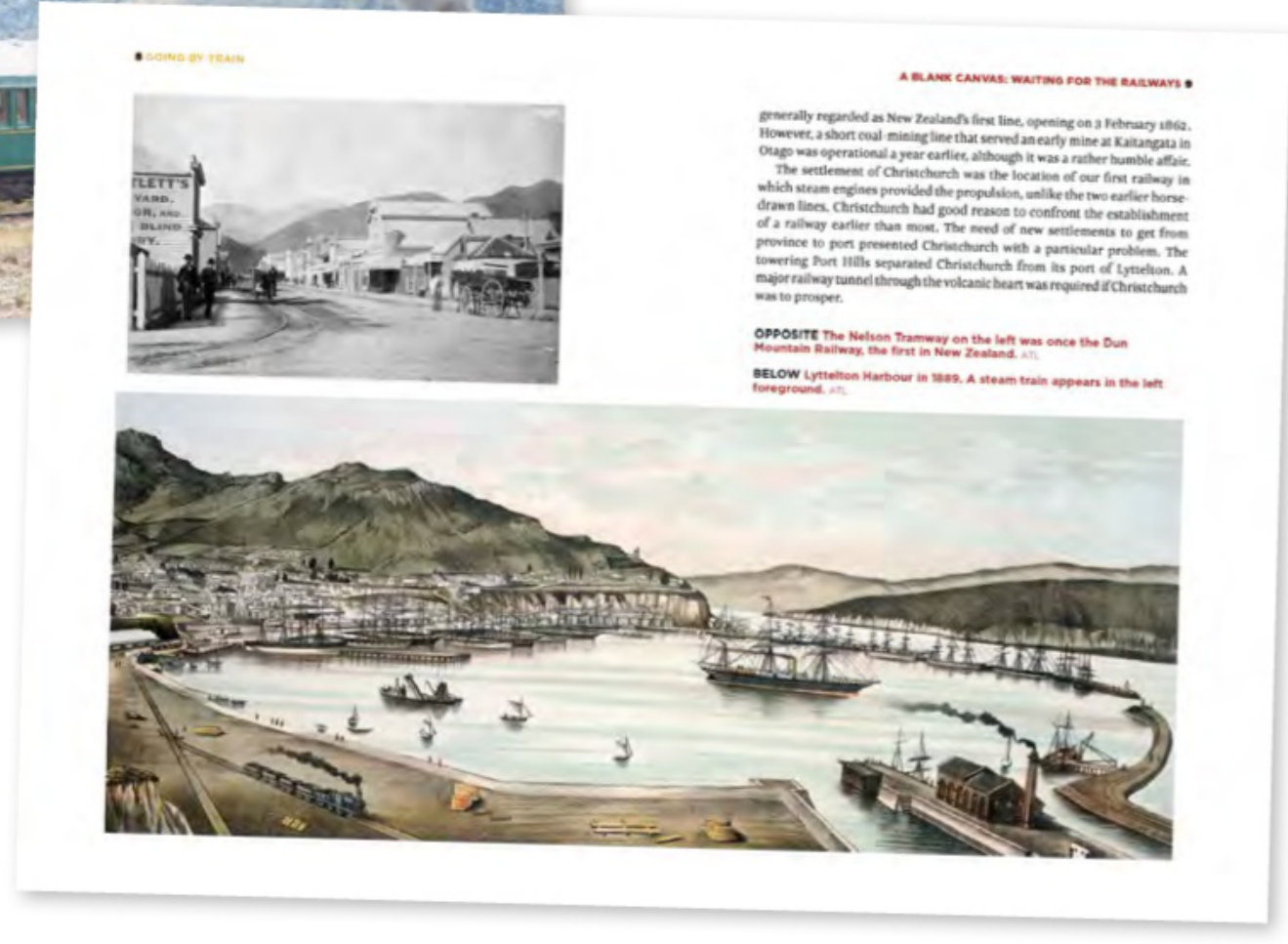
The many text boxes throughout the book contain tall tales of poor behaviour that span the history of rail travel, as well as the reminiscences of driver Dave Simpson and of the author.

Books for railway buffs

This is an enjoyable book, written in a racy, conversational style. It is filled with evocative and beautiful photographs and has an excellent index. The final pages include a chronology of railway developments since 1863, a list of the locomotives that have operated on the national railway network, and another of the various New Zealand lines, many long closed.

There is a useful bibliography (five of the volumes by Graham Hutchins) including Neill Atkinson's *Trainland* (2007) and Gordon Troup's *Steel Roads of New Zealand* (1973). There are no maps, and the locomotives aren't given their Whyte wheel designation, which would have given a better idea of the less familiar locomotives from New Zealand's past.




GOING BY TRAIN

A BLANK CANVAS: WAITING FOR THE RAILWAYS

generally regarded as New Zealand's first line, opening on 3 February 1862. However, a short coal-mining line that served an early mine at Kaitangata in Otago was operational a year earlier, although it was a rather humble affair.

The settlement of Christchurch was the location of our first railway in which steam engines provided the propulsion, unlike the two earlier horse-drawn lines. Christchurch had good reason to confront the establishment of a railway earlier than most. The need of new settlements to get from province to port presented Christchurch with a particular problem. The towering Port Hills separated Christchurch from its port of Lyttelton. A major railway tunnel through the volcanic heart was required if Christchurch was to prosper.

OPPOSITE The Nelson Tramway on the left was once the Dun Mountain Railway, the first in New Zealand. ATL

BELOW Lyttelton Harbour in 1869. A steam train appears in the left foreground. ATL

I hadn't realized before that towns such as Graham Hutchins' hometown of Te Kuiti were once railheads and so enjoyed temporary eminence

Book info

- Published by Exisle Publishing
- 2019
- Hardback
- 307 pages
- RRP $59.95

GETTING STARTED — A GUIDE TO MICROPYTHON

TAKING A FURTHER STEP INTO THE WORLD OF PROGRAMMING

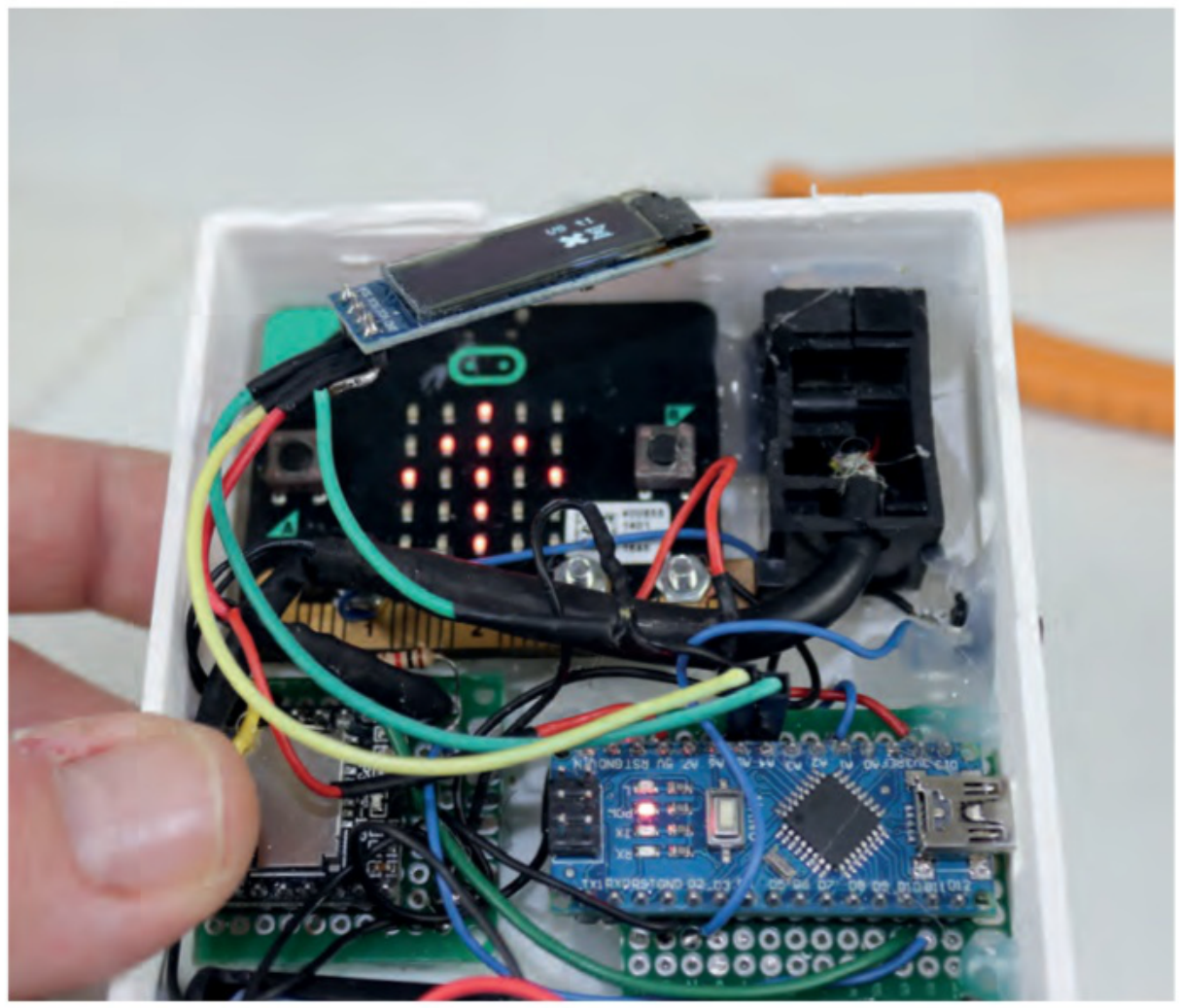
By Enrico Miglino Photographs: Enrico Miglino

In the Making a Music Box article in Issue No. 89 of *The Shed* we saw that it is possible to use the BBC micro:bit in conjunction with other boards, in that case an Arduino Nano, to accomplish complex tasks.

We developed the micro:bit software using the standard graphic tool available on the site; the language behind the graphical interface for programming the micro:bit was Javascript.

An easy way to programme with blocks and learn coding is to check the Javascript programme corresponding to the graphic blocks of code. However, when going deeper into the use of micro:bit, making projects more complex, this method becomes less user-friendly. The process we followed to programme the micro:bit with the blocks language can be summarized in four steps:

1. **make the blocks programme on the browser**
2. **eventually, see the Javascript source and edit it**
3. **download the compiled programme for the micro:bit**
4. **copy the downloaded file to the micro:bit.**



At the top of this close-up of the first prototype is the micro:bit — the core of the electronics — and at bottom right is the Arduino Nano, which controls the MP3 player

Obtaining certainty

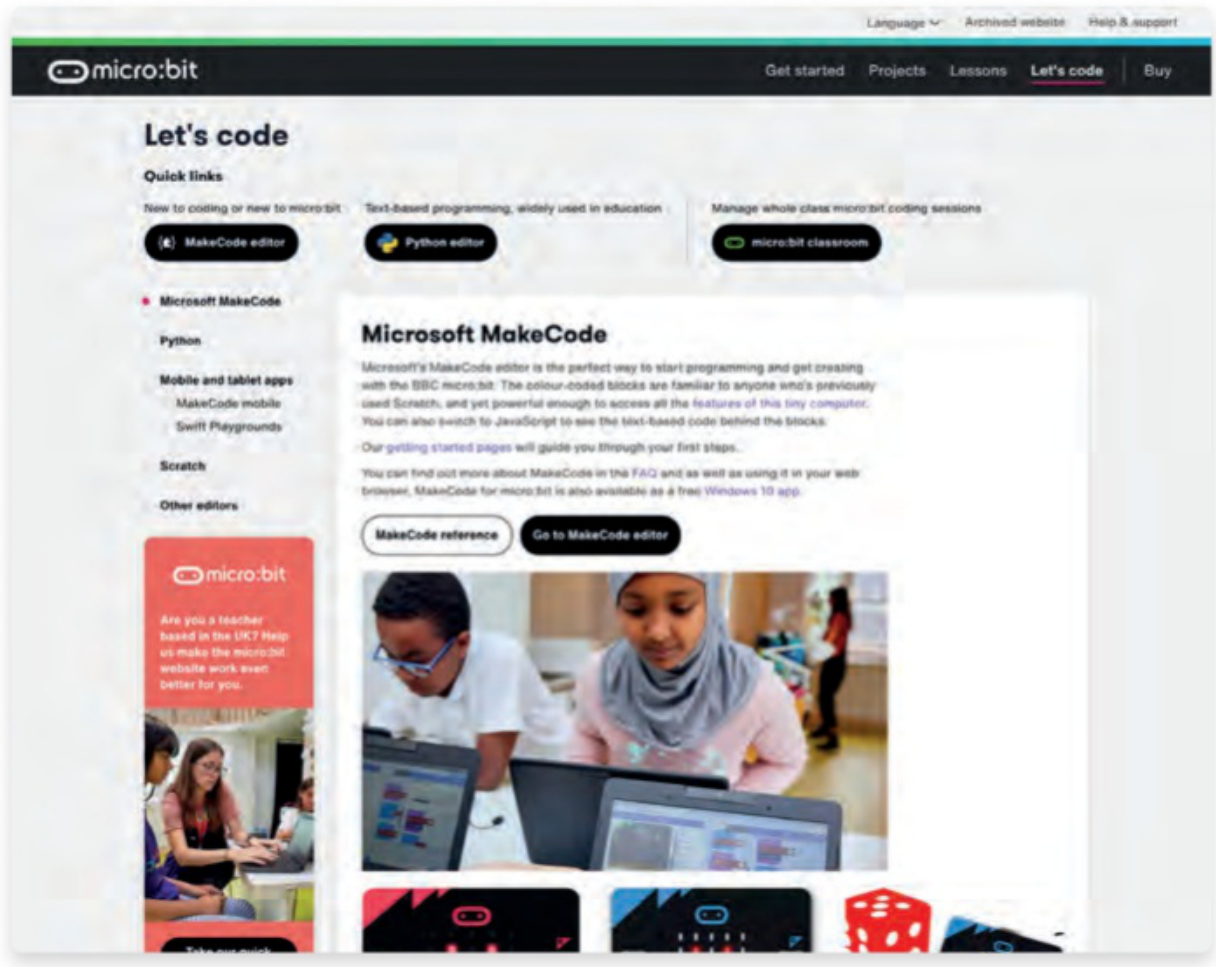
This procedure is very easy but does not give us full control of the programme's life cycle.

In this issue we will move a step further and start developing something more consistent. As with most microcontroller boards, the micro:bit can be programmed with more languages; the two most important options are C and MicroPython.

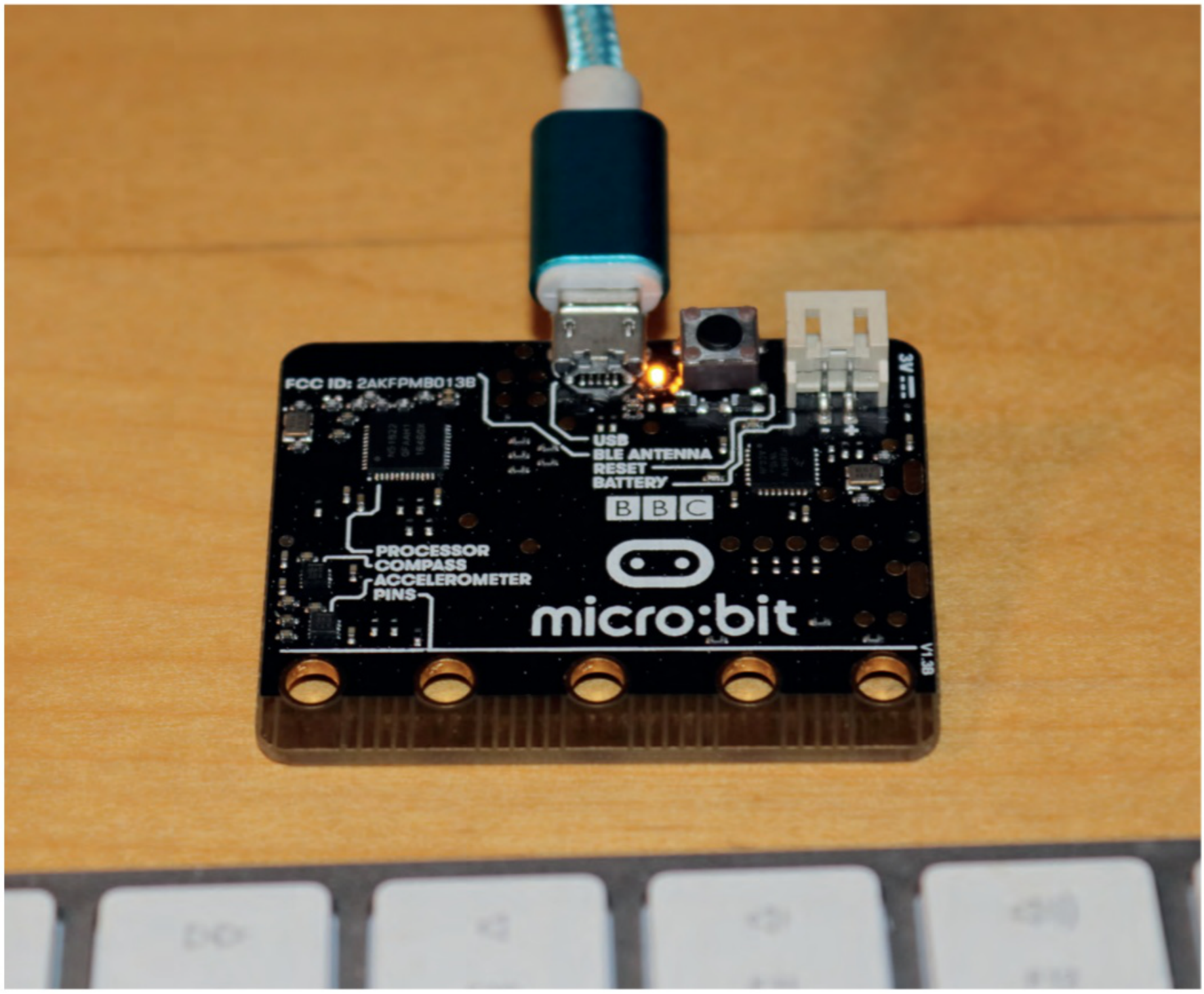
A view of the Ingegno Maker lab during a user activity. The project described in this article was born in this creative laboratory, as were many other creative buildings, a number with educational purposes (http://decreatievestem.be/voor-jongeren/)

When going deeper into the use of micro:bit … this method becomes less user-friendly

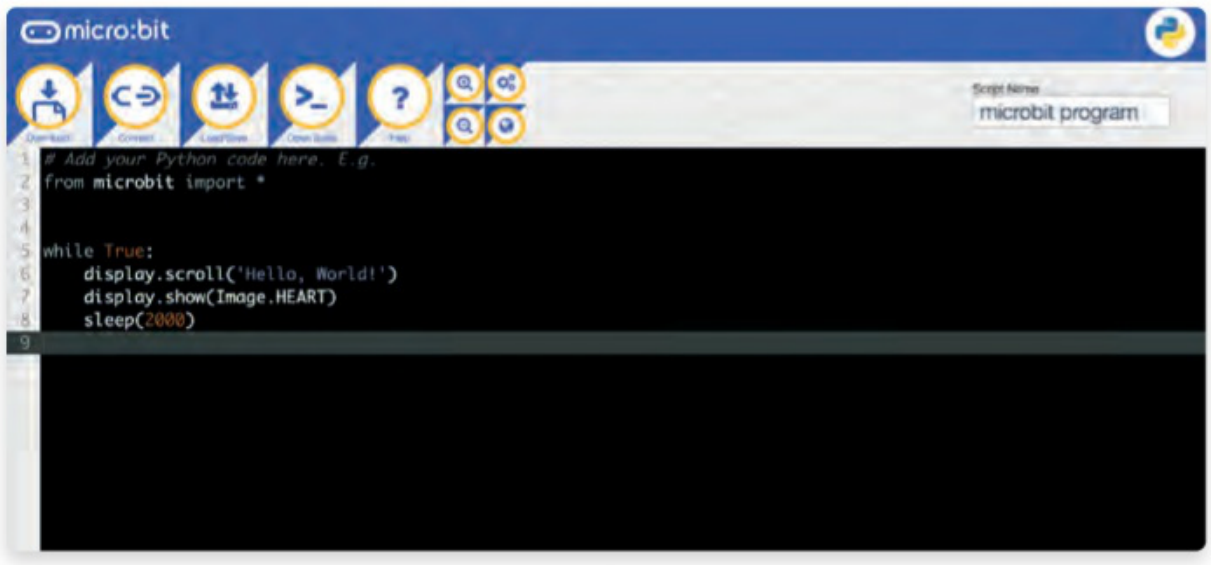
The software development life cycle with the block language is a script language; the programmer can only write his own code in the browser. The code source is then stored in the micro:bit Cloud. When the user presses the download button on the web-based Interface Development Environment (IDE) the Cloud-stored programme is compiled on a remote server and the binary executable file is downloaded locally on the host computer. ▶



The official micro:bit home page, where you can start coding and creating your software. The programme is compiled remotely and — as you can see in the image —the Python language is also supported



A close-up of the micro:bit connected to the USB cable for programming



The online editor offered on the micro:bit site. Coding with this method is useful for educational purposes but the user who wants to go further encounters the limitations of this system: the compilation is remote and the view of the development's life cycle is partial

Connecting the micro:bit board to the computer through a USB cable, we see removable storage, like a USB memory stick. The file downloaded from the Cloud should be copied into this folder so that the micro:bit can install it and the programme will run.

Note that the only option we have to save the source files is to switch the browser view to Javascript, then copy and paste the programme into a plain text editor and save the Javascript file.

Develop your own software

The most interesting alternative to this method is developing our own software using the MicroPython language and the Mu editor.

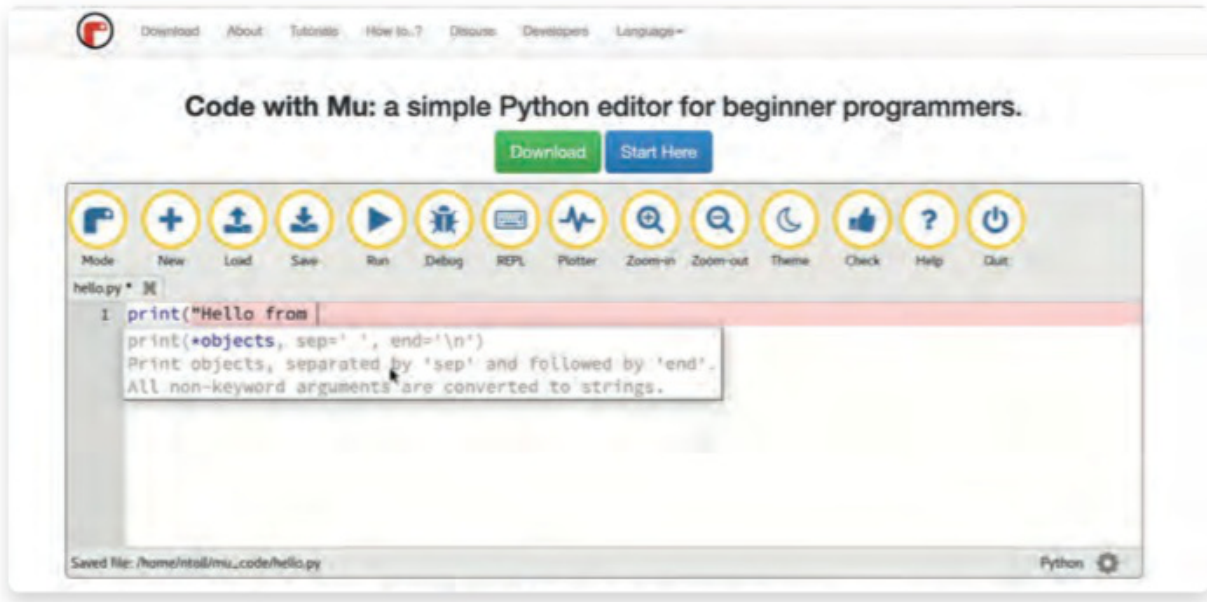
MicroPython is the implementation of the popular and easy-to-programme Python language optimized for microcontrollers. It includes a full working compiler and a runtime that works on many microcontrollers, including the micro:bit board. Many of the most popular Python libraries have been ported to MicroPython, as have specific libraries to interface the hardware features of the supported microcontrollers.

MicroPython (micropython.org) is written in C 99 and is distributed as a fully open-source platform.

Developing with MicroPython: the IDE

The MicroPython language is also supported by the web interface provided by micro:bit but in this case the platform poses some limitations and simplifications that are not necessarily useful.

The projects we will present in the micro:bit section of the upcoming issues of *The Shed* are all based on MicroPython; it is worth treating this issue's column as a 'Getting started' guide to MicroPython for micro:bit programming.



The Mu editor home page (https://codewith.mu). Extremely simple and well documented, this multiplatform IDE has been built to support MicroPython development. It has a lot of useful features created just to work with microcontrollers such as the micro:bit. This open-source application supports many platforms. The platform only shows the features available for the specific microcontroller the user wishes to use

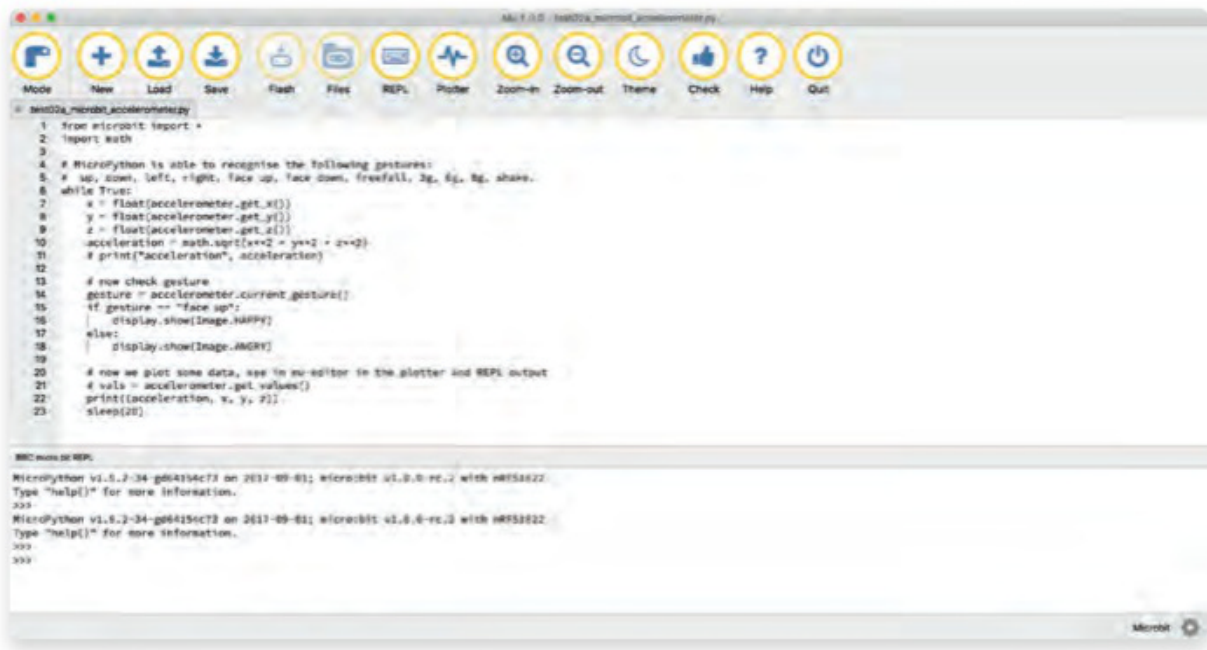
The Cloud-stored programme is compiled on a remote server and the binary executable file is downloaded locally on the host computer

As expected, to programme a microcontroller we need a computer to write the source code, compile it, and send it to the microcontroller.

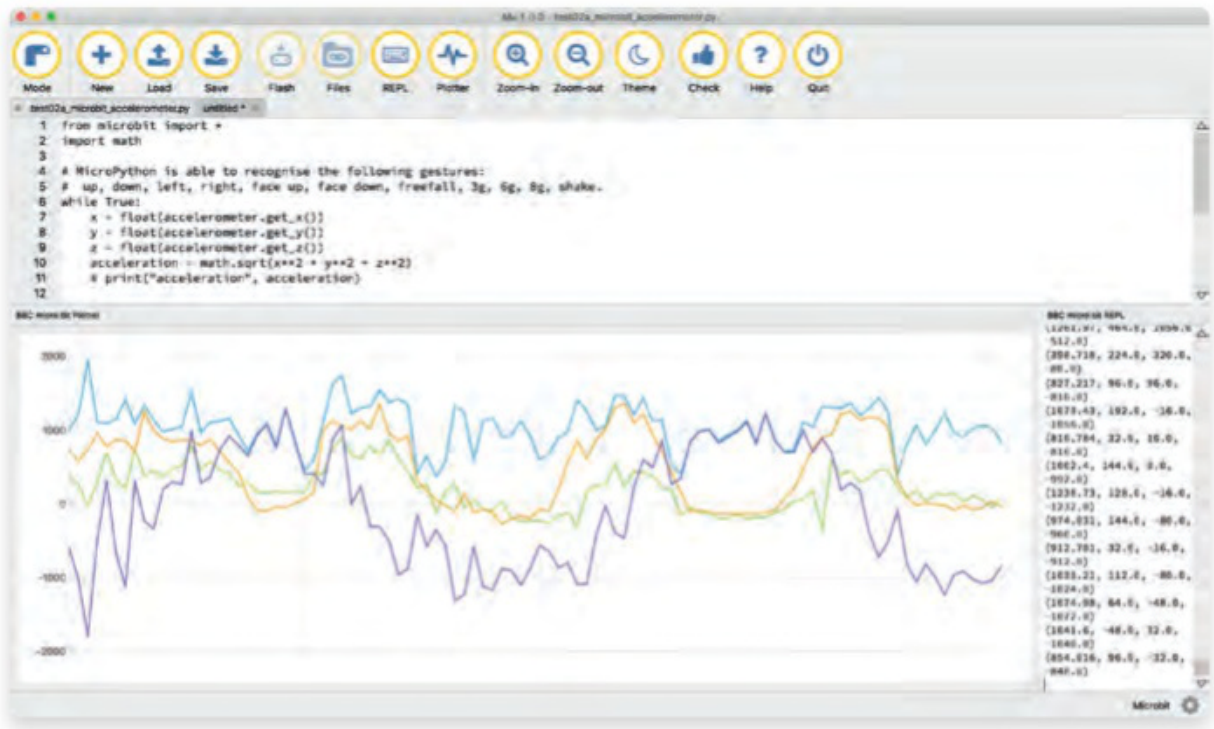
In the case of the micro:bit we will use the USB port. The best solution is an IDE that includes a complete development environment for our microcontroller; for this reason I suggest you install Mu editor — this is a multiplatform application compatible with Windows and Mac computers and available as a portable version — and a Python package, compatible with the Raspberry Pi.

Mu includes all the resources and components to cover the entire life cycle of the MicroPython development, from coding up to compiling and sending the binary file to the microcontroller. The Mu editor and IDE for the micro:bit can be downloaded from the official site: codewith.mu.

Projects in upcoming issues will provide step-by-step details on how to use and get the best results from MicroPython development for the BBC micro:bit in the Mu editor environment.



While the 'Print' Python command has no effect when used alone in with micro:bit, the command produces an output on the Python console shown by the Mu editor when the programme runs and the micro:bit is connected to the IDE. This is especially useful for debugging the programmes



Using the Python 'Print' command in a script, the micro:bit can be used, for example, for data collection. Printing series of values — in this case the variable with three-axis acceleration values along the time — the Mu IDE can show the numbers in a column while plotting the graphic showing the values trend during a period of time

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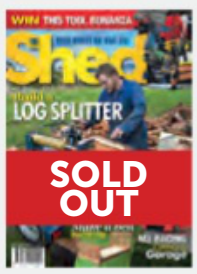

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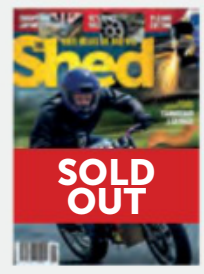

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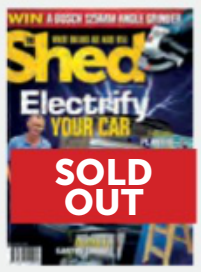

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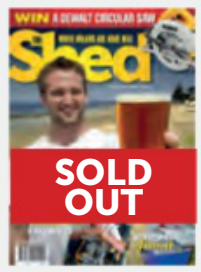

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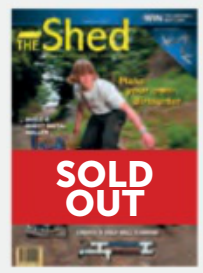

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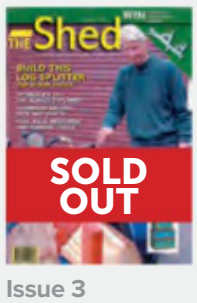

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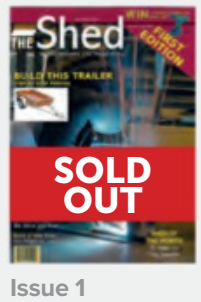

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ANCIENT CRAFT BRINGS NEW LIFE

I WENT DOWN TO LAWRENCE WITH THE POTENTIAL OF FINDING SOMETHING TO DO WITH MY LIFE AND CAME AWAY WITH THE KNOWLEDGE THAT I'D FOUND IT

By Nathalie Brown Photographs: Brian High

Rod is part way through the process of warping up 90 metres of lambswool plaid. At left in the foreground, part of a tappet loom; in the background a dobby loom — one of only two operational in the world. Behind Rod, the green and yellow yarn on bobbins.

The descendants of George Hattersley of Keighley, in England, might have had Rod McLean of Oamaru in mind when they developed the Hattersley Domestic Weaving System in the late 19th century.

Hattersley looms, as they became known, became especially popular in the UK after World War I when servicemen returned shell shocked and otherwise disabled. This domestic weaving system allowed them to earn a living at home without having to work in the fraught environment of mills and factories. The Hattersley looms were, and still are, also used to weave the original Harris tweed.

Rod suffered a trauma that affected him in a way that was similar to the WW1 soldiers' shell shock. He was felled by a brain aneurysm in 1988 and the injury left him unable to continue his work as a self-employed plumber. Thirty-one years after the assault to his brain and the chronic fatigue that came with it, he still needs to take particular care with his health.

Providential find

In 2005 one of Rod's friends found a Hattersley loom system for sale in the small Central Otago town of Lawrence and suggested it might help Rod with his rehabilitation. Rod and his wife Sue were enthusiastic about the prospect.

"I went down to Lawrence with the potential of finding something to do with my life and came away with the knowledge that I'd found it," Rod says. "I fell in love with the simple mechanics of the looms and knew that I wanted them."

The next year, same sheep, different yarn because of different climatic conditions and feeding regimes

When Rod first saw the weaving system, the machines were assembled except for the dobby loom — a separate machine that extends the number of possible patterns. The other parts of the weaving system — the warping mill, bobbin winder, and pirn winder — were on separate pallets and he carted them to Oamaru on a truck ▶

Once it has been darned the fabric goes through the fulling process where it is soaked in warm soapy water and repeatedly compressed between wooden rollers until it has the right “handle” or finish.

Fabric is immersed in the warm water bath

and trailer. There was no instruction manual and almost no online presence at the time.

At first Rod and Sue installed the looms in the space above The Oamaru Textile Emporium (TOTE) in Oamaru's Victorian precinct.

"The woman who sold us the looms, Vallory Brook, came up from

Lawrence, showed me how to warp up the loom, and taught me the basics," Rod tells us. "She gave us some yarn and I began to teach myself to weave. I worked from TOTE for about 14 months but then our youngest son, Lachlan, died and it all became too much, so I stopped for some time."

The loom comes home

Rod and Sue decided it would be better for him to work from home, so

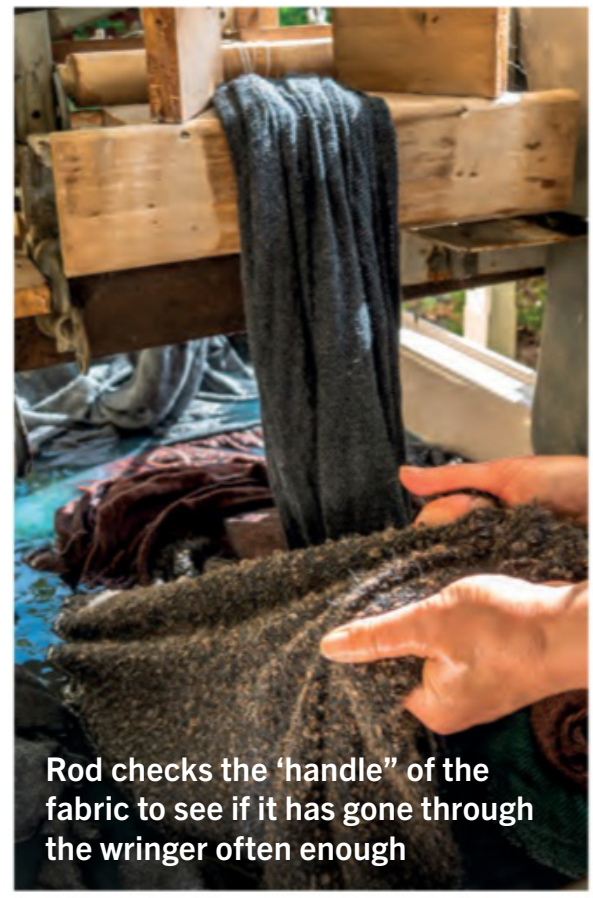
he built a 9x6-metre shed opposite their back door and installed the

Hattersley system there at Christmas 2009.

The 19th century weaving system is intriguing, but then so are other tools and processes Rod uses — such as the hospital bed, the bath, the wooden roller attached the frames of the sash window near the top of the 11-foot ceiling stud in the McLean's living room, and the three-day stoking of the log burner in the same room. Wait; we're coming to all that.

"The first step in the weaving process involves making decisions about the design and use of the fabric," explains Rod. "Then, using the bobbin winder, the yarn is wound from the cones onto the bobbins I use to thread up the warping mill.

"Every warping is different. Every yarn is different. You can have one year's shearing off a particular sheep and get that spun up. The next year, same sheep, different yarn because of different climatic conditions and feeding regimes. That gives different tension and smoothness. So much is trial and error." ▶



Rod checks the 'handle" of the fabric to see if it has gone through the wringer often enough

It's slow, methodical, soothing work and it suits Rod just fine

The fabric is compressed through wooden rollers

He checks this time and again to be sure he gets the right handle

The Hattersley Domestic Weaving System

George Hattersley & Sons Ltd of Keighley, England, designed this domestic weaving system in 1895. The firm had designed full-width looms since 1789, and made every type of loom and a vast range of associated textile equipment until the company closed in 1981.

Not much is known about the history of the Hattersley domestic loom, which combines all the know-how of 19th century loom engineering into a compact cast-iron format. Initially, it has been said, they were developed for markets overseas in the British Empire. However, it was the Harris tweed industry that adopted the Hattersley domestic loom in the greatest numbers.

The first 30 of the looms were sent to the Outer Hebrides in 1919. These were 36 inches in the reed space and single shuttle. In 1924 the first six-shuttle, 40-inch reed space looms arrived in Stornoway and this type of loom was the most commonly used in the islands, possibly to this day.

People talk about the Hattersley Loom, but to be correct the loom was just one part of the Hattersley Domestic Weaving System — consisting of a loom, a pirn winder, and a warping mill. Indeed, over the years there were several developments, although the underlying concept stayed the same.

Each loom was assembled at the Hattersley works in Keighley to ensure all the parts worked properly. Then, before being dismantled for shipping, the various parts of the loom were numbered and marked with paint in order to make it easier to assemble it later. The loom was then placed in a crate and on arrival at its destination was unpacked and assembled with reference only to a simple guide.

Hattersley aficionados will tell you never to give your loom a nice fresh coat of black gloss paint, as you will obliterate the assembly marks. Also, you should never try to lift the loom in one piece from its top with a winch — it was never designed for that.

The basic Mark I loom is treadle operated and the amount of effort to start the machine from rest and to keep it in motion varies from loom to loom, depending on how well it has been erected and tuned.

Basically, no two looms feel the same to weave on — each has a distinct personality — and that is part of their charm.

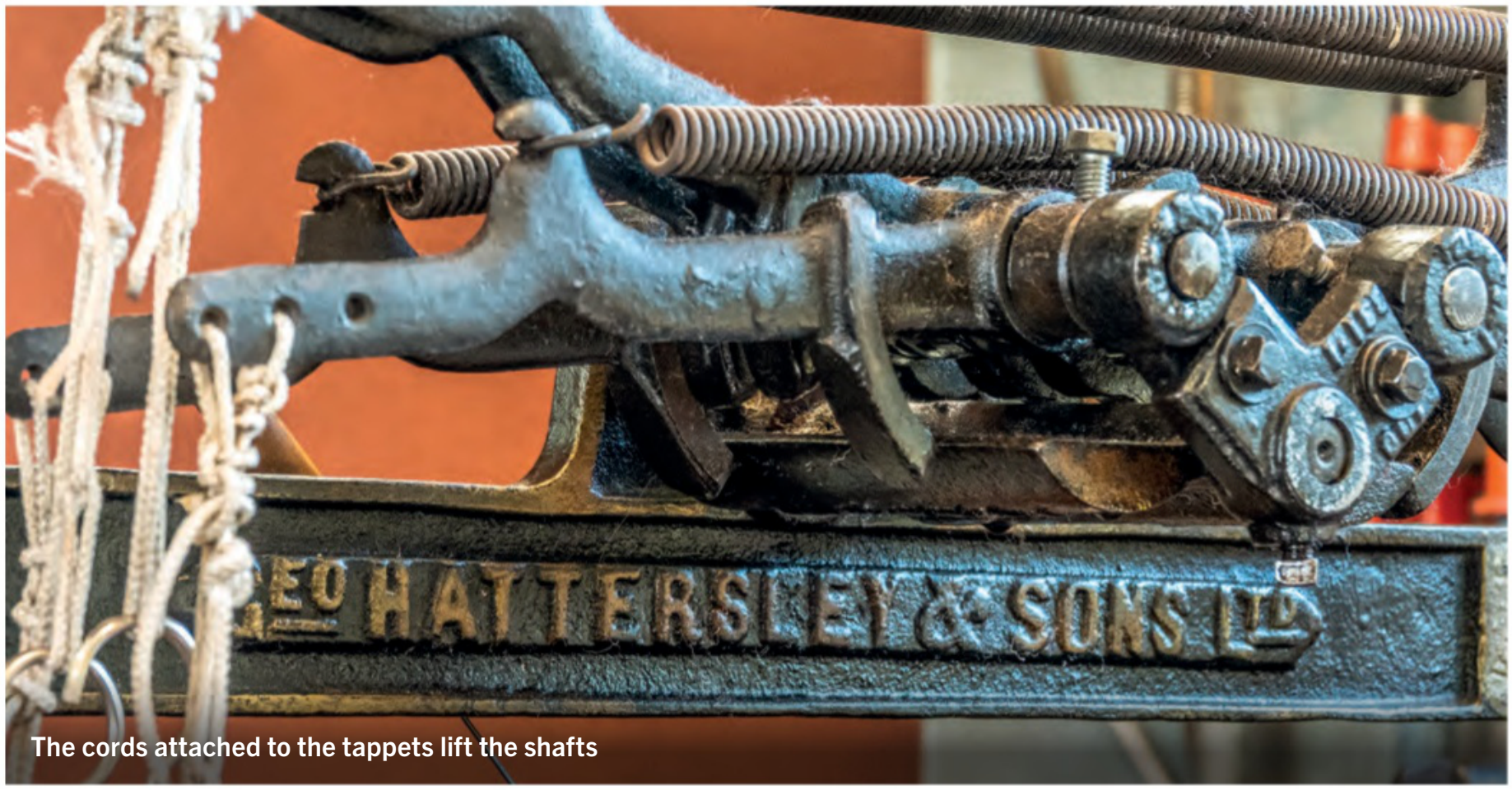
Most looms have four shafts and a set of four 2/2 twill tappets and four plain weave tappets. However, the spare parts catalogue shows a huge range of five, six, seven, and eight pick tappets in the most wonderful shapes.

Hattersley also developed a dobby loom, although it was never very popular. Rod says his dobby is one of only five known in the world and the only one that's operational.

"It extends the number of shafts you can use from 4 to 12 and takes the possible number of patterns you can weave to about 4000."

Some take the view that the dobby was hard to pedal and that this accounted for its lack of appeal to the weavers. The more likely explanation is that in the Harris tweed industry most of the tweeds are woven using standard lifts, so the flexibility of the dobby simply was not required.

The Hattersley system is a fine set of machines that in the hands of a skilled weaver like Rod can produce beautiful textiles.



The cords attached to the tappets lift the shafts

One of the two tappet looms with a rotary shuttle box in the foreground, which allows the weaver to create stripes in the fabric automatically

$2 well spent

Rod spends days warping up the loom, and weeks weaving the traditionally inspired tweed or tartan fabric — or variations on these. It's slow, methodical, soothing work and it suits Rod just fine.

Once the fabric has been woven it is hung over a roller, which hangs from the ceiling of the shed. A strong light is trained on it to check for faults, which are remedied by hand with a darning needle, a process that takes between 8 and 12 hours.

Now for the bath and the hospital bed. When Oamaru's old hospital was demolished the iron-framed beds were sold. Rod got one from the local recycling centre for $2. He uses the bed as a cradle for the bath.

The washing process involves filling the bath with lukewarm water, washing soda, and detergent, then placing the woven fabric in the bath and feeding it through wooden rollers multiple times until it has the right 'handle' — a term used to describe how the fabric feels when handled. Rods says wood works best with wool. Rod does a final rinse and spins out the fabric in the home washing machine.

We're still afloat, which is pretty good because I'm told the first two years are the hardest

"Then I take the wet fabric into the lounge and stretch it onto a wooden roller, which looks like a giant cotton spool and is attached to the top of the bay window frame, where it dries with help from the sun and heat from the log burner.

"I love every part of this work," Rod mentions. "I do it every day. Because I'm still living with chronic fatigue, each job just takes the time it takes. I don't work to tight deadlines."

Rod acknowledges that he has a really good mechanical mind, but says his weaving technique is still in the refinement process. ▶

A wooden shuttle encases the pirn with the yarn wound onto it

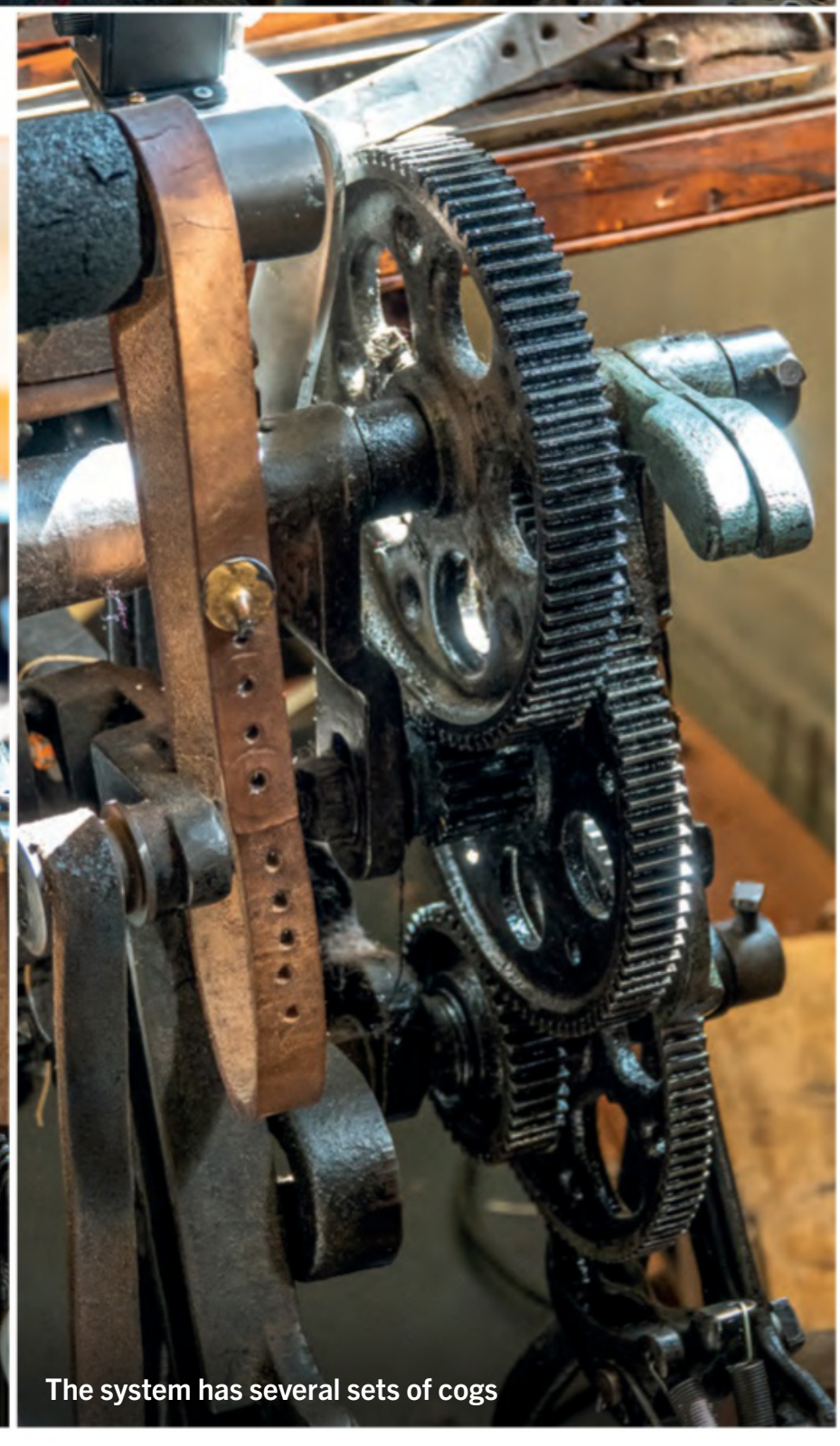
Rod weaving

The loom pedals

Rod made the two kauri shuttles on the left

The warp coming off the back beam and through the shafts

The shafts on the dobby loom



The system has several sets of cogs

Rod checks the warping mill

He adjusts the counter to zero in preparation for winding the next section of the warp onto the mill

And ties threads of yarn

A few years ago, their children gave Rod a birthday gift of a piece of railway sleeper and a plaque engraved

Rod's shed from the garden

The wet, fulled fabric is wound around the drying roller in the bay window of their lounge. The curtains woven on the Hattersley loom can be seen in the background

Niche market

While Rod is weaving in his shed, Sue is inside taking care of everything else that makes their handwoven textile business tick. She resigned her full-time teaching position five years ago to concentrate on McLean&Co., although she still teaches part time. Her role is developing, making, and marketing the products, and handling the paperwork for the business.

Bespoke weaving is a precarious pursuit, but the McLeans have found a niche among sheep farmers who want to have their wool clip transformed into custom-made drapes, upholstery fabrics, throws, and cushions. At the moment it's not a big niche so there's plenty of room for it to grow.

"At present about half our income comes from commissions," Sue tells us.

"In addition to the really big undertakings, we have worked with wool growers to design and weave their own tartans and tweeds, with a handful of fashion designers, and with retail outlets with ranges of scarves and wraps. We have also woven metres of fabric for people with individual textile needs."

McLean & Co have been in business nearly five years and, says Sue,

"We're still afloat, which is pretty good because I'm told the first two years are the hardest. Now when we go to regional markets people recognize us and our wares; people are talking about our textiles.

"Part of our business ethos is to give back to the community, and we do this though supporting local organizations and initiatives such as Crafted Artisan Gallery, a collective of 16 Waitaki artisans in Oamaru's historic precinct. It's proving to be a really good way for creative people to get their names known and to earn a regular income."

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STAYING IN

IS A PARKING OFFENCE REALLY DESERVING OF THE ULTIMATE PUNISHMENT?

By Jude Woodside

Things are getting more serious by the day.

I am a trifle concerned because I am the target host of this virus: old and immune compromised. I had planned to make some sort of spacesuit that would recycle my breath and maybe turn my urine into drinking water or even, with the judicious application of hops, sugar, and yeast, 'falling down water' — something I could face the world in without having to be 'of' the world. I figure it would come in handy later in the year, too, assuming we avoid the apocalypse, when the political canvassers turn up.

I used to think that confinement would be great — it would allow me to catch up on all those books I have been meaning to read —but then I remember what it's really like.

Time in the pokey

Years ago, as a callow youth in Sydney with a fistful of unpaid parking tickets, and being somewhat short of funds, I took advantage of a quirk in the Australian justice system that allowed you to cut out your fines in return for a short spell in the lag.

I had pre-booked with the local constabulary and was told that the value of my fines would take roughly 48 hours to account for. So, equipped with several packets of fags and a few good books that needed to be read, I turned up on a Friday night to my local wallopers office and handed myself in. *How bad could it be?* I thought, and indeed, it wasn't so bad the first night.

The local constabulary suggested they would send me to the local remand centre, which I wasn't all that keen on; the idea of mixing with real criminals hadn't actually occurred to me, but the cops assured me it was a holiday camp with pool tables, etc.

Nevertheless that night, while

The idea of mixing with real criminals hadn't actually occurred to me

interesting judging by the noise, passed unremarkably other than for the appalling tinned food they served me. I remained alone and uninterrupted all night. I managed to read the first book by the next morning, *The Power and the Glory* by Graham Greene. I had also managed to get some sleep in spite of the lively goings-on in the cell block.

Time starts to drag

The next day dawned bright and clear, as I could tell from the tiny window set up high in the cell. "That little tent of blue which prisoners call the sky" did resonate with me locked in my own private Reading Gaol.

The day dragged on a bit. No, it dragged on a lot. I tried to read the other books but I couldn't focus. I paced, I sat, I lay down. I tried to read. I smoked too much.

The station was rather quieter than the night before and the day was warm. Breakfast was unremarkable — instant coffee and cold toast, I think — and lunch was nothing to look forward to, either, but then I was there to be punished and if this was as bad as it got, I was fine.

By lunchtime I was actually looking forward to being taken to the remand centre. The prospect of mixing and mingling with the crème of Sydney's underbelly was more appealing than pacing the floor again. However, it didn't happen and that night was even more interesting than the night before.

The next day, Sunday, was apparently a similarly beautiful day judging by the half a square metre I could see of it. I resumed my pacing, disturbed reading, and generally climbing the walls. In retrospect I was very lucky that the local wallopers were good enough to let me keep my cigarettes and lighter and my books. You usually don't get such luxuries in the slammer.

I was eventually released in the afternoon and the officer stamped all my misdemeanours writ large in the book of justice with the official stamp 'executed', which I thought was rather an extreme punishment for a parking fine.

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