One for the road

Emu Engineering Empire Twin E120S

The family prior to E120S: From left: E120R, B66, M46.

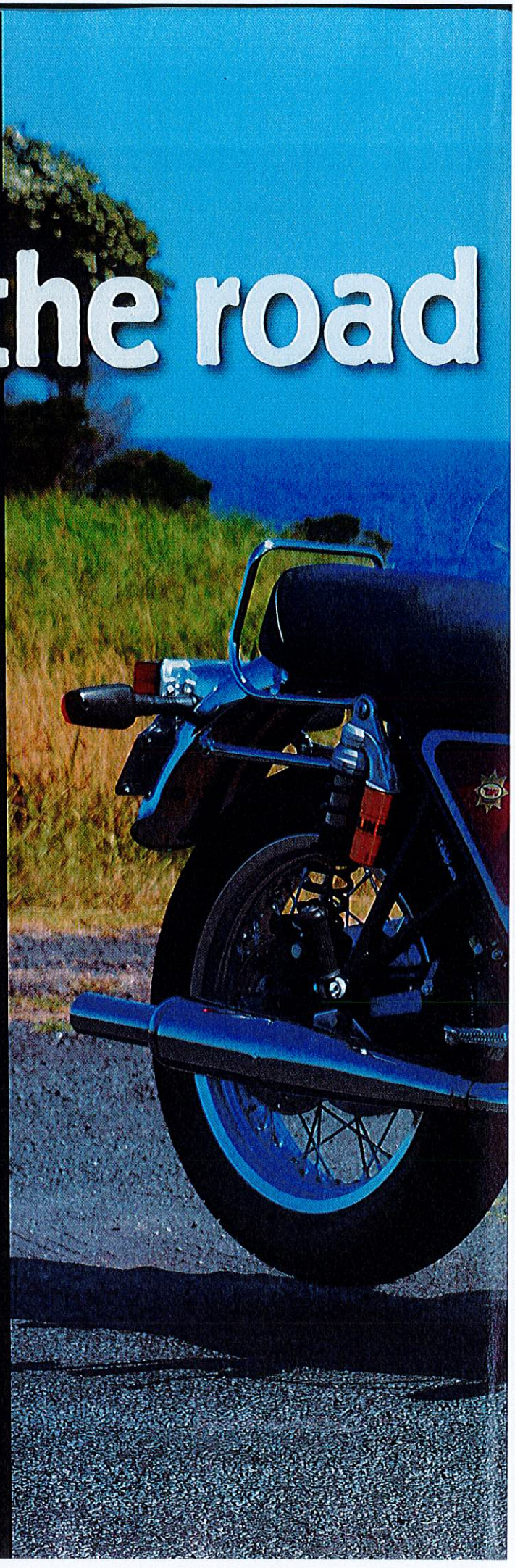
Just when you think you've completed the story of the range of v-twins built entirely in-house by Doug Fraser in Melbourne, along comes a new chapter. Doug calls his creations Empire Twins, after BSA's pre-war Empire Star singles from which the concept sprang.

For a brief update on this evolving saga, let's hark back to Chapter One, which appeared in OBA issue 10 – eleven years ago! Doug says this seminal machine in the Empire Twin story is the motorcycle that BSA designer Val Page would have built had he been given a free hand. Instead, shackled by management policy, BSA's v-twin was the Y13, a motorcycle that has never overly thrilled Doug Fraser. So he made his own.

The 2008 Empire Twin M46 (two x M23) displaces 1120cc, with a bore and stroke of 87 x 94mm and a 9.0:1 compression ratio. There were M20 parts incorporated, including the "stretched" frame, but basically it is all Doug's work, and there are no CNC machines in the EMU Engineering workshop, which is his core business, manufacturing electrical components. 1400 hours later, it was a runner, completed just in time for the All British Rally at Castlemaine, Victoria, where it stole the show and won "Best Bike of the Rally".

During construction of the Empire Twin, Doug completed a second set of crankcases, and Chapter Two appeared in the form of the B66 (two x B33) which was completed in 2010 and featured in OBA issue 20. This is essentially a pair of highly modified BSA B33 top ends on Doug's crankcases, although he made the top ends too. Inside the cases sit a pair of M20 drive-side flywheels, joined by a Harley-Davidson crankpin on a four roller bearing crank. With a bore of 88mm and a 94mm stroke, 1140cc was the result, with a 9.25:1 compression ratio. Mounted in what could be, but isn't, a Gold Star rolling chassis, the result is a superbly styled motorcycle, that, had it been built in Small Heath in 1955 ➢

Story Jim Scaysbrook
Photography Sue Scaysbrook



EMPIRE TWIN E120S

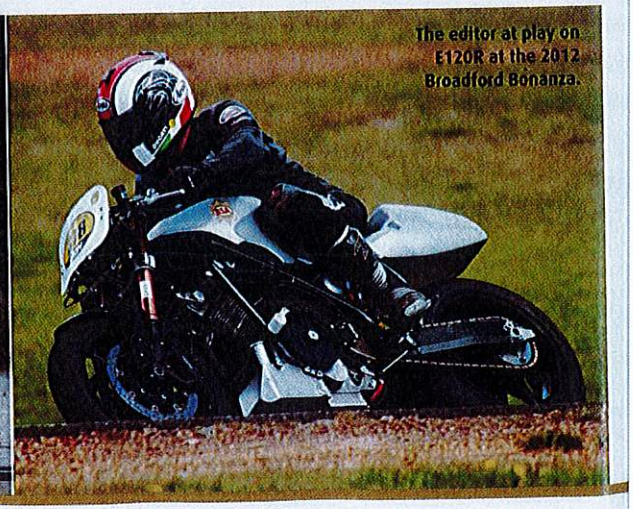
EMPIRE TWIN E120S

instead of Melbourne 55 years later, may well have saved Britain's largest motorcycle company.

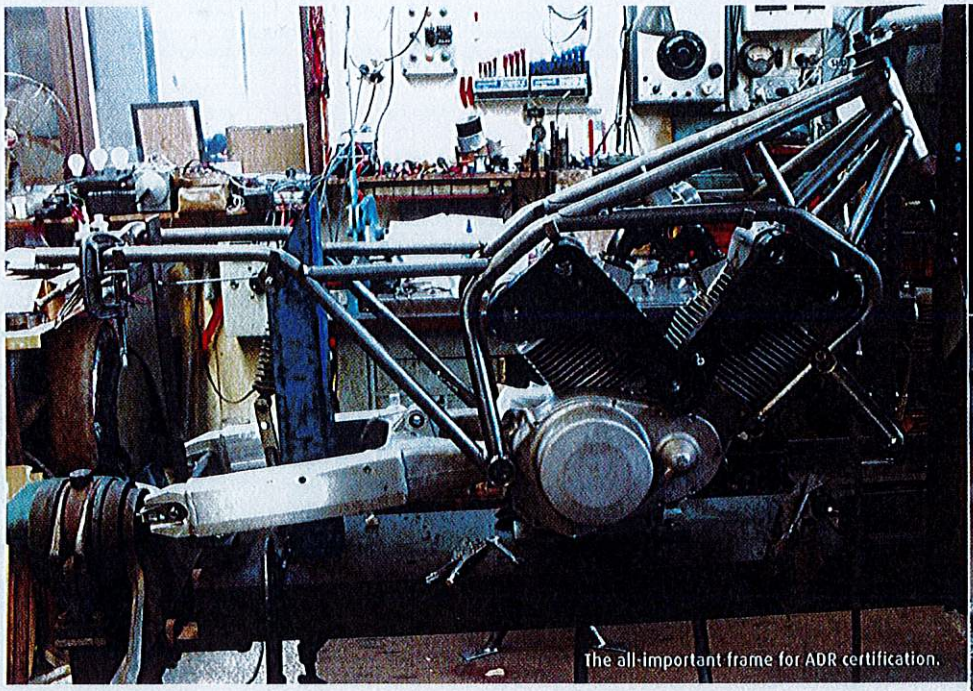
This could have been the end of the Empire Twin story, but oh no, not yet. With two big road burners completed and being well used, Doug turned his attention to a track-only version, because he has always been a keen and highly talented racer. His most recent track weapon was a self-built and developed (what else?) Norton Rotary which he has raced with considerable verve in Australia and New Zealand. But in his words, the Norton was pretty much worn out, so it was time to get out the drawing board once again. Having created a line of the V-twins BSA should have built, he now wanted one that incorporated some really original thinking – and the question, "What would BSA have built if they were still in business in 2012?" sprang to mind. That became E120R (R for Racing), which broke cover in late 2011, and which I was able to sample at Easter 2012 at the Broadford Bonanza. My impressions were published in OBA 34, but suffice to say, it was quite an experience. An eye-watering, adrenaline-pumping experience!

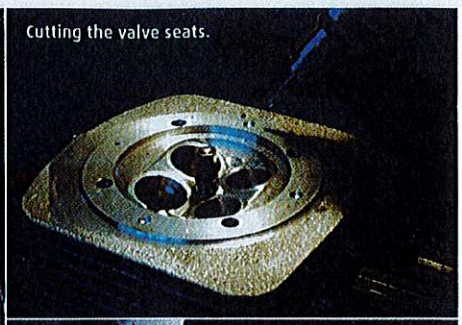
So here we are, seven years later, and number four in the series has just broken cover – E120S (S for Sports). This is very much from the E120R mould, and yet, completely different. The singular reason for this fact is that the E120S has been carefully planned from the outset to be a fully compliant motorcycle, not a Red Plate special. Complying with Australian Design Rules (ADR) is a massive undertaking in itself, and it is only due to the existence of what is termed Individual Vehicle Compliance (IVC) that Doug was able to do it. IVC allows an individual person to make one vehicle per year for his (or her) own use, which suited Doug perfectly. He gave himself 18 months to have the new machine ready for the 2018 BSA International Rally at Halls Gap, Victoria last November, and he made it, just. "I had two reasons for choosing that event," says Doug. "Firstly the International Rally only comes to Australia infrequently, so it was a

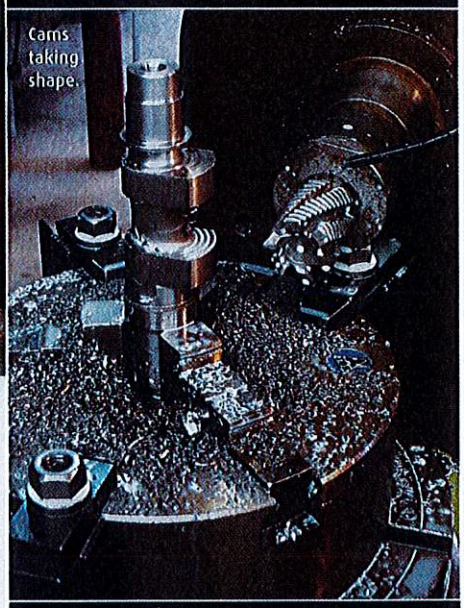
The first 75 degree v-twin: E120R.



The editor at play on E120R at the 2012 Broadford Bonanza.


The all-important frame for ADR certification.


Cutting the valve seats.


Cams taking shape.


Fuel tank components.


Exhaust components.

great opportunity to make a bit of a splash, and secondly, I wanted to beat BSA's new owners, Mahindra, to the punch!"

While the midnight oil was being burned in the workshop, there was an equally intense operation going on between Emu Engineering and Vic Roads. Doug takes up the story. "The first aim is to get a 17-digit VIN, issued by Vic Roads. You start off by being issued a Vic Roads engine number, which enabled me to get a testing permit, which I theoretically needed to get an ADR, which I needed to be able to take it to the BSA Rally. I actually ran it on a permit there, but two weeks later I was able to fully register it – as BSA 12 – the plate for which I now own. I figured after what I'd spent to build it, what's a few hundred dollars more? The ADR was expensive and tricky but it had to meet lighting regulations, braking systems, and most of all, noise. I had to prove I made the frame, and that has to be fully documented, so I had an engineer do an inspection on the frame when it was in the roughed out stage. They are not so concerned with the engine but the frame has to be built by you, to stop re-birthing I suspect. The engineer could see that because I had built the other bikes I vaguely knew what I was doing, so I had no problems there. For IVC ADR there are no emission requirements, so there is no catalytic converter in the exhaust system, which is how I get away with carbs (38mm Mk2 Concentrics) instead of fuel injection, and it doesn't have to have ABS. The exhausts do have Lambda probes, which is the only way I could properly tune it. The exhaust measures 94 db at 3,000 rpm, with the noise meter 500mm from the exhaust pipe, set at 45 degrees."

Although the E120S is closely based on the E120R, there are many detail changes, which Doug explains. "To address the noise issue, I decided to reduce the size of the fins on the heads and barrels, and that meant making new patterns. It runs a milder cam and with the ADR exhaust and a special induction system the noise level is now acceptable. As with the race bike, I use Porsche internals, all proprietary parts, Mahle pistons and sleeves, Pankel titanium rods, valves, INA inverted hydraulic buckets so there is no tappet adjustment. Without building the race bike first I would never had got this one on the road – the race bike was a mule to develop the road bike. For the belt drive for instance, I found (with help from the belt supplier Gates) that the teeth of the belt don't fit snugly in the pulley so I had to machine my own pullies with an interference fit – you now have to stretch the belt onto it". Like many of the proprietary components, the gearbox came from a Honda VTR, or more specifically, a Honda Valadero, which is the dual-sport version. "With such a torquey engine, I wanted to use a five-speed gearbox," says Doug. "The VTR 1000 Honda has a six speeder, but the Varadero has basically the same gearbox except that it is five speed, so that's what I used, along with a Fireblade clutch."

"For the IVC you can use a braking system from a motorcycle of equivalent weight and performance. I looked at the VTR Showa forks which looked right to me, they're relatively easy to modify to fit a conventional mudguard, and I could use the standard VTR brakes. The VTR runs clip-ons but I was able to find a yoke that I could use with conventional handlebars. The VTR rear brake caliper and disc actually fitted the spoked Triumph rear wheel I had, which is from a 2006 Bonneville. I needed a wheel with a cush drive and good spoke angle to handle the torque of the engine. Although the sprocket and disc were on the other side, everything worked quite well once it was swapped around. But at the front end I needed a spoked wheel, and to find one that had the right spoke angle and that would fit between the relatively narrow forks was difficult, so I made the hub and spoked a Takasago rim, same as the rear, which ➢

LEFT Mandatory tyre pump hides behind frame tube.
RIGHT ND instruments are original Hesketh items.

CENTRE RIGHT Doug's front hub with Nissin discs and calipers. Showa forks ex-Honda VTR.
RIGHT Left handlebar switch is from a Honda VTR250 with a manual choke and right side from a VTR1000 with an Amal twistgrip.

Emu Engineering E120S
Specifications

ENGINE	75-degree v-twin. DOHC 4 valves per cylinder, air cooled.
BORE X STROKE	100mm x 76mm
STARTING	Electric:
IGNITION	Points and coil.
FUEL	2 x 38mm Amal Concentric MK2 carbs.
GEARBOX	5 speed.
COMP. RATIO	11.5:1
FRAME	Tubular steel
SUSPENSION	Front: Showa telescopic forks. Rear: Öhlins twin shocks with remote reservoirs.
WHEELS	Steel spoked on Takasago alloy rims.
TYRES	Avon Road Runner. Front: 100/90 x 19 Rear: 130/80 x 17.
BRAKES	Nissin. Front: 2 x 296mm fixed discs with four-piston calipers. Rear: 1 x 220mm disc with single-piston floating caliper.
WHEELBASE	1500mm
WEIGHT	200kg
FUEL CAPACITY	17 litres

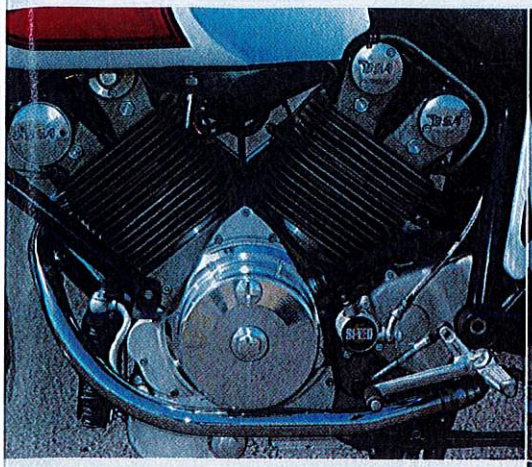
was cross drilled with a special lace pattern to increase spoke angle to produce a rigid wheel. I used high tensile steel spokes, not stainless, because stainless doesn't have the tensile strength. The only other hassle I had was to mount a drive to the analogue speedo. The instruments are from a Hesketh. I have one of these motorcycles and have accumulated a stock of parts over the years, including these instruments. Modern bikes don't have mechanical speedo drives, but I was able to find a drive that had the same ratio as the Hesketh speedo and mount it into the hub I'd designed.

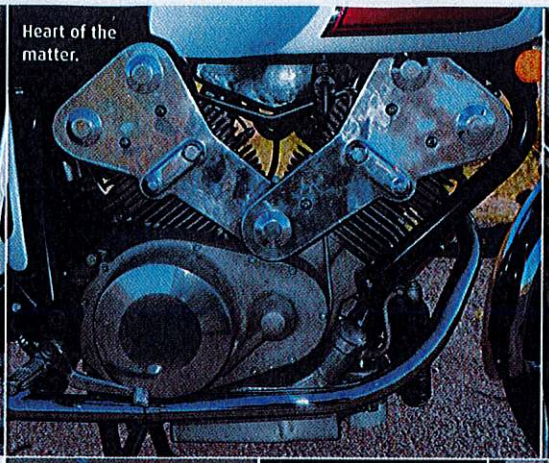
"The frame is totally different from the race bike; it is 75mm longer to give a wheelbase of 1500mm. The race bike has an alloy swinging arm from a Honda CB600RR, but the road bike uses twin shocks so I used another of these arms which are internally braced, but I had to cut it and weld it so it probably would have been easier to make one from scratch. I should mention here that all this stuff came from Victorian Motorcycle Wreckers. I used to work there years ago and even though it now has different management I get on really well with them – I couldn't have done this without them. They just let me take various bits until I work out what I need, then I bring back what I don't want. Take the starting system. I designed the crankcases to take the VTR starter, but that engine doesn't use any form of decompression. The Honda is 1000cc on 9.0:1 compression, whereas the E120S is 1200cc on 11.5:1, and it just wouldn't work. So I had to pull the motor apart and fit Screaming Eagle Harley-Davidson decompressors, but the compression is too high and they pop off too quickly, so it was back to Vic Wreckers to see what they had in the same diameter and length. I ended up with one that is half Honda, half Yamaha, all Mitsuba components, and it now works well and doesn't need decompressers. With a good strong battery you just hit the button and off you go."

Prior to letting me loose around the back roads of Phillip Island, Doug gave me a rundown on what to expect, performance wise. "I find on the open road you get to about 130 km/h and open the throttle, and it just launches, despite all the gear I had to fit to meet ADR. The biggest problem is the restriction from the air cleaner and the exhaust, it just stops breathing. It has a slow action throttle and when you accelerate you hear the induction roar. It will happily rev to 7,000 or beyond but it hits 6,000 and it ceases to increase power because it can't breathe. It makes 76 bhp at 6,000 rpm at the rear wheel and has over 90Nm of torque from 3,000, which for a road bike is fantastic. It doesn't matter what gear you're in, you just hit it and away it goes. I am very happy with the rigidity of the frame, it is great in the twisties. The 1500mm wheelbase is relatively long for a semi-sports motorcycle. I had to cut away the front of the tank to increase turning manoeuvrability – with the long wheelbase if you don't have decent steering lock it's a hassle in traffic.

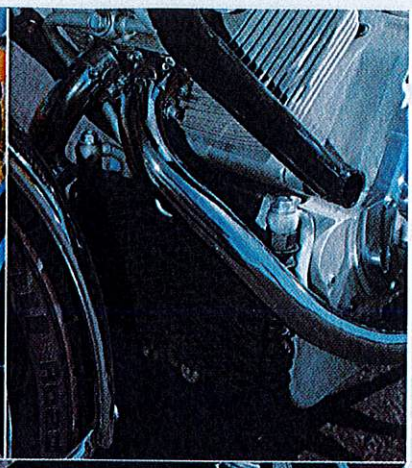
"I made the steel tank, starting with a big block of wood and a hammer to get it into a rough shape, then ran it through an English Wheel and shrank and

EMPIRE TWIN E120S





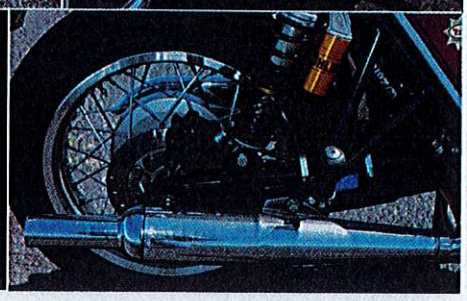
Heart of the matter.



TOP RIGHT Oil cooler sits in front of main tank.

RIGHT Triumph rear hub with Honda VTR disc and caliper. BSA Gold Star-style muffler of course.

LEFT For keeping bugs at bay.



stretched it in some places. It is not a standard three-piece tank, it is five pieces all gas welded. The paintwork was done by Glen Olsen who specialises in restoring E Type Jaguars – he is a world-renowned expert. I rewired his bike for him so he painted the tank and side covers for me. I made the seat and it is very comfortable. I think the ergonomics are good; the positioning of handlebars, seat, footrests etc seems pretty right. It has a 12 volt power socket and it is wired for heated grips. "

So armed with a few tips, off I went, touring around some of the roads that made up the original Phillip Island road circuit that was used in the 'twenties and 'thirties. I was itching to try Doug's suggestion of 'hitting it' in top gear from 130km/h, but on the Australia Day weekend in school holidays, I don't think so. Nevertheless I did give it some decent handfuls of that slow-action throttle, and it sure does get up and go. As he says, there's no point in ringing the bells too hard, the E120S has such massive reserves of torque you just shift up until 5th gear and stay there. And he's dead right about the handling too. Flicking through corners is an absolute delight, at any speed. Given the pedigree of the components, it is no surprise that the suspension and brakes behave impeccably, as does the gearbox – and that seat is really comfortable. In fact, there's little, if anything to criticise, nor to compare, because this really is a completely unique motorcycle.

It is also a motorcycle that is guaranteed to draw a crowd whenever it is parked – the subject of intense scrutiny and much head scratching. "Never saw a BSA like this," you can hear them mutter. No, that's dead right.

All too soon it was time to return E120S to Doug, who reaffirmed his offer of another ride, "on more suitable roads". By that, he means roads where you just "hit it!" I'm up for it. So will there be further chapters in the Emu Engineering/BSA/Empire Twin/E120 saga? Doug is non-committal on the subject but adds, almost as an afterthought, "But I am allowed to make one every twelve months... for my own use." And mine, I hope! ■

ABOVE The old Phillip Island GP circuit made an interesting test track. LEFT Doug says just "hit it!"