

SETTING

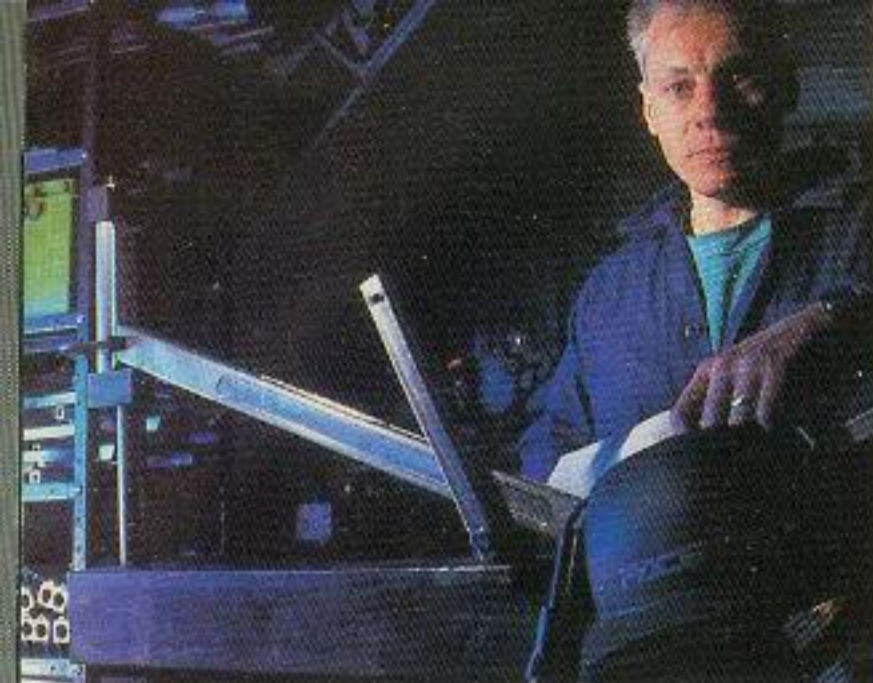
THE PACE

Pace have a new baby, a prototype suspension bike that, they hope, works as a cross-country bike as well as a downhiller. BRANT RICHARDS and STEVE BEHR headed deep into the Yorkshire Moors for a ride and to find out just how the development process works at the original British mountain bike innovators. Studio pics by PETER CANNING



Pace have been fascinated with the project of building a fully suspended cross-country bike for a couple of years now. They wowed the shows last year with the DPD downhill bike, and their new machine is another step up the learning curve towards a workable all-round suspension bike. Their race-led interest has meant that they are fascinated with the idea of building a bike that has an advantage over a rigid scooter on a cross-country course.

It's fairly easy to build a downhill-specific bike – just use a pivot and a shock absorber and you've got it, but nothing out there works perfectly for cross-country, and



Duncan MacDonald is Pace's design and fabrication wizard. His motocross background gives him a deep understanding of suspension.

JARGON BUSTER:

DPD: A three letter acronym that stands for Duncan's Purple Descender

Pace RC-100: The original Pace designed MTB

Pace RC-35: The Pace designed, carbon legged elastomer suspension fork

Atmosphere balanced: An internal valving system for RC-35s designed to stop 'muck suck'

MMC: Metal Matrix Composite. An advanced composite material using ceramic fibres or particles to strengthen and stiffen a metal

Finite element analysis: Part of the CAD (Computer Assisted Design) and CAM (Computer Assisted Manufacture) process

Stanchions: The fixed upper legs of a telescopic fork that the sliders move on

Hawkwind: Loud, 70s heavy rock group

that's what Pace are aiming for. So, while the works *DPD* was a great extreme-conditions downhill bike, there was no way it was viable for general riding, let alone racing. At 34lb, and with an unacceptable degree of back end flex, it was a dog on the climbs.

In the spare time they've had between managing production of their other components, Pace head honchos Duncan MacDonald and Adrian Carter have a new suspension bike which works better than most. "It's not a production bike, it's just a prototype," Duncan told us over the phone, as the final weld bead was still cooling. "I don't even know how it rides yet, so come and have a look."

Suspended origins

The first Pace suspension bike was a modified *RC-100* that had been damaged in transit. It used a pivot position at the bottom bracket, just as a *Manitou* bike does, but with a single elastomer rather than twin shocks. It actually worked reasonably well, but it did react a lot to the pedalling action, and with every pedal stroke the bike absorbed power. To overcome that, they changed the angle of the elastomers to get a greater rising rate on the material. This was disastrous! The bike bobbed up and down like a circus bike, and you could actually get it bouncing down the road. Having had a go at a suspended bike, basically without looking at the problems, they sat down and looked at what a suspended bike should do.

Duncan and Adrian looked at the forces from the trail, they looked at the power from the rider, and then looked at ways of isolating them and making the bike work. In an attempt to isolate the pedalling load from the suspension, it was necessary to position the pivot at a point where the chain tension would not affect the rear wheel. With different size sprockets and chainrings, this isn't

possible all the time, but a compromise can be reached.

The pivot could be placed anywhere along the line, but Pace chose a rearward position to keep the rear triangle short. Building a lightweight motorcycle swing-arm from aluminium, they showed the bike to the world at Bicyclexpo '91. It wasn't great to ride because the rear triangle was incredibly flexible.

During the winter of '92, the *DPD* was conceived and built as very much a tool for a specific job - going down hills very fast - but was hard to ride uphill. Pace learnt a lot from that bike, and after going through the problems with the *DPD*, Duncan renewed the suspension project with vigour.

Building a new version of the bike shown at Expo, he welded up a tubular steel rear triangle in a space frame design, which was far more rigid than the previous aluminium one. A steel rear triangle is also far

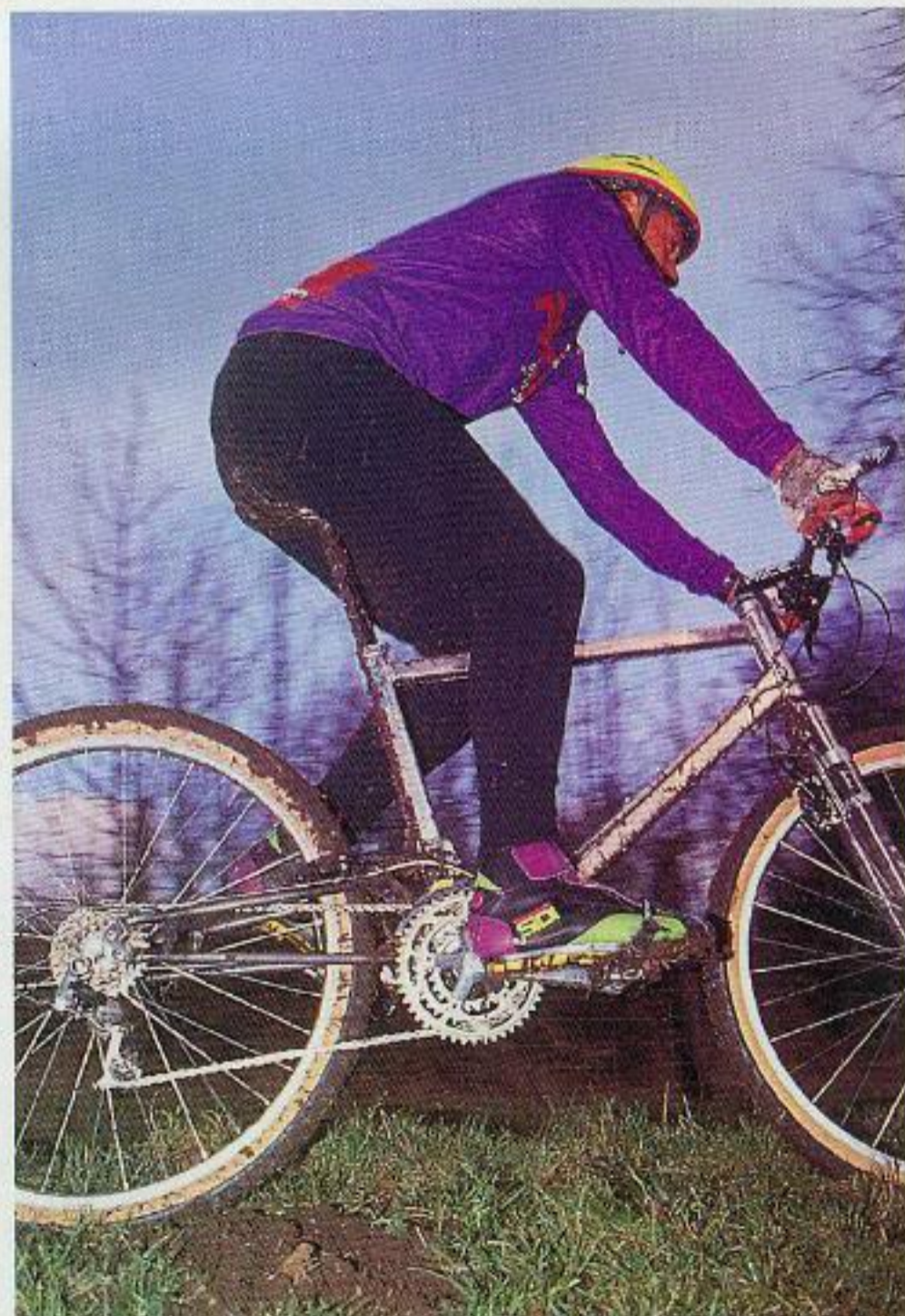
easier to build because the round tubes allow you to avoid the complexities of bending square tubing at funny angles.

The rear brakes are *Maguras*, because they're ideally suited to swinging arms as they don't need cable stops, and they work great when the speeds increase. The rest of the kit is pretty standard, so the rear suspension can be concentrated on, without having to worry about other bits.

The future

Duncan already has ideas for the next bike, a really radical jump in technology that hasn't been tried on mountain bikes before. He's trying to isolate the power fluctuations from the drive so the suspension works all the time, and doesn't react to the chain tension. It's a big task, and one that requires quite a lot of time in manufacturing alone.

Says Duncan: "If we had six



The new bike in action. The RC-500 Mk V is another stage on the long road to the perfect suspension bike. It's not there yet, but it's only a prototype.

months of development time on nothing but full suspension, I think we could do something pretty good, but we just haven't got the time.

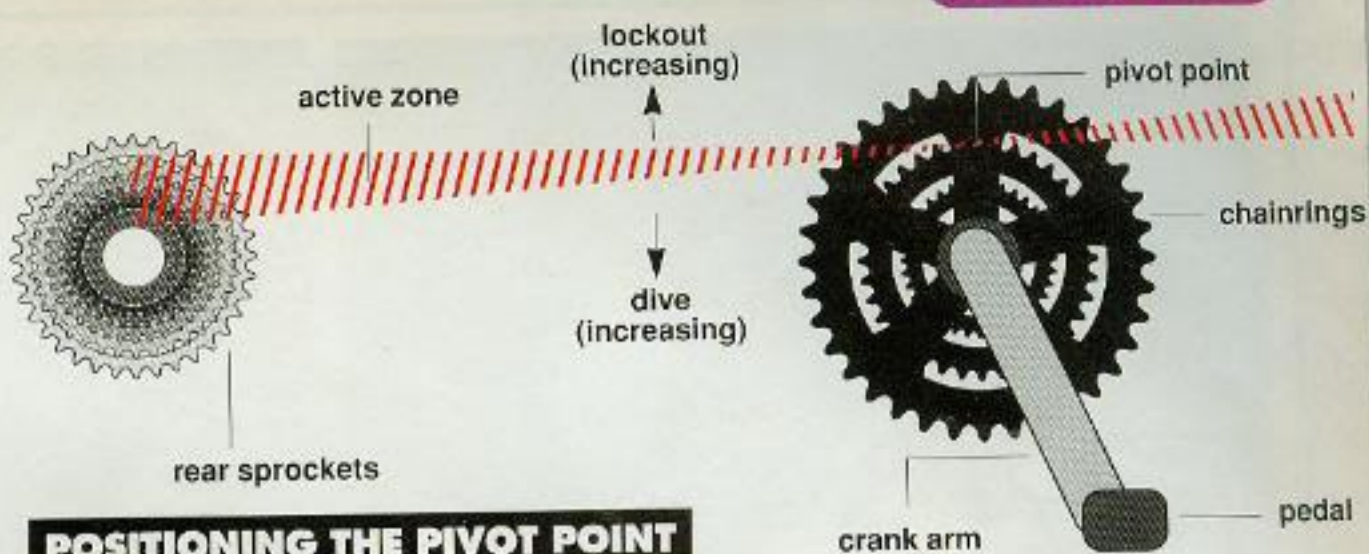
"If Ford decided to get into suspension mountain bikes and threw, say, \$10 million at it, they'd have the result in six months. It's just a matter of time."

Pace don't consider the market for a full suspension cross-country bike to be big enough just yet to justify the time that is needed to develop one. So, between fitting in their other work, they'll grab a week here and there to do some prototyping.

Whatever the outcome, there's definitely a need for everyone involved in the sport to get out and do some serious riding with different systems, to determine the way forward for full suspension.

Pace get into MMC

The fuss about metal matrix composite (MMC) tubing has been going on for a couple of years now, and while a few inroads have been made with the M2 frame from Specialized, and Raleigh's bikes, there have been few applications in other areas. Pace have been trying to reduce the weight of their suspension forks since their conception and last year



POSITIONING THE PIVOT POINT

they made a show special with chrome-plated carbon fibre stanchions. These never got into production because the surface of the material degraded too easily. Looking at alternatives, Pace aren't convinced that titanium is right for stanchions as it is too flexible and chews up seals and bearings.

So, the hot scoop is that Duncan has a pair of aluminium-based MMC stanchions on his bike. Aluminium isn't new to stanchions, the Tange Shockblades run them, but theirs are so thick that there's no advantage. Pace's prototype blades are 1mm thick, so they're lighter than steel, but just as strong and nearly as stiff. However, there's a catch: they're

incredibly expensive bits of tubing, at over £100 per metre! And if that's a problem, then this is a nightmare: the current tubing dies are the wrong diameter for making tubes to use as stanchions for forks, and Pace will have to invest megabucks in a die to make them the right size. Ideally, the material would be extruded in an oversize diameter, surface ground to the right tolerance, and then hard anodised to work as a bearing surface. Expensive, expensive and expensive.

With some rigorous testing they'll see how the new stanchions work in terms of wear and strength, and then maybe they'll be an upgrade for the RC-35 sometime in

To isolate chain tension when in the middle ring, the pivot must lie in the shaded 'active zone', which represents all the possible positions of the chain. Below this, the suspension will be compressed by chain tension. Above this, suspension will be 'locked out' under chain tension.

Pace, a brief history



Last year's DPD was a great big engineless motorbike of a downhill machine, but too heavy and flexible to be practical for anything else.

Both Adrian and Duncan were involved in motocross enduro riding, having met on the start line of a Welsh enduro. Duncan was involved with the production of motocross silencers, and built his own trials bikes, with hand made air shocks. This engineering experience was essential to the development of Pace, as it meant that Duncan already had a complete fabrication shop in his garage.

As they got into mountain biking to keep fit, they quickly became exasperated with the limited amount of thought that had gone into contemporary production bikes.

Duncan disappeared into his garage and built a frame. His engineering background told him that

design in mountain biking. The public stood back and gapped.

The RC-100 was only available as a complete bike. Pace's own forks, which they'd developed along with the bike, Bullseye cranks, and other stock high performance bits were used. The public looked again. Regrettably, the public didn't buy them in huge numbers, mainly because of the take-it-or-leave-it complete-package approach. After the suspension forks, hubs and chainrings, the refined RC-200 appeared about 18 months ago, a bike that would take standard cranks and brakes, and that the customer could fit their own bits to. In fact, as much over priced US rubbish could be put on the bike as space would allow.

box section tubes would be the easiest to work with. Strength and stiffness aside, they could all be laid flat on a table and welded up without a jig! That first frame weighed 6.5lb, and was one of the most jarring that they'd ever ridden.

They soon found that using different depths of machining to 'butt' the tube improved the ride.

With some CAD Finite Element Analysis from a friend with a big computer, they determined the areas which could be milled away to save the grams and not affect the strength.

The result of this was the RC-100, a watershed



Adrian Carter in dark and moody mode.



Duncan: "It needs to be just this big..."



All Pace's parts start life as prototypes in Duncan's workshop. If they work on Duncan and Adrian's bikes, they could still take a couple of years to get to the shops.

the future when Pace find some cash down the back of the sofa.

From idea to reality

So how does a component end up as a production model? In the early days of Pace we used to joke that Duncan would design a brilliant part, and Adrian would decide whether to paint it grey or yellow. What actually happens is that either Adrian or Duncan will have an idea, then they'll get together and talk it through. After they've run some numbers on it, in terms of strength and stiffness and that sort of thing, they'll run up a prototype in the workshop. That prototype will then get a real bashing over all sorts of terrain: mud and rocks and sand. Next step is a pre-production run of, say, four or five pieces identical to the production models which go to a few trusted riders. If they still hold up and look good, then they may go on the team bikes. What Pace don't do is to put unproven components on the team bikes "because the one thing that they've got to do is to finish a race." In motocross a team will be riding '94 bikes and components for the whole of the '93 season. That's what Pace would really like to do, but at this stage, they've enough

work just managing production and keeping up with demand.

Take the *Atmosphere Balanced* fork, for example. Duncan first considered the idea at the end of '91, soon after the *RC-35* was released. Prototypes were being ridden from Easter '92. After a little development work, the team were running the forks at the end of last season. Then Adrian decided it should be a slightly lighter grey than last year.

Duncan's bike

Though Adrian is currently riding a standard Pace *RC-200*, with *XTR* ("just to see how well it works"), Duncan's bike is the cutting edge of cool. The best thing is the weight. Currently it's 19.5lb, with front suspension, and there are still a few titanium parts here and there to add. With a change of seatpost, a carbon saddle, titanium *SPD* spindles and some cool new brakes it should be down to about 19lb. There isn't too much difference between this and what anyone could build from a stock *RC-200*, but there's some little stuff that helps grab the grams. The frame tubes are double-milled, whereas the standard frame is only milled to one depth. The butting extends further along the tube at a



lesser depth. The biggest weight saving is probably on the fork, with the MMC stanchions. Also, there's a titanium and carbon steerer still under development. Add to that a custom machined stem that's coming up, and it's a great R&D vehicle. All this kit will be out over the next year or so, with the double-milled frame probably not available until '94.

The new baby's rear suspension in detail. The main pivot is right behind the middle ring, and there are a couple of additional pivots by the rear wheel.

5 top secret things we found out

- 1 Pace nearly dabbled in carbon fibre frames, and even have a set of tubes tucked behind a filing cabinet. Too much hassle to build.
- 2 For '94 expect three smaller elastomers inside the fork, with a new rebound rubber. Elastomers will be available in loads of different grades. And it's all upgradable.
- 3 The first carbon fibre fork prototype was bonded in Duncan's Aga kitchen stove.
- 4 Pace are getting into stems, with a super-sleek *Aheadset* style stem for threadless steerers. *Aheadset* is similar to the original *RC-100* headset turned upside-down.
- 5 Duncan used to be a roadie for Hawkwind. (Not proven!)

Riding the Pace RC-500 MK V

Brant's test notes...

"The bike is as good as anything else I've ridden, with progressive if a little stiff movement. There's still quite a bit of flex in the rear triangle, but it's not distracting. The bike descends superbly and climbs excellently in the saddle, but when you stand to climb out of the seat it still tends to 'sit down' on you. The extra movement that being out of the saddle produces activates the suspension, causing it to absorb some of your effort. It would be fine for recreational riding as it is, but too inefficient for fast/flat racing."