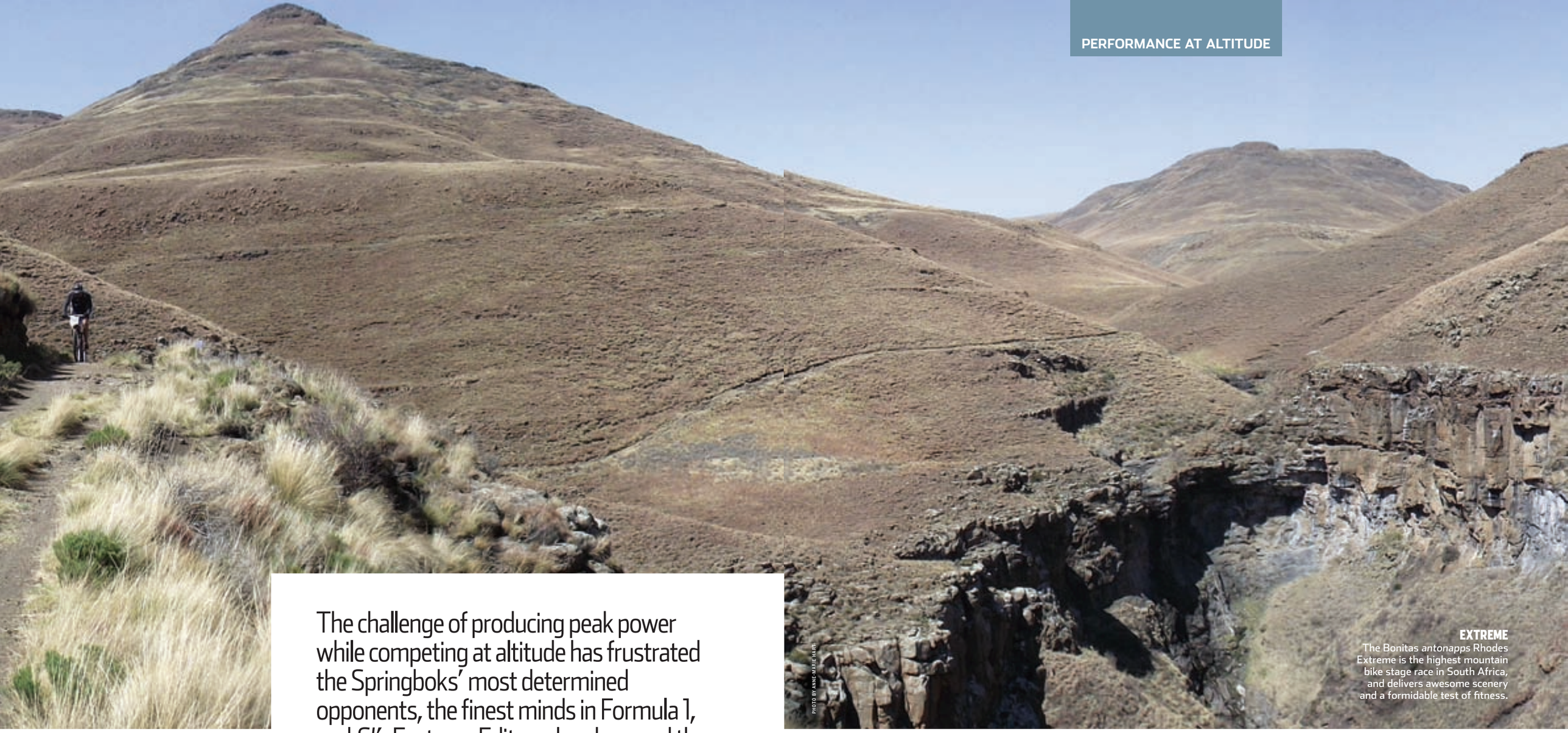

PHOTO BY ANNE-MARIE HARE

EXTREME
The Bonitas *antonapps* Rhodes Extreme is the highest mountain bike stage race in South Africa, and delivers awesome scenery and a formidable test of fitness.

The challenge of producing peak power while competing at altitude has frustrated the Springboks' most determined opponents, the finest minds in Formula 1, and *SI*'s Features Editor when he raced the highest mountain bike event in South Africa.

HIGH PERFORMANCE

BY ANGUS POWERS

Before he was Michael Schumacher's race engineer at Benetton in the early 1990s, Frank Dernie was on the pitwall for a dozen South African Grands Prix at Kyalami. He had wrestled with the problems a normally aspirated Formula 1 engine encounters in the oxygen-deprived highveld air, and had discovered how a turbo-charged machine might cheat altitude. Coincidentally, a few kilometres away at the Springboks' fortress of Ellis Park, international rugby teams had also spent decades experimenting. Trying to get the human engine to sidestep the debilitating effects of altitude seemed to mean 'turbo-charging' the players' minds, rather than their bodies, in the hope that fearless motivation would overcome the inevitable oxygen debt. But judging by the tourists' abysmal records in Bloemfontein, Pretoria and Johannesburg, surely their reasoning was flawed.

Racing mountain bikes just below the snowline of the Drakensberg provides a neat case study of the effects of elevation. The Rhodes Extreme is the original *mountain* bike race in South Africa. Long before front shocks and disc brakes appeared on off-road bicycles, riders were making the pilgrimage for the visceral experience of riding up and down *mountains*. The complications associated with the endeavour only added to the mystique. Hundreds of kilometres from anywhere, deep in the southern Drakensberg, the race had always centred on the tiny village of Rhodes (with a permanent population of 30). From this tranquil centre point,

competitors tracked an 85km orbit through the surrounding vastness. The beauty of the race is that it's high. Very high. At an altitude of 1 850m, Rhodes is slightly higher than Johannesburg, and the only way out is up. That makes the Rhodes Extreme the perfect analysis of performance at altitude. Because your first impression is also the most important. You can't breathe.

OK, maybe that's a slight exaggeration. You can't breathe like you're used to breathing. If you've ascended rapidly from the coast, you may have a headache that gradually fades. In September, when the race is run, the air is dry. Your throat may burn. These can be discomfiting sensations for the uninitiated, often exacerbated by the prospect of rolling over the start line to commence a 20km climb straight up Naude's Nek pass, racing 30km of exquisite singletrack at an average height of 2 600m, and then plummeting 15km off the escarpment down gradients as steep as 1-in-3. If you've got what it takes to ride three stages in two days, totalling 139km and 2 900m of climbing, you will take something special home with you: magnificent mountain scenery burnt into your memory, and a bike computer bursting with unique performance data.

The closer you get to the sun, the more complicated it gets. Your body loses fluids and gets sunburnt more quickly. Your heartrate increases (to pump more of the oxygen-scarce air to your muscles), yet your power output drops. You breathe faster to get more of that air to your heart – maybe even to the point of hyper-ventilation (the human body's version, in F1 terms, of forced air induction) – yet the point of fatigue is reached earlier. Equally importantly, your perception of exertion gets skewed out of all proportion.

FORMULA DEANS

Australia rugby coach Robbie Deans likes to tell the story of a touring Aussie player complaining how hard he was finding the playing and training in South Africa. "Until it was pointed out to him that he was still at sea level!" Deans laughs. "His perception was that anywhere in Africa it was difficult! We all tend to set our own bars, and the key is to not self-limit or you'll never find out what's possible."

Deans is the most successful coach at altitude outside of South Africa. In thirteen years of preparing overseas rugby teams to play on the highveld, his philosophy of taking his squads out of their comfort zones has borne impressive fruit. As coach of the Crusaders, in between picking up four Super Rugby titles (and three second-place finishes, and a third place) between 2000 and 2008, Deans won six and lost five playing at altitude. As All Black assistant coach, he was part of the management team who masterminded the Boks' heaviest defeat on home soil, 53-16 at Loftus Versfeld in 2003. And he has become the most successful Wallaby coach in South Africa, winning two of his five Tests on South African soil, including the famous 41-39 Tri-Nations win at Free State Stadium in September, Australia's first win at altitude since 1963.

"The biggest challenge of playing at altitude is that it's an experience that is distinct from the norm," says Deans. "So it comes with some potential barriers to performance. Some of them are physical, some are mental. In order to succeed, you've got to find a way of getting beyond those barriers.

"I recall the first win the Crusaders had at altitude, which was at Bloemfontein, and I recall challenging the group the week prior about the fact that we had never succeeded on the highveld. I just posed a couple of questions to them in terms of whether it was mental or not. They obviously resisted that suggestion. But if you had seen the response of the group after we won, clearly there was some mental baggage which we were fortunate enough to begin to alleviate."

Deans' current approach places a premium on physically preparing the Australian team as thoroughly as possible in an environment in which, psychologically, they will thrive. That means basing themselves at the coast, in Durban or Cape Town, taking advantage of the excellent and familiar training facilities, as well as the off-field attractions, and flying up the day before a Test at altitude. Deans' method wagers that the all-round benefits of putting together perfect pre-Test preparation in conducive conditions will cancel out the "seeds of doubt", as he calls it, which are sown when that dry feeling at the back of his players' throats makes itself felt in the second half. It's a routine that works for the Wallabies and, having been fine-tuned over 15 years of professional rugby, is one largely focused on not giving altitude any undue importance in the pre-match build-up. But, unusually for a team so adept at harnessing pioneering training techniques, it's an approach that has no physiological basis in science at all.

PHOTOS BY GALLO IMAGES/GETTY IMAGES/AFP

UNUSUALLY FOR AUSTRALIA IT'S AN APPROACH THAT HAS **NO PHYSIOLOGICAL BASIS IN SCIENCE** AT ALL.

COLD, HARD SCIENCE

"There's a rapid, partial acclimatisation to altitude in the first four to five days," says sports scientist Ian Rodger, who trains my Rhodes Extreme partner, Gavin Rossouw, the South African 24-hour solo mountain bike champion. "Every day you can spend up there makes a difference." This kind of thinking didn't help Gavin and I racing in the Drakensberg for the same reason it doesn't help the Australian rugby team: expecting to produce your best performance the day after arriving from sea level is simply not physically feasible.

The reasons for this are not complex. The human body – the original internal combustion engine – uses oxygen to burn fuel (in the form of carbohydrates and fats) to create energy to lengthen and contract the muscles. However, the body also has access to an oxygen-independent, or anaerobic, energy system in which energy is released without oxygen being present. The two energy systems usually run concurrently, with the anaerobic system kicking in when there is a shortage of oxygen, either because the lungs and heart can't supply it in large enough quantities to sustain the exercise intensity, or because there is a lack of it in the atmosphere in the first place.

ALTITUDE ODDS
Robbie Deans successfully encouraged his Australian charges to their first win at altitude since 1963 in September's Tri-Nations clash in Bloemfontein.

If an athlete who lives and trains at sea-level is required to produce a maximum effort at altitude, the lack of atmospheric oxygen will cause him to go anaerobic far sooner than he is used to. He will burn his muscles' stored carbohydrates faster, fatigue quicker, and require more recovery time between efforts. His very heavy breathing also comes at a price: blood that should feed oxygen to his leg muscles will be diverted to cater to the demands of his ventilatory muscles instead. Worst of all, being accustomed to the oxygen-laden air at the coast, his body misses two decisive adaptations that all people who live at altitude enjoy: a relative abundance of red blood cells (which carry oxygen in the bloodstream); and a relative abundance of a chemical known as 2.3DPG, which facilitates the easy transfer of oxygen from the blood to the muscles.

The good news for coastal teams is that these are temporary disadvantages and disappear wholly with acclimatisation. The bad news is that it takes two to three weeks for a sea-level athlete to completely adapt to altitude. So far, so good. But this is where the issue gets fudged. Flimsy science has always said that, in the absence of those crucial couple of weeks to acclimatise, the same physical performance will be produced whether you travel up to an elevated venue one day before the game or four or five days before. "Absolute bollocks," counters Rodger. As soon as you step out of the aeroplane and suck in that first deep breath of dry highveld air, your body begins to frenetically manufacture new red blood cells and more 2.3DPG. Which means that your performance at altitude will never be as bad as immediately after your arrival.

THE CONUNDRUM

So why don't coastal sides travel up earlier for important matches? For teams like the Sharks or Stormers, the hassle of abandoning their home base in favour of a Pretoria hotel the week before a big Bulls game doesn't outweigh the acclimatisation gains. But for an international touring team, who are living out of suitcases anyway, the message is clear: every day you can spend at altitude improves your performance.

Running that other kind of internal combustion engine – a motor racing car – at altitude is likewise dependent on oxygen-based calculations. The only difference is that tinkering with that machine is a lot easier, especially if your name is Frank Dernie, a man who's engineered the success of legendary F1 names like Schumacher, Damon Hill, Nelson Piquet, Williams, Lotus and Benetton. As you'd expect, a normally aspirated F1 engine loses power in direct proportion to the lack of atmospheric oxygen available to burn. But reduced power doesn't compromise top speed, as drag similarly decreases because the thinner air at altitude offers much less resistance. Cooling also stays under control as reduced horsepower produces less heat to be dissipated through the radiator water into the surrounding air. In fact, the only variable arises with the decrease in grip caused by the combination of lower downforce (due to the less dense air) and an unchanged top speed.

It's when you attempt to maintain top end power by turbo-charging the engine that you hit trouble. A turbo-charged or super-charged car solves the dilemma of a lack of oxygen by mechanically pumping extra air mass through the engine, though not without compromise. At Kyalami, turbo-charged power is (almost) equal to what is developed at sea-level, and top speed even increases, but heat management becomes a headache as more heat has to be shed into the less dense atmosphere. "That's the critical point," says Dernie. "Everything was tough at altitude with a turbo-charged engine. Over-heating becomes a problem with the turbo. But because a normally aspirated set-up self-compensates, we didn't worry about it too much."

CAR CONCERNS
Setting up an F1 car to race at altitude (as at Kyalami) is always a challenge for race engineers like Frank Dernie *(below, right)*.

That worry that F1 consultants so casually shrugged off is what no international team can escape when they face the Springboks at altitude. The magnitude of the mental challenge undoubtedly helps to explain why Deans prefers to prepare his side in less hostile settings at the coast, devoting his energy to nurturing in them an unshakeable self-belief.

"South Africa is a rugby destination, and they have a proud history that can become quite intimidating," he admits. "There's no doubt that the Springboks have exploited that, and anything that they believe is going to be a point of advantage will become a point of advantage. If you think it's so, then it is so. One thing for sure is that the Boks have a great belief that altitude serves them well. So you've got to meet that belief. There are no shortcuts to it. Even if you do totally acclimatise, the Boks have such a belief in your lack of experience of playing at altitude... you've still got to deal with that."

Ironically enough, if you take the mental game to its logical end point, you still don't have an open-and-shut case. For instance, realistically speaking, how psyched up by the prospect of playing in the green-and-gold at altitude can a Stormers or a Sharks player actually get, considering that he spends half of the domestic season dreading a trip to Free State Stadium, Loftus or Ellis Park? Or is he instead energised by the very real performance advantage that his Cheetahs, Bulls and Lions mates bring to the Bok team? As much as the Springboks' opponents might hope that success at altitude is really more of a question of mind over matter, the science suggests that they wish in vain. SI

ONE THING FOR SURE IS THAT THE BOKS HAVE A GREAT BELIEF THAT ALTITUDE SERVES THEM WELL.

Robbie Deans

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