



Stone-Age Stride

If humans evolved through running, how do we recapture the form of our forebears?

By Alex Hutchinson

The giant screen at the front of the lecture theatre shows, in gruesome detail, a dissected bare foot connected through tendons to ten different muscles in the lower leg, all pulling in slightly different directions. Benno Nigg, a renowned professor of biomechanics who co-directs the University of Calgary's Human Performance Laboratory, is leading an audience of Australian academics gathered at the University of Sydney through a presentation titled "The Future of Footwear." During almost four decades as one of the world's leading athletic shoe researchers, Nigg has worked closely with major companies such as Adidas, Nike and Mizuno. But plotting the future of the running shoe, he now believes, may require a look to the past, at what worked for our ancestors.

"Look at all these muscles here," he says, gesturing at the dissected ankle. He asks the audience to guess which of the

muscles we need in order to walk while wearing a typical shoe. Only two of the ten are needed, it turns out: the tibialis anterior (shin) and the triceps surae (calf). "And all the other ones, you don't need, because the shoes take over." Nigg pauses to let his audience consider this piece of trivia, then poses the central question of his talk: "Is that a problem?"

There are, of course, very good reasons for the existence of all the long, spring-like tendons and muscles in our legs. With each stride, we store energy in these coiled springs and then release it with the next stride – a process that researchers estimate saves about 50 per cent of the energy we would otherwise require to run. This is one of the key observations made by Dennis Bramble of the University of Utah and Daniel Lieberman of Harvard University in a controversial 2004 cover story in the scientific journal *Nature*. Bramble and Lieberman enumerated

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"Everything I've been told about running is wrong. The limits, the hazards, the necessities – it's flat-out wrong." –Christopher McDougall

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Bramble and Lieberman's ER (for "endurance running") hypothesis argues that running, rather than walking, was the crucial skill that separated us from our tree-borne simian cousins. Loping for long distances across the savannah allowed us to scavenge for meat from leftover kills and perhaps even chase live animals to exhaustion, and the demands of that pursuit shaped our subsequent evolution. The theory remains hotly disputed, though it has received widespread attention – especially from runners, who delight in newfound kinship with their post-Australopithecine forebears and vindication of their not-so-odd-after-all hobby. But from a runner's point of view, it also leaves a puzzling question unanswered – one that Benno Nigg has been considering throughout his career. By some estimates, in any given year 70 to 80 per cent of active runners will suffer a running injury. So if we were born to run, why are our bodies constantly breaking down?

Copper Canyon is an isolated, inaccessible valley in the state of Chihuahua, in northern Mexico, where vestiges of the Stone Age still linger. This is the home of the fabled Tarahumara, a pre-Aztec people whose culture revolves around long-distance running. Running is their entertainment, in the form of group races that range from a few hours to a few days, and it's also the most efficient means of transportation through the rugged terrain. "A route that might take six hours for a burro, a trail runner can cover in 45 minutes," says Christopher McDougall, a journalist who has written extensively about the tribe. "And then they don't have to feed a burro, either."

Stories of Tarahumara running prowess have surfaced periodically in the outside world, most notably when a 55-year-old shod in rubber sandals cut from a tire showed up at the 1993 Leadville

100-mile ultramarathon in Colorado and won it. But what intrigued McDougall most when he was sent to write a magazine story about them was the tribe's preternatural good health. The roll-call of running injuries familiar to all of us – shin splints, plantar fasciitis, Achilles tendinitis, and so on – seem to be completely unknown in Copper Canyon. "I asked a lot of people about this," McDougall recalls, "and it was just an alien concept to them, like having salad forks growing out of your ears." The experience launched McDougall on a three-year quest of his own to discover the secrets of the Tarahumara, which he describes in his new book, *Born to Run: A Hidden Tribe, Superathletes, and the Greatest Race the World Has Never Seen*.

One of the keys, McDougall came to believe, was the rubber-tire sandals. Unlike our fancy shoes, the sandals force Tarahumara runners to engage all the muscles and tendons in their legs, to cushion the impact forces that would otherwise rattle their joints. They're also forced into a distinctive stride, landing on the midfoot – one that looks a lot like the stride most of us adopt if we suddenly need to run across a room in bare feet. The result is not a small cadre of elite super-runners, but rather an entire society for whom running hours on end is an unremarkable part of day-to-day life. It's in this universal capacity for running that the Tarahumara most resemble our hypothetical running ancestors. Evolution, after all, doesn't select for a few superstars: the more useful a trait, the more widely it will be distributed.

Though customs are gradually changing, there are still stories of Tarahumara running deer to exhaustion after following them for distances reportedly as long as 160 kilometres. In the mid-1980s, John Kennedy, the foremost anthropologist to study the Tarahumara, witnessed the tail end of a "persistence hunt" by a father and two sons, McDougall says. More recently, Bushmen in Africa's Kalahari desert have been filmed chasing an antelope for 25 to 35 kilometres through the scorching midday heat until it gives up. This seems like a crazy feat of abnormal endurance – but if Lieberman is correct, there was a time when running ungulates into the ground was all in a day's work for the average homo erectus.

In March, a zoology professor at the University of Wisconsin named Karen Steudel made news with a study about the "optimum running speed" for humans. Scientists had long believed that, within a certain aerobic range, the number of calories you burn when running a given distance is completely independent of the speed you run at: sprint a kilometre in four minutes, or jog it in eight minutes, and you use the same amount of fuel. "It sounds counterintuitive," Steudel says, "but that was just the dogma. It was what everyone 'knew.'" With a series of careful experiments, Steudel was able to show that each of us does have a pace where we're most efficient, which in her small sample of nine runners averaged 5:44 per kilometre for women and 4:30 per kilometre for men. That doesn't mean that running slower than that optimum pace feels harder – it just means that you'll have to burn a few more calories to cover the same distance.

Since the publication of the study, Steudel's inbox has been inundated with emails from runners asking for training advice. But the real point of her study is to refine the painstaking calculations of whether running could really have been an efficient means of running large quadrupeds to exhaustion. The average distance of Kalahari persistence hunts observed by South African tracker Louis Liebenberg in 2006 was 27.8 kilometres, which Steudel calculates would require 1,798 calories for males running at their optimum speed. Running at their least efficient speed, in comparison, would incur a penalty of an additional 302 calories.

Since the average speed of the hunts that Liebenberg observed was a pedestrian 9:41 per kilometre, the hunters were far from their most efficient speed. As a result, Steudel's findings add another piece of evidence suggesting that running for persistence hunting might not have been the overwhelming evolutionary force that Lieberman proposes. "This whole question is still totally up for debate," Steudel says – which is why she's currently collecting further data, this time subjecting her volunteers to 30 C heat and investigating whether longer legs help heat dissipation while running. One explanation for the slow speed of the hunt is that the Kalahari Bushmen mix periods of slow walking while they carefully track the route of the out-of-sight animal with long, steady periods of running – so the speed might be an average of their most efficient walking pace and their most efficient running pace. Or it may be that an inefficiency of a few hundred calories doesn't even matter, given that killing a single 200-kilogram antelope provides a windfall of 240,000 calories.

Benno Nigg's source of inspiration, meanwhile, comes from a few thousand kilometres northeast of the Kalahari desert. His lab has been testing highly unorthodox shoes marketed under the name Masai Barefoot Technology, or MBT, named for the semi-nomadic Maasai people of Kenya and northern Tanzania. Made by a Swiss company, these "anti-shoes" have rounded soles shaped like the bottom of a rocking chair, designed to simulate "the natural instability of soft grounds such as Korean paddy fields or the East African savannah." Modern motion control shoes, Nigg tells his Australian audience, "make damn sure that you don't use your muscles," since the shoes provide all the support you need. In contrast, the MBT shoes function as a training device, forcing you to use the atrophied stability muscles that would be required

for barefoot running, without exposing your tender soles to the harsh surfaces of the urban world.

This desire to recapture the antediluvian purity of barefoot running has become a major trend in recent years. Most visibly, in 2004 Nike began marketing its series of "Free" shoes, ultralightweight (and despite the name, far from cheap) trainers that release the foot to move more naturally, inspired by the barefoot running drills the national-champion distance runners at Stanford University were doing under legendary coach Vin Lananna. The merits of the Nike Free are vigorously debated among "minimalist running" advocates, along with similar offerings such as the Puma H Street, Vibram FiveFingers, and Mizuno Universe (which McDougall describes enthusiastically as "like running in two sandwich bags," due to their featherweight design). On a scale of zero to 10, where zero is barefoot and 10 represents the average shoe, Nike's wispiest Free rates a 3 – still too much, according to diehards.

Lieberman has just begun studying barefoot running in his Harvard lab, and is currently enrolling subjects for another study of runners who use the Vibram FiveFingers, to explore whether the biomechanics of barefoot or near-barefoot running can shed more light on the evolutionary pressures that shaped our bodies. Despite widespread hype among runners, there's still little research and lots of uncertainty relating to how well we can handle the "natural" state. It's certainly clear that, if you've spent your whole life coddled by the latest cushioning technologies, you can't just quit shoes cold turkey. Even the heavily padded MBT shoes require an adjustment period, Nigg says: "When you start, you don't want to wear them all day at first. For a normal person, it takes about a week to get used to them."

More extreme options require much greater care, as Christopher McDougall's cautionary tale illustrates. Long plagued by an endless series of running injuries, he set out to remake his running form under the guidance of expert mentors, doctors and gurus. He adjusted to flimsier and flimsier shoes, learning to avoid crashing down on his heel with each stride and landing more gently on his midfoot. It was initially successful, and after nine months of blissful training, he achieved the once-unthinkable goal of completing a 50-mile race with the Tarahumara. But soon afterwards, he was felled by a persistent case of plantar fasciitis that lingered for two years. "I thought my technique was Tarahumara pure," he recalls ruefully, "but I had regressed to my old form." Now, having re-corrected the "errors" in his running form, he is once again running pain-free.

McDougall's experiences illustrate a dilemma described by sports scientists Ross Tucker and Jonathan Dugas on their blog, *The Science of Sport*. An increasing body of evidence suggests that runners can, in fact, learn to run differently, resulting in a potentially beneficial redistribution of the forces on joints. Tucker was involved in a study at the University of Cape Town, in South Africa, of the POSE running technique advocated by McDougall's mentor, Nicholas Romanov. Sure enough, the subjects were able to adopt quicker stride rates, with lower loading on the knee joint (and correspondingly higher loading on the ankle). But two weeks after the study finished, once the one-on-one tutoring was finished, more than half the subjects were injured. "What good is a technique," Tucker asks, "if it gets taught and then is 'forgotten' or unlearned in only two weeks?"

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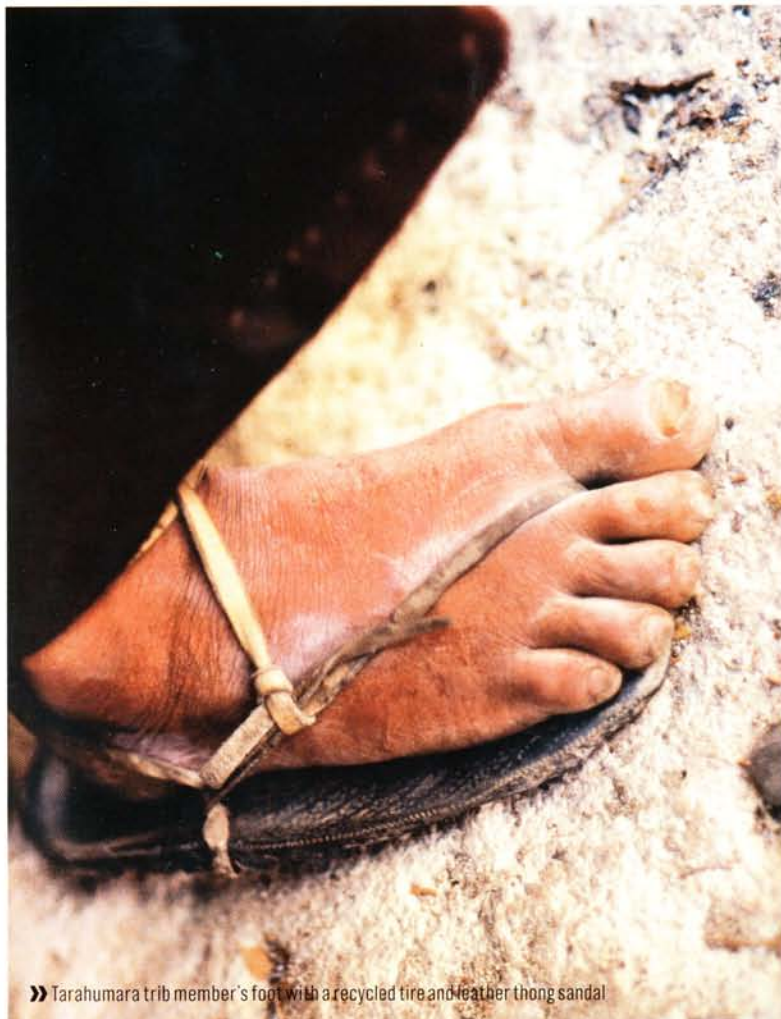


Photo: Ian Austin / Aurora Photos

» Tarahumara trib member's foot with a recycled tire and feather thong sandal

For now, no one really knows if it would benefit the average modern human to learn how to run with some idealized prehistoric stride, or if it's even possible. More research, as the academic papers invariably conclude, is needed. But the implications of the ER hypothesis are as much psychological as they are biomechanical. If our ancestors really did chase wildebeest to exhaustion – and if those who couldn't hack it were consigned to the evolutionary dustbin – then we need to re-evaluate our conception of “normal.”

When McDougall started his odyssey, he was weighed down by dreary conventional wisdom. “I went to one of the top sports physicians in America,” he recalls. “And he said, ‘Ah, not all of us were designed to run. You especially: your body's not designed to run!’” That's a message of “learned helplessness” that many of us have heard, but it makes no sense in an evolutionary context. All of us evolved together, with the same basic body type. As McDougall considered the evidence, and observed the incredible everyday feats of the Tarahumara, he came to a startling conclusion: “Everything I've been told about running is wrong. The limits, the hazards, the necessities – it's flat-out wrong.”

During his research, McDougall visited Dennis Bramble's biological anthropology lab at the University of Utah, where he found them puzzling over the ultimate limit of human endurance. “What will stop someone from running? They just have no idea,” he recalls. “As long as you keep fueling the tank, why would the machine ever stop?” It sounds like a rhetorical question, but it's one that McDougall has taken to heart. When his coach suggested that he could train for and complete the 50-mile race, McDougall was skeptical. “I said, ‘There's no way, dude. I will get injured, guaranteed.’”

“Nine months later, I'm doing five-hour runs with no problem. So if I can go five hours, why can't I go 10? Why can't I go 30?” **R**

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