

# dead runners society

## The Ultimate Running Machine ( From Wired Magazine [10.08](#) )

**Inside a Soviet-style training camp, corporate scientists are reengineering neuro-mechanics, blood chemistry, and brain waves. Welcome to the Oregon Project, where Nike is rebuilding the US marathon team one high tech step at a time.**

By Andrew Tilin

**IT'S A SATURDAY MORNING IN CENTRAL PARK**, and 44 elite runners nervously stretch, retie their shoelaces, and jog in place before the start of the USA Men's 8K Championships. Most of the invited athletes are mulling over typical prerace concerns: Did I log enough miles? Am I psyched to push my body? Should I hit the Porta Potti?



Photo by Ian White  
Oregon Project coach Alberto Salazar, who set the world marathon record in 1981. His runners are training with algorithms and molecular sieves.

But two runners, Dan Browne and Chad Johnson, have more on their minds: Was there enough oxygen in our hermetically sealed house? How reliable is the Russian brain wave software? Did that high-frequency neuro-mechanical stimulator actually strengthen our legs?

Browne and Johnson are among the half-dozen runners on a Nike team dubbed the Oregon Project, a stealth experiment headed by onetime marathon star Alberto Salazar to create a radically better runner. Over the last eight months, they've lived in a five-bedroom Portland bungalow, training pretty much like other top-tier racers. They run about 105 miles a week, sleep 10 hours a night, and wolf down pasta by the bowl. But the rest of their regimen is highly unusual - a multimillion-dollar lab project that relies on up-to-the-minute, sometimes untested, scientific theory and technological gizmos.

For starters, there's the house itself. Research shows that sleeping at high altitude increases the production of oxygen-carrying red blood cells, which, when combined with intense, low-elevation workouts, dramatically improves athletic performance. Of course, it's logistically tricky to live high and train low - unless Nike makes you a special mock-altitude house. Which is exactly what happened. Molecular filters inside the house remove oxygen, creating the thin air found at 12,000 feet. Runners eat, sleep, watch TV, and play videogames at what their bodies think is high elevation. Meanwhile, they train at Portland's sea level.

Then there's the laptop loaded with some \$35,000 worth of Russian software. By analyzing heart rate patterns, the software aims to take the guesswork out of training. Plug electrodes into the auxiliary box, wire up the runner's chest, and four minutes later there's an onscreen message suggesting just how intensely to work out that day. If the runner adds an electrode to his forehead, in 15 more minutes the system assesses overall health by checking the condition of his liver, kidneys, and central nervous system. Johnson, for one, is a big believer in the software. "It knows when I'm ready to go," he says.

Other high tech tools available to the Oregon team include a vibrating platform to increase leg power and a hyperbaric (high-pressure oxygen) chamber to repair muscle tears. The company's goal in all this is clear: use technology to counter the increasing domination of African runners, many of whom were born and train at altitude. "The rest of the world has gotten faster, and Americans have gotten slower," says Salazar. "Our methods have gone awry."



Photo by Ian White

From left to right: Marathoners Karl Keska, Dan Browne, Phillimon Hanneck, and Mike Donnelly.

No one doubts that. The question is whether Salazar's unstinting embrace of technology is the solution. He's the first to admit that it's a quixotic gamble - nobody's ever accumulated so much machinery in the name of making marathoners faster. Which is why this obscure Central Park race (who's ever heard of an 8K?) is significant. The April contest represents the first serious test of the science behind the Oregon Project.

Stripping down to their skimpy blue singlets and black shorts, Johnson and Browne shake the last kinks out of their legs. They inch toward the start line. The gun sounds and they lunge forward, arrowing through the park at a 4.5-minute-mile pace.

**THE RECORD** books tell the humiliating truth: From 1983 through 2001, US distance runners won a mere 4 percent of Olympic and World Championship gold medals. In the marathon, only one American appears on the list of the race's 50 fastest times. That runner, Khalid Khannouchi, first appeared on the list as a Moroccan in 1999, when he set the world record. This April, Khannouchi - now a US citizen - broke his own record with a time of 2:05:38 in Boston.

It wasn't always like this for American marathoners. In the '70s, the US fielded some of the best long-distance runners in the world. Frank Shorter won marathon gold at the 1972 Olympics and a silver at the 1976 games. Bill Rodgers won both the Boston and New York City marathons four times.

But two decades of lackluster results have frustrated American running enthusiasts. Nike vice president Tom Clarke, a veteran of 35 marathons, got particularly angry watching a train of foreigners dominate the 2001 Boston Marathon. As head of the corporation's new ventures, Clarke found a way to channel that anger: He decided to create a US enclave dedicated to the marathon. He knew such a program could resuscitate American racing - and, not so incidentally, would make great business sense for a company that began by selling running shoes. Just think if Nike could create a Michael Jordan or a Tiger Woods for the running world. Or, more realistically, a Lance Armstrong. The Tour de France champion, who is sponsored by Nike, has given a big boost to its new line of cycling apparel - proving that the company can squeeze profits out of swooshed athletes in less-heralded sports. "If we could come in with another wave of champions," concedes Clarke, "it'd be exciting for anything even related to running as a business."

Clarke sold the idea to Nike chair Phil Knight. Then he set out to find two things: a coach and some athletes. He approached Salazar, who had a longstanding relationship with Nike as both a sponsored athlete and an employee (working mostly in sports marketing). Over the years, Salazar and Clarke had discussed the faltering US running scene. When they met last summer, Salazar suggested a marathon-training approach that relies on obscure technology. Clarke, who has a doctorate in biomechanics, figured the unorthodox plan might succeed where standard regimens have failed.

Then Salazar went looking for runners with the right stuff: a willingness to live together, experiment with unusual training methods, and build on their already freakish genetic gift for running fast. Each Oregon Project athlete has posted plenty of impressive race results showing potential for a 10K (6.2 miles) time under 28:30 - sufficient speed for getting to world-class times around 2:08 in the marathon.

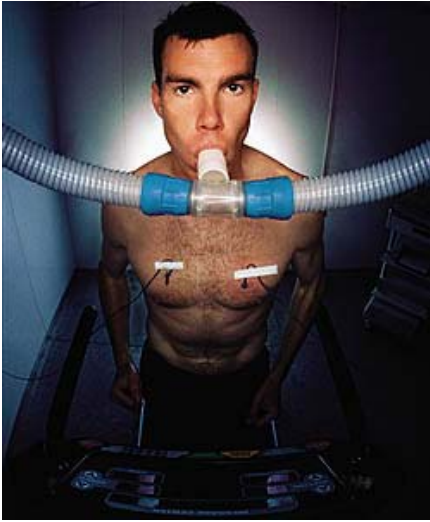


Photo by Ian White

**Dan Browne is measured for maximum oxygen consumption in the Nike Sports Research Lab; his red blood cell count has increased 11 percent since joining the team.**

Back in Central Park, the lead runners are reaching Cat Hill, the race's 3.5-mile mark. Johnson has fallen back, but Browne shares the lead with two others. Into the last mile, the three are still bunched. Finally, with 400 meters left, Tim Broe, from Ann Arbor, Michigan, inches ahead to beat Browne by three seconds and win with a time of 22:26. Browne, however, tops his personal 8K record by more than 30 seconds. Salazar is encouraged yet remains cautious. "There are lots of great ideas out there, great coaches and athletes, on other American teams. But for whatever reason, they don't win," he says. "We're trying to train smarter."

**THE SEARCH** for novel ways to win dates back to the Roman era. Gladiators ate strychnine as a Punic War pick-me-up, although excessive amounts proved deadly. In the 19th century, European cyclists explored the effectiveness of heroin and cocaine. And Charlie Paddock, the 100-meter-dash champion in the 1920 Olympics, swore by a sports drink of sherry and raw egg. By World War II, primitive physiology labs across the United States, Europe, and Russia demonstrated the benefits of aerobic exercise and weight lifting.

Still, sports and science were hardly overlapping fields. That changed after two unrelated developments in the months before the 1968 Olympics. First, the International Olympic Committee introduced drug testing for athletes. The decision to test suggested that illicit chemicals were in fact effective in improving performance - and it triggered an underground scientific movement of renegades determined to stay one step ahead of the drug enforcers. Around the same time, American Jim Ryun set a world record in the mile, clocking 3:51.1. Ryun's achievement suggested the wisdom of his training methods, which relied on the untested scientific notion that running in rarified air helps an athlete absorb oxygen and then convert it to energy. A believer, Ryun did his prerace conditioning at high altitude. Today's endurance athletes follow in the wake of the trail blazed by Ryun; they pack their aerodynamic bike helmets, wrist altimeters, and nutritional supplements into duffels and migrate to high-elevation burgs like Albuquerque, New Mexico, and Durango, Colorado.

Shortly after Ryun's record-setting run, Salazar, who was born in Cuba and raised in Boston, started jogging in the footsteps of his older brother, Ricardo. Soon everyone was chasing Alberto. In high school, he trained with marathon legend Bill Rodgers. He became a track star in the late 1970s at the University of Oregon. Following a disappointing sixth-place finish in one NCAA championship, he put a sign on his bedroom wall with the mantra WILL NEVER BE BROKEN AGAIN. Salazar still occasionally lost - he once received last rites from a race-going priest after his body temperature reached 108 degrees - but he usually won big. From 1980 to 1984, he took the New York Marathon three times, the Boston Marathon once, and made two Olympic teams. And he did it all without regard for science.

"I had a blood-and-guts mentality. I didn't think I needed sports drinks or water," says Salazar.

When a bad case of bronchitis triggered the onset of asthma in the mid-1980s, Salazar experimented with innovative training equipment. He slept in a primitive hypobaric (low-oxygen) chamber to simulate living at altitude and a hyperbaric chamber to saturate his sore muscles with healing O<sub>2</sub>. Yet nothing helped him overcome the effects of losing 40 percent of his lung function, and Salazar stopped competing in 1994. His enthusiasm for sports science, however, never waned. Salazar turned two sons into all-state football and soccer players by mixing them protein potions and making them sprint with parachutes on their backs.

**LATE** last year, with the project approved, Salazar rented a 3,000-square-foot house in northwest Portland and started recruiting top-flight runners interested in becoming marathoners. For the athletes, the call from Salazar was like winning the lottery: Join a group of talented training partners; live in a rent-free, high tech house; score plenty of Nike schwag; and have the whole thing overseen by a marathon legend turned coach. Mike Donnelly was working part-time at a bank and running alone when Salazar made the offer. Dave Davis was completely broke and about to start landscaping for cash. Now Nike pays them an undisclosed stipend so they can train full-time. For Karl Keska, signing on with the Oregon

Project was an easy decision. "I'd like to do well in an Olympic marathon," he says. "As frightening as it sometimes sounds, this seems like a very natural and normal environment for helping me reach my goal."

There's nothing natural or normal about a sea-level house that simulates 12,000 feet. The idea for the altitude house is based on research done in 1997 by Benjamin Levine and James Stray-Gundersen. Their 39-person study proved the benefits of the live high, train low theory. They found that runners who bedded down in the mountain town of Deer Valley, Utah, and went to train in Salt Lake City - some 4,000 vertical feet lower - posted improvements in their 5K times that were unmatched by athletes sleeping and training at either high or low altitudes. By breathing rarified air, the live high, train low subjects benefited from boosted oxygen-carrying capacity and improved oxygen delivery to the muscles. Exercising in oxygen-rich air, the subjects could reach peak training intensities. Live high, train low offers the best of two ambient worlds: Sleep your way to better physiology, and redline your muscles into condition during workouts.

Salazar met with Levine and Stray-Gundersen in Dallas in 1998 to get advice about his asthma. He quickly became a convert to the live high, train low method. The Oregon Project house has been outfitted with a few airtight light fixtures and about \$110,000 worth of nascent, air-thinning technology. In three bedrooms and a common room, electrical pumps draw air through molecular sieves. The sieves trap unwanted oxygen, which gets flushed back outside, while carbon-dioxide filters, various sensors, and wall-mounted keypads work to maintain the rooms' air mixtures. Outside the altitude house lie the endless running trails of Portland's Forest Park, but inside, behind sealed windows, is the air usually found somewhere above snow-capped Mount Hood.



**Photo by Ian White**  
**Mike Donnelly relaxes behind the sealed windows of the rec room; after one staggering day, the team realized controls were mistakenly set at a Himalayan 14,000 feet.**

"We've got to recalibrate in here," says Salazar over the din of two thigh-high pumps in the rec room. It's a Thursday morning, the runners are out for a 10-miler, and Salazar has been summoned to the house because the system alarm went off. "The athletes didn't change a filter when they should have," he says, studying the digital display on the altitude-system keypad. "At least there are no headaches or nosebleeds to report."

Not yet, anyway. But Salazar and the coaches of other live high, train low athletes, including Lance Armstrong and 2001 world mountain-bike champion Alison Dunlap, admit they're just guessing about the proper air thinness. As early adopters, they have no one to consult. Their best guide, the 1997 study, lasted only a month.

Dunlap slept in her altitude room for weeks before the 2000 Summer Olympics, and her hematocrit - the ratio of red blood cells to total blood volume - successfully jumped 21 percent. But she blames living high for her inability to recover from hard workouts and shake a bad chest infection. Undeterred, Salazar has programmed the Oregon Project's systems at 12,000 feet based on recommendations of Colorado Altitude Training, the Boulder-based manufacturer of the house's equipment. "We think the sweet spot is somewhere between 8,000 and 13,200 feet," says CAT president Larry Kutt.

The athletes felt the elevation as soon as they moved in. Johnson had a hard time catching his breath after rearranging his bedroom. Keska couldn't sleep and plodded through his workouts. Then someone noticed that the rec room controls were mistakenly set to 14,000 feet, staggering most of the runners as if they were approaching the Himalayas.

"It could turn out that what's good for one guy is bad for another," says Salazar, futzing with a handheld sensor to verify the rec room's oxygen content. "We'll need to find out if somebody should sleep at 9,000, not 12,000. Or if most of the runners should go four weeks at altitude, then three weeks off. There are endless scenarios."

Salazar and Nike won't wait for the sport science community to provide answers. Nike exercise physiologist Loren Myhre regularly takes blood samples from each runner to monitor differences in the counts of their oxygen-toting red cells; the first of what could be years' worth of lab samples were submitted before the New York City 8K. When Myhre has enough data, the Oregon Project findings could provide a live high, train low road map for every willing athlete.

That promise could, thanks to the drug cops, go unrealized. In February, the United States Anti-Doping Agency, the governing body responsible for fighting drugs in Olympic sports, hired a think tank to establish recommendations on where acceptable performance-enhancement practices end and cheating begins. One key consideration: the ethics of the altitude house. Preliminary recommendations will be made public early next year.

"The argument for altitude rooms is that they make up for those athletes that can't live high. What they don't take into account is that people living high don't get the benefits of training low," says the agency's senior managing director, Larry Bowers. "There's nothing that says sport is fair. But where do you draw the line?"

Salazar's confident that the Anti-Doping Agency will ultimately approve the altitude house. He says it's no different from other legal scientific advances like heart rate monitors and sports drinks.

In the meantime, the common goal of striding ever faster has bonded the athletes. Even Salazar's request that the runners spend 12 hours of each day in the house - specifically, the three bedrooms and rec room outfitted with air-thinning equipment - hasn't dampened spirits. There's always an action flick on television, and Keska and Johnson spend hours playing *Halo* matches on an Xbox. (Their enthusiasm is contagious: They plan to network several units to expand the competition to the other housemates.) Saturday night comes and they're hanging together - looking out at the Willamette River through sealed windows and plastic liners.

**TWO** days before a 3,000-meter race at the University of Washington, Salazar wants to check Chad Johnson's condition. He could start by asking Johnson how he feels, maybe factor in the color of his urine or the rate of his pulse. Instead, Salazar tells the lanky runner to lie faceup on the living-room floor, next to a laptop wired to a box that's sprouting electrodes.

"Chad just had one of the best workouts he's run in the last week and a half," says Salazar, attaching the conductors to Johnson's bare chest. "I bet he's ready to run great."

"I think I'm running pretty good," affirms Johnson.

They wait for the OmegaWave Sports Technology System to blip to life. In four minutes, the electrodes will read heart rate variability - the small dips and rises in heart rate that indicate health, illness, or exhaustion. Then algorithms will crunch the data to assess Johnson's condition. (A lengthier procedure charts slow-moving omega brain waves, which reflect the state of a subject's hormonal and nervous systems. The brain wave test provides further guidance as to whether the runner should rest or push the envelope.)

A small graph appears on the screen. "That's what we want," says Salazar, pointing to a loose cluster of dots. "When there's too little variation, the heart is tense and tired." Indeed, the OmegaWave reports in its robotlike language: THIS SYSTEM READY FOR INDIVIDUAL LOADS OF MAX QUANTITY AND INTENSITY.

Developed by Russian scientists and computer programmers during the '80s and '90s, the OmegaWave system has won a following. The Oxford rowing team, underdogs last March against Cambridge in their annual head-to-head race on the Thames River, used the OmegaWave to guide their training, and won. The NFL's Miami Dolphins also recently bought a system. Stanford's rowing team, the NBA's Phoenix Suns, and a couple of professional baseball teams have all examined but passed on the technology.



Photo by Ian White

**While Chad Johnson and Dan Browne air it out on Nike's Michael Johnson track, Coach Salazar hasn't changed his approach to unorthodox -- and unproven -- tech: Why not try?**

What stopped them? There's the expense. And also the lack of scientific evidence. Neurologists have never heard of the "omega waves" the system supposedly charts. Cardiologists agree that changes in heart rate can indicate physiological abnormalities, but correlating that information with a training plan remains sketchy. "It's smarmy of them to be marketing something that has little to no publication," says Robert Schoene, an exercise physiologist and pulmonologist at the University of Washington.

The OmegaWave boosters say Western researchers are close-minded. They insist that Russian and American scientific literature supports the underlying theories behind the software; the system simply ties those theories together in a logical package. The Russians insist that the OmegaWave can stand up to the rigors of clinical testing.

The debate over the system plays out in the ranks of the altitude house. Johnson uses the OmegaWave system nearly every day and doesn't mind surrendering his intuition. "I started believing in it when I was really tired. I'd check myself, and the system would say I was tired," he says, propping himself onto his elbows.

Keska's not so sure. He backed out of one intense workout on the OmegaWave's recommendation. "But another time it said I was absolutely screwed, and I had a tremendous workout," he says. "I take what it says with a grain of salt." The first time Browne was tested, the system missed by 15 percent his rate of maximum oxygen consumption, a key figure in assessing an endurance athlete's abilities. So he's sticking with his own impulses.

Salazar, however, hates to rely on a runner's word for his own condition. The coach knows the obsessive-compulsive instinct to overtrain - and the perils of it, too. His tenure as a top marathoner lasted just two years.

"These guys are so dedicated and determined," he says. "Maybe they'll tell me, 'I don't feel great.' Well, you know, how *not* great do you feel?"

Salazar finds the OmegaWave valuable because it replaces the need to regularly poke a subject for blood or run him to exhaustion in a lab. He says that the system will eventually win over all the Oregon Project runners, especially as they bend under the strain of increasingly hard workouts. Salazar forgives the system an occasional miscalculation, because he believes the OmegaWave reliably indicates trends. "Is it perfect? I don't think anything's perfect," says Salazar, pulling the OmegaWave electrodes off Johnson's chest. "But it gives valuable information."

A few days later at the University of Washington, Johnson runs a personal best 7:55 for the 3K. That 4:15-per-mile pace earns him second place.

**SALAZAR** is up-front about his willingness to try almost anything in the name of improving performance. To some, his training methods reek of desperation. But he figures that embracing unorthodox - and as-yet unproven - technologies may in the end give his athletes an edge. So why not try? "As you improve, you have less room for improvement," he says, sitting with Browne and Johnson on a couch in the altitude house. "That's when you really start adding things. You don't leave any stone unturned."

Which explains why Salazar and the project members are clustered in the living room, watching a laptop that shows a split screen of Browne and Johnson running their individual track workouts. DartTrainer, the \$3,000 software coaching package, slices up video into 30 frames per second. Designed to help athletes from gymnasts to skaters to baseball players polish their techniques, the software made a splash during the 2002 Winter Olympics telecasts, when DartTrainer generated cool instant replays by superimposing

images of skiers competing side by side against their peers. What helps downhillers Salazar figures could help distance runners.

"See how you toe out?" Salazar tells Browne, clicking frame by frame through video to expose a slight flaring of the runner's right foot. "We want to bring that in." Browne nods, adding, "I'm bringing my hands too high."

Working with the DartTrainer is risky, since changing even one aspect of a runner's style might trigger injuries or breakdowns in form. "But you don't have a chance to compete against the very best unless you run like them," says Salazar. He expects DartTrainer to help lower each runner's 5K time by about 10 seconds - roughly 1 percent.

Perhaps the most curious device in Salazar's tech arsenal, a vibrating platform, was set up in the living room back when the athletes moved in. The neuro-mechanical stimulator, called Nemes, looks like a mutant bathroom scale with a telescoping handlebar for support. To "work out" on the machine, athletes stand on the motorized platform for several 1-minute intervals while it agitates just 4 millimeters up and down - an imperceptible movement unless you're along for the weird, leg-tingling ride.

Studies published in periodicals like the *European Journal of Applied Physiology* report that athletes who incorporate vibration training into their regimens make significant power gains. The Nemes, which is used by Austrian skiing star Hermann Maier, increases the amount of electricity running from the brain to the muscles and recruits greater strength by firing up usually dormant muscle fibers. The brain also learns to dispatch more electricity in subsequent physical efforts. "It seems to be reprogramming the brain or rewiring the nervous system. We don't exactly know yet," says Henk Kraaijenhof, a Dutch track coach who works with Nemes inventor and former Italian track team physiologist Carmelo Bosco. Kraaijenhof and others have evidence that Nemes workouts help, with elite athletes improving their vertical leaps - a measure of lower-body power - by up to 5 inches.

Salazar figures improved jumping ability could lead to a longer running stride, which could produce big payoffs: A 1 percent gain in distance covered per second saves a competitive runner about 80 seconds in a marathon. "It's all physics," he says.

One machine that Salazar hasn't yet set up is his old hyperbaric chamber. When inflated, the couch-sized, pressurized tube seals around a supine athlete. By compressing air by 30 percent - akin to being submerged in 10 feet of water - the chamber allows the body to become highly saturated with oxygen, accelerating recovery from muscle tears, sprains, and bruises. Or so the theory goes.

Since much larger hyperbaric chambers aid in the regeneration of tissue for burn victims and plastic surgery patients, athletes from NFL linebacker Bill Romanowski to boxer Evander Holyfield believe smaller, lower-pressure chambers deliver similar benefits, along with better sleep and miraculous recoveries from serious injuries. However, there's no science to back up the claims. "You read the promotional literature, and it tells you the chambers do everything," says Salazar. "Hey, they certainly won't hurt you."

And that, in a nutshell, captures Salazar's I'll-try-anything enthusiasm. Not everyone in the running community shares it. "I'm sure there's lots of equipment out there that I don't even know about. I just use the things that I understand," says Joe Vigil, who coached 19 national-champion collegiate cross-country teams and currently trains six Olympic-caliber runners. "I don't have time to mess around."

Even those willing to entertain the Oregon Project's scientific potential believe that the technology's biggest effect could be psychological. "Whether or not you think it works or it actually does work, if your competition is thinking the same, then it all plays into an advantage," says Olympic medalist Frank Shorter, an early subscriber to the benefits of living at altitude. "When I was running, my motto was 'I'll never deny a good rumor about me.'"

A couple of months into the program, however, the runners began to question Salazar's fanatical enthusiasm for dabbling. They staged a mutiny of sorts, dragging the Nemes platform into the garage to gather dust and persuading Salazar to cancel the Pilates sessions.

"We run 10 miles in the morning, 5 miles in the afternoon, and the altitude rooms don't allow us to recover so quickly. That doesn't leave a lot of energy to frivolously waste on whatever else," says Browne. "We can only do so much in a day."

Salazar acknowledges that he's pushing the standard training program into unfamiliar territory. So he's lightening up. He's postponed regular use of the DartTrainer software until the end of the grueling summer racing season; that's also when he'll insist on Nemes training and on consistent visits to the hyperbaric chamber. He hopes that by fall his athletes will be so much faster that they'll accept any device he introduces. "I don't want to force things on the runners. If they improve a lot, then they'll say, gee, yeah, let's take another look at the vibration platform," says the coach. "They've got to believe in what they're doing."

**FOR SALAZAR** the route to the 2004 Olympic Games is clear. This summer, his runners will compete in track events and short road races. By spring 2003, he wants them putting together a string of six sub-4:30 miles, finishing a 10K in 27:40. "That's what other 2:08 marathoners can run," he says. Then he'll prescribe the longer workouts needed to win a 26.2-mile race that fall.

If an Oregon Project runner delivers an impressive performance in his first marathon - Salazar won in his debut - all eyes will fall on him at the Athens Olympics. And if a team runner medals in Greece, the Nike project will be lauded as genius. The last win by an American marathoner in the Olympics was Shorter's victory 30 years ago, which kicked off a national running boom.

There's the destination, and then there's the journey. Blood tests in the spring suggested that the altitude house was working - both Donnelly and Johnson showed big spikes in their hematocrit levels. But then Donnelly and Keska began experiencing shortness of breath and abnormally high heart rates, so Salazar lowered the elevation in their bedroom to 7,000 feet. Donnelly aggravated an Achilles tendon injury, requiring surgery that would put him out of competition for most of the summer. One stride forward, two strides back.

But Salazar won't stray from his innovate-or-bust training formula. "The plan remains doing whatever is necessary to create winners. We'll think out of the box, not just for the sake of being different but to find what really works," says the coach. "I know this is the way to go."

Early last May, Salazar had another opportunity to show the track world that technology can help push American runners to the fore. On a cool, still Palo Alto night at Stanford University's Cardinal Invitational 10,000-meter race, Dan Browne took off against a field of Kenyans and African-born Meb Keflezighi, who holds the American record at the distance.

The Kenyans and Keflezighi immediately bolted to the front, and Browne fell to the rear of a pack for the first 5 kilometers. Then he made his move, passing rivals until, on the last lap, Browne powered by three more athletes and closed fast on a fourth. Salazar, standing on the track's perimeter, only looked calm. "I was jumping up and down inside," he says. Kenyan Albert Chepkurui won, followed closely by Keflezighi. Kenya's Luke Kipkosgei crossed the line third - only a hair ahead of Browne, who finished in 27:47.04, shattering his old best by half a minute.

On a great day, an elite 10,000-meter runner competing in a pressure-packed international competition can maybe take a double-digit chunk out of his time. Reducing one's mark by 30 seconds, however, borders on the unnatural - and perhaps Browne's feat was exactly that. His red blood cell count, measured before traveling to the Bay Area, was 11 percent higher than it was the day he joined the team. While Browne can't quantify how much the altitude house contributed to his performance, he knows one thing: He didn't run like this before the project.

"It was the best competition of my life. I went after those guys," says Browne. "I was in a world-class race. And I ran on a world-class level."