Outside magazine, October 2000

If you want to get high, there's still a price to be paid for invading the towering ranges—despite some newfangled shortcuts

By Mark Jenkins

I am suffocating. The thought transfuses into me intravenously. It is cave-black and hot and wet and there is the throb of an underground river and my arms are bound along my sides and I can't breathe. I don't understand what's happening until I jerk my head around and see a masked assailant behind me. He has pulled a plastic bag over my head and twisted it tight around my neck, and now I'm trying to scream, my mouth stretched open—but there's no air and I can't believe this is how I will die, with my brain popping and my lungs collapsing simply for lack of a little oxygen....

I wake. The sweat-drenched sleeping bag is twisted like a tourniquet around my torso. I grope for my headlamp, switch it on, check the time, find my notepad, and pencil in: "Night 10, 23:35, 13.6% O2, 18,200 ft, can't breathe, hellish headache."

I take a swallow from my water bottle, force myself to take another, kick off the sleeping ba apnea, with fatigue, dizziness, and violent bouts of nausea still left to look forward to. All these symptoms may pass, or they may not; AMS is a fickle torturer. And there's only one sure cure: descent. It's the middle of the night and I am loath to lose altitude, but my body is clearly telling me that I'm not yet capable of sleeping at 18,200. No sleep tonight and tomorrow I'll feel hollow-headed, agitated, buzzy—the perfect mental malaise for screwing up.

I reluctantly swing my feet out of my sleeping bag, open the door, step out of the room, and instantly plunge 11,000 feet.

CLIMB HIGH, SLEEP LOW. That has been the mountaineer's maxim for a century. The old paradigm: Get to the base of your chosen massif, set up base camp, start ferrying loads. Up for the day, down for the night. Put in Camps I, II, III, or more over the course of several weeks, giving your physiology plenty of time to acclimatize. Then, when the clouds clear, blast for the summit. With skill, tenacity, stamina, and strength (in that order), you may come home. Throw in good luck and good weather and you may come home having summited. Throw in a good partner and a healthy sense of humor and you may come home having actually enjoyed yourself.

A thousand feet a day. Another traditional mountain-climbing maxim. Hence mountains in the 15,000- to 19,000-foot range would take about a week; 20,000- to 25,000-foot peaks, three weeks; 8,000-meter peaks (higher than about 26,250 feet), six weeks—not because of the technical difficulty of the climbing or the number of feet to be ascended, but simply because the average human body requires that much time to adjust to the lack of oxygen at high altitude.

Enter the new paradigm: speed. If the Eiger could be done in eight days, why not seven, or three, or one? The record for climbing the North Face of the Eiger is now less than seven hours. That's fine for summits under 16,000 feet. But on the high peaks, genetics has gotten in the way of modern man's ever-accelerating pursuit of acceleration. Humans evolved at or near sea level, where the air is 78 percent nitrogen, 21 percent oxygen, and 1 percent trace gases, such as carbon dioxide. Along with food and water, oxygen is necessary to keep our body's 100 trillion cells alive. Like a sophisticated, finely tuned engine, the human body is calibrated to perform optimally with air that contains 21 percent oxygen at 14.7 pounds of atmospheric pressure per square inch at sea level. Drive the average human machine up 10,000 or 20,000 feet and it will start sputtering and choking like a car with a maladjusted carburetor. Although the relative percentage of oxygen in the air remains constant, the higher you go, the more the air pressure drops—and the more the pressure of oxygen drops in turn. Imagine a column of air five or six miles high. At the bottom of the column—sea level—the weight of all the air above compresses the air below. Halfway up the column, at around 18,000 feet, there's half of the pressure and thus half of the oxygen. Near the top of the column—say, on the summit of Everest (29,035 feet)—there's only one-third the pressure that exists at sea level and thus only one-third the oxygen.

No way around it. We were not designed for high altitude, and by God, you know it every time you go up there. That said, for years mountain climbers have been attempting to preacclimatize—hiking, climbing, skiing, or just hanging out at elevations lower than their goal but higher than their home. Doing a few fourteeners before heading for Mount Foraker, scrambling in the Alps before climbing in the Andes. Still, although these preclimb climbing trips have honed many an alpinist's mental acuity, mountain acumen, and technical skill, they are usually too short to effectively jump-start physiological acclimatization. The only way to acclimatize for high-altitude mountaineering has been the slow way: Go up high and stay there until you stop puking.

Until now.

"CONTRARY TO POPULAR belief, it was proven back in the seventies that living and training at moderate or high altitude did not produce faster endurance athletes," says cardiologist Ben Levine, director of the Institute for Exercise and Environmental Medicine in Dallas, who spent a year living in Nepal and working for the Himalayan Rescue Association. "Any beneficial acclimatization effect was detrimentally offset by the nability to train at high intensity due to the lack of oxygen."

Humans can survive without food for three weeks, without water for three days, but without oxygen for barely three minutes. Responding to conditions at high altitude, respiration and heart rate escalate immediately, straining to deliver oxygen. The kidneys, sensitive monitors of our blood chemistry, react by secreting a hormone called erythropoietin (EPO), which stimulates the production of extra red blood cells in the bone marrow. These are the tractor-trailers that haul oxygen to the power plants (cell mitochondria). Put a lot more tractor-trailers on the highway and you'll be able to burn a lot more fuel, substantially boosting endurance and power. (More red blood cells is exactly what blood-doping and synthetic EPO injections create, hence the suppurating controversy in some sports, particularly road cycling.) Although going from sea level to the top of a fourteener will temporarily stimulate the kidneys to increase EPO production threefold, the importance of this increase to mountain climbing pales in comparison to increasing your blood oxygen level simply by breathing harder and faster—otherwise known as ventilatory acclimatization.

"A decade and a half ago, after studying the current literature, it occurred to us that there might be a way to get the best of both worlds," says Levine. "That is, have athletes live at moderate altitude, taking advantage of the improved oxygen transport system, but train at low altitude, where the extra oxygen would allow for maximal workouts."

With colleague James Stray-Gundersen, and funded by the U.S. Olympic Committee, Levine set out in 1989 to test his hypothesis. For seven years the team conducted multiple experiments with elite American endurance athletes—some living and training at moderately high altitude (Deer Valley, Utah, 7,200 feet), some living and training at sea level (San Diego), and some living at moderately high altitude (Deer Valley) but training at moderate altitude (Salt Lake City, 4,390 feet). In 1997 Levine and Stray-Gundersen published their findings in the Journal of Applied Physiology in an influential paper titled "Living High—Training Low."

"What we found then," says Levine, "and have confirmed in subsequent studies, is that athletes who live at moderately high altitude but train at low altitude can improve performance at sea level by 1 to 3 percent." In other words, living high and training low turns out to be a legal, natural, noninvasive form of blood doping. (Whether it is ethical or not is another, very complicated question.)

At about the same time, Heikki Rusko, a sports scientist from Finland, reported similar results, although his method of bringing endurance athletes up and down in altitude was dramatically different. Finland is as flat as the lakes that cover it, so Rusko built "nitrogen huts" to simulate high altitude. These huts reduced the availability of oxygen not by altering the atmospheric pressure, but by simply pumping in more nitrogen. Again, athletes increased their performance by 1 to 3 percent.

Which may not seem like much until you realize that in the 10,000 meters at the 1996 Olympics, the difference between the gold medal, won by Ethiopian Haile Gebrselassie in 27:07.34, and eighth place, taken by Rwandan Mathias Ntawulikura in 27:50.73, was less than 3 percent. The difference between Lance Armstrong's winning time in this year's Tour de France and that of the 100th-place finisher was also less than 3 percent.

"Put it this way," says Larry Kutt, owner of Colorado Altitude Training (CAT). "In the world of professional endurance athletics, 3 percent is the difference between being the best on earth, with all the fame and million-dollar contracts that that brings, and flipping burgers, trying to find time to train."

At least that's Kutt's claim. His company, capitalizing on Levine's research and Rusko's engineering, has begun to build something called a Colorado Mountain Room for professional athletes. As part of my preparation before heading off on an expedition to climb a notorious 20,000-foot peak, I spent about two weeks sleeping—or trying to—in a room jury-rigged with CAT equipment to simulate oxygen availability at varying altitudes. "No more driving up and down the mountain," promises Kutt. "We turn your bedroom into a nitrogen room—an oxygen-deprived environment in which you can sleep high–train low right in your own home."

I had contacted CAT, one of several U.S. companies now marketing oxygen-deprivation chambers for endurance athletes, at the suggestion of Peter Hackett, another of America's foremost altitude specialists. Hackett has published extensively on the pathophysiology of altitude-induced illnesses. He summited

Everest on a medical research expedition in 1981, directed his own physiology research lab at 14,200 feet on Mount McKinley from 1981 to 1989, and is now president of the International Society for Mountain Medicine. I was interested in finding out whether such a device might be useful in preacclimatizing for a speed ascent of a high peak.

"It would be a worthwhile, if limited, experiment," Hackett said. "If you sleep in a nitrogen room every night for several weeks prior to departure, even if it doesn't make you climb any faster, it will definitely reduce your risk of AMS, HAPE [high-altitude pulmonary edema] and HACE [high-altitude cerebral edema]."

MY WIFE, SUE, is accustomed to my departures, but not to my leaving before I'm gone. In this case, I quit sleeping with her and moved into the spare bedroom upstairs.

"Honey," I said, "this is all in the name of science."

"You brave guinea pig, you," she said, adding that altitude must have already killed too many of my brain cells.

Nevertheless, she helped me duct-tape opaque plastic sheets over the room's windows, closet doorjambs, light fixtures, and electrical outlets.

Once the spare bedroom was swathed in plastic, two "oxygen concentrators," dishwasher-size machines that separate oxygen from nitrogen, were placed outside the door. Each machine had two hoses that were plugged into the room via holes drilled through the door. One hose sucked normal air out, the other pumped nitrogen-enriched air in. A computerized control panel with an LED screen that reported the room's oxygen content was bolted onto the inside of the door. Just below it, an eight-inch hole was bored through the door and a ventilation fan installed. Two small oxygen sensors and one carbon-dioxide sensor were taped to the walls. A carbon-dioxide scrubber—a large metal box filled with a kitty-litterlike gravel that would absorb the excess carbon dioxide I would be exhaling—was set up inside the room.

Because I was the first mountaineer willing to try out the mountain room, and because the computer controlling the machines was a new, untested prototype, Kutt insisted that Hackett plan my altitude protocol, which he did. If everything went smoothly, I was to spend two nights at 10,000 feet, two nights at 12,000 feet, three nights at 14,000 feet, three nights at 16,000 feet, and six nights at 18,000 feet.

The first two nights I set the oxygen meter at 18.69 percent, which translates to 10,000 feet above sea level. Since I already live at 7,200 feet, I slept fine, although the computer-controlled fan kicked on and off erratically, bumping the oxygen level in the room up and down. The third night I staggered in after downing a few too many beers, dialed the meter to 17.3 percent oxygen (12,000 feet), and woke in the middle of the night with nothing less than what I deserved—a screaming headache and a sketchy stomach. But it wasn't all my fault; the computer had again malfunctioned, and I was actually up at almost 15,000 feet.

Night four went fine at 12,000 feet, but on nights five, six, and seven I slept little. The computer was acting up again, and to compensate I started manually overriding the system by simply opening and shutting the door to attain the desired oxygen concentration in the room—a procedure that meant waking up about every hour.

Night eight I should have been at 14.89 percent oxygen—16,000 feet—but I couldn't get the level above 15,000 feet, and the overheating machines made the room as hot as a brothel in Bangkok. Sometime after midnight I bailed, tiptoeing downstairs and slipping into bed with my wife. ("So," she murmured, "the boy in the bubble returneth!")

Thereafter I missed three nights because my "mountain room" was too hot. (CAT now sells an air-conditioner to supplement its $14,500 setup.)

On night 12 I fell asleep at 10,000 feet and woke at 17,000, choking for air in a room stiflingly hot. On night 13 I zoomed from 7,200 to 18,200 feet and had some fine hallucinations. Nights 14 and 15, more heat and more hallucinations. On night 16, my last, I shot up to 18,500 feet, got myself good and sick for a few hours, and then escaped to sleep with my wife before leaving for the mountain in the morning.

BJÖRN DAEHLIE, arguably the greatest cross-country skier ever, winner of eight Olympic gold medals, purportedly drives his own oxygen-deprivation "mountain room" RV from race to race, eating, sleeping, and living at moderately high altitude and competing at low altitude.

According to Rolf Saeterdal, altitude consultant for the Norwegian Olympic Committee, "Many of Scandinavia's top endurance athletes—runners, cyclists, rowers, cross-country skiers—are using this technology. The Finns have an entire 'nitrogen hotel' where their endurance athletes live. Oxygen is the key element in endurance sports. Controlling it, in both the living and training of athletes, is the future of elite aerobic athletics."

But are oxygen-deprivation chambers part of the future of high-altitude mountaineering, notwithstanding my own obviously flawed experiment?

"It's not the increase in the number of red blood cells that's important to a mountaineer," says Hackett, "but rather the pressure of oxygen in these red blood cells, which is a function of breathing harder. Still, it's likely that sleeping or living in a nitrogen chamber for an extended period before going to high altitude will decrease the amount of time it takes to acclimatize in the mountains."

Levine is more circumspect. "If you think of altitude as medicine," he says, "when it comes to preacclimatizing for mountains in a nitrogen chamber, we don't yet know what the dose should be or how long it should be administered.

"What determines success or even survival on a mountain usually isn't speed," continues Levine. "More often it comes down to good judgment, experience, and common sense—none of which you acquire in a chamber. And given the option of sleeping in a chamber or climbing in the Alps to preacclimatize, well, which one would you choose?"

SO DID MY WIFELESS, sleep-deprived fortnight of sleeping high and training low make any difference on my climb? Alas, if only mountaineering were as straightforward as cycling, swimming, or running. The temperature the morning we went for the summit was minus 37, the snow on our planned route was avalanche-prone windslab over blue ice, I hadn't slept well for a week because the tent was too small, and my partner and I were as compatible as teeth and tinfoil.