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Supercharge Your Training

FOR ROADIES

By Fred Matheny

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Contents

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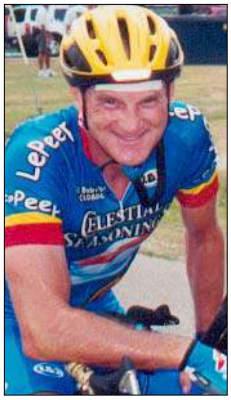
About the Author



Fred Matheny has written about cycling for 25 years, including a dozen books and hundreds of articles. He has coached at numerous cycling camps and authored the "Ask Coach Fred" column in the weekly *Road-BikeRider.com Newsletter*. He also has served as VP of RBR Publishing Company, which includes the www.RoadBikeRider.com website, newsletter and a book division that specializes in "how to" information for road cyclists.

Fred began cycling in the early 1970s after an athletic career that included football and track in high school and football at Baldwin-Wallace College in Ohio, where he was named all-league and his team's outstanding offensive lineman.

After he moved to Colorado in 1970, cycling helped him lose 50 pounds he had gained to play college ball. He enjoyed riding so much that it became his passion.

Fred rode his first race in 1976. A category 2 racer since 1978, his top placings include a cat 3 win in the Mount Evans Hill Climb; a world record of 5 days, 11 hours in the 1996 Team Race Across America; first place in the Colorado Masters Time Trial Championships; and third place at the 2000 Masters National Time Trial Championships.

Fred and his wife of 34 years, Debbie, live in Montrose, Colorado. Their son Ross is a high school teacher in Washington state.

Introduction

If you've followed the plans laid out in our 3-eBook series "For Roadies" —*Basic Training*, *Off-Season Training* and *Spring Training*—you're in the best cycling shape of your life.

You built a solid base over the winter. Then you converted off-season strength and endurance into cycling-specific power during the 8-week spring transition.

Now it's summer and time to cash in on all your hard work. This may mean top performances in competition or fun and adventure riding centuries or tours.

During the season, it's natural to want something extra for a special event. Perhaps you want to sharpen your form for a hilly tour or the high-mileage demands of a cross-state ride. Maybe a century PR is your goal, or getting onto the podium in your club's road race championship.

"Something extra" is what this eBook is all about. I'll reveal dozens of special training and racing techniques used by the world's best riders to supercharge their performances. Some are secrets that coaches and pros would prefer to keep to themselves. Others are gleaned from physiology studies conducted by exercise scientists obsessed with finding out how the body

performs. And some are just common sense—but go against traditional tenets of the sport that riders have clung to for years.

Some will help you peak for specific events. Others will guide your daily training. And several of these workouts are designed to fight the staleness that you might experience as the season wears on. They'll make you eager to get in the saddle at a time of year when other cyclists are losing interest in the bike.

HOW TO USE THIS BOOK

Don't indiscriminately begin to use these workouts!

Picking a training technique that strikes your fancy and trying it on your next ride is a haphazard and potentially dangerous approach. Using the book as a "workout buffet" will probably stall your progress and could lead to overtraining and burnout.

Instead, read each chapter carefully and decide if the workout suits your goals and current fitness. I've included guidelines to help you decide.

What if you haven't been on a structured program?

Many workouts in this book are designed to help you peak for specific events. They assume that you already have a solid cycling fitness base. If you don't, these techniques are still valuable. But use them with care.

Better yet, check out the yearly program I've created in the *Basic Training*, *Off-Season Training* and *Spring Training* eBooks, or my all-inclusive new paperback, *Fred Matheny's Complete Book of Road Bike Training*. The books (available in the online Bookstore at RoadBikeRider.com) will help you design a consistent and moderate training program that makes the advanced techniques in this book much more effective.

Fred Matheny

CHAPTER 1

Manipulating Intensity — the Key to Improvement

This concept in a nutshell: Go real hard when you go hard. Go real easy when you go easy.

Most of the techniques in this book are hard work. Doing them correctly requires you to perform at painful levels of intensity.

When you do stage race training (chapter 6), coach Dean Golich's "as hard as you can" intervals (chapter 8) or low-cadence, high-resistance workouts (chapter 9), you'll be working (some would say suffering) at levels most riders never reach except in competition—or when fleeing from a rabid mastiff.

That's what's required to nudge your fitness to new levels. As Golich says, "Training is hard work. But so is bike racing. If you want to be able to ride hard in competition, you have to ride hard in training."

Of course, training shouldn't be composed of nothing but miserable suffering. If you employ the techniques in this book during all of your training, you'll burn out quickly. So before you read the following chapters, get all fired up and flame out spectacularly in a couple of weeks, please read (and heed) the following wisdom I've gained from top coaches and riders of the last 25 years.

VARY THE INTENSITY

If there's one trait that distinguishes pros from recreational riders, it's how they pace their training. Professional riders can go fast because when they train hard (or race), they go like lightning. But when they train slowly, they go very, very slowly.

Conversely, most recreational riders train at a moderate pace—fast enough to feel like they're accomplishing something but not so hard that they're suffering unduly. You'll hear some coaches refer to this pace—about 80 percent of max heart rate—as "no-man's land." Like the shell-pocked wasteland between dug-in armies during World War 1, you don't want to be there very often.

Why? Because no-man's land delivers a double whammy. It compromises recovery *and* improvement.

At a moderately brisk pace of around 80 percent of max heart rate, you're not going slowly enough to recover. You need a pace around 65 percent of max heart rate to pump nutrient-rich blood to your leg muscles without stressing them further.

Unfortunately, when you're languishing in no-man's land, you're also not going fast enough to improve. That takes an intensity of about 90 percent of max.

When every ride is done at a medium pace, your results are bound to be mediocre.

FAST IS BETTER

There's an emerging consensus among researchers and coaches in favor of high-intensity training. In fact, some exercise scientists argue that about 25 percent of your total training time should be done at intensities slightly below, at, or slightly above your lactate threshold (LT). That's almost certainly extreme, but it illustrates the direction your training should take for maximum improvement.

Riding at high intensity saves training time, too. As American pro roadman Jonathan Vaughters says, "You can work intensely at 80 to 85 percent of max heart rate for an hour, or you can ride six hours at 70 percent of max and get the same benefit." If your training time is limited, you have little choice but to opt for intensity.

Lactate threshold is about 90 percent of max heart rate in well-trained riders. That's not a comfortable level. Think back to your last time trial or long, steep climb. You probably don't go that hard very often.

Instead, you're either warming up at 65 percent of max or cruising at 80 percent. Sometimes, usually on hills, your heart rate may rise toward the 90 percent figure, but if you calculate the total percentage of riding time when it reaches that level, the number is likely to be closer to 5 percent than 25 percent.

Now think about spending a quarter of your training time at 90 percent. Intimidating!

What does it take to have the physical (and mental) reserves required to tolerate a program of intense training? Obviously, if you ride extremely hard a quarter of the time, you have to ride extremely easy the remainder of the time.

You need slow rides to promote recovery. You need fast efforts to build the top-end speed required to meet your goals. The problem is that going slowly makes many riders feel guilty. And going fast is painful.

Nevertheless, if you're bent on improvement, you must schedule both hard training and "hard" resting into your program. This is especially important at the height of the season. When you go hard, go *really* hard. The techniques in this book will help you do it with maximum efficiency—and minimum pain.

Then when you go easy, ride at an effort and speed that anyone could keep up. In the words of coach Skip Hamilton, these rides should be "guilt-producingly slow." Vaughters cruises the bike paths of Denver on his easy days and says that "senior citizens on beach cruisers blow by me."

The result of carefully planned slow riding will be greater recovery between hard efforts and, because of that hard training, greater improvement.

IS NO-MAN'S LAND EVER APPROPRIATE?

Of course. Early-season endurance training is often done, appropriately, at about 80 percent of max heart rate. There's an enjoyment factor, too. Some rides should be medium-paced because it's a vigorous-yet-comfortable intensity that's rewarding. It feels hard enough to be satisfying but not so hard that you're suffering. Riding your bike should be fun. There's no reason to avoid the intensity zone that pegs the fun meter rather than your heart monitor. Just don't give in to the temptation to dwell there ride after ride.

Also, some events—centuries, for instance—are usually ridden at a steady, moderate intensity. If you'll be riding 100 miles in no-man's land, it's appropriate to spend some training time there, too.

It's up to you to listen to your body and determine the lower level of intensity that promotes recovery and the higher level that makes you faster.

CHAPTER 2

Warming Up for Top Performance

This concept in a nutshell: Get your body ready before you ask it to perform.

Why have a consistent warm-up routine? Why isn't it sufficient merely to spin easily for the first few minutes of a ride?

A structured warm-up accomplishes several important things:

- **It raises body temperature**. Sweating means that your muscles are warm, loose and relaxed. There's some evidence that higher body temperature thins bodily fluids, lessening strain on joints and the heart.

- **It reduces initial levels of muscular stress**. If you've ever had to go hard on the bike without a warm-up—like when a group ride rages out of the parking lot—you know how your legs burn for the first couple of minutes. A good warm-up, on the other hand, alerts your systems that it's going to get harder soon.

- **It conserves glycogen**. Fast-from-the-gun workouts or races dip into your precious supplies of glycogen, your muscles' primary fuel. A slower start allows you to begin by burning a higher percentage of fat, conserving glycogen for when you really need it.

- **It opens capillaries**. A warm-up dilates the capillaries that allow your blood to bathe muscle cells with oxygen and nutrients. More blood flow means more fuel and a better-performing engine.

- **It compensates for aging**. The older you are, the more you need a warm-up. When we were kids, we could go full speed right off the couch when a friend wanted to run pass routes in the back yard. That's not how it works as we age, and we're more apt to get injured, too. The quality of our training suffers if we don't prepare for hard work.

For all these reasons, the warm-up is a vital part of each ride.

> **TIP!** Because many of the workouts in this book require high intensity that approaches race effort, a warm-up is crucial to help you perform well and avoid injury. Get in the habit of using the same warm-up routine before every hard workout. I include a sample protocol below.

SHORTER MAY BE BETTER

For years, I used a fairly long warm-up routine before time trials and short road races. I patterned it after what I understood top riders do. I'd spin around for 20 minutes, ride a few hills hard, do some sprints, and top it off with several minutes at TT pace.

But sometimes this made me feel drained for the event itself. When the crunch came in a road race or I needed a strong final 10K in a time trial, there wasn't enough in my tank. I'd used too much energy in my warm-up.

Then I read that England's Chris Boardman, the world hour record holder, had switched from hour-long warm-ups to a focused routine of 15-20 minutes.

I tried it and developed an abbreviated routine like the one described below. It worked great and left me plenty of energy for the race itself.

Most riders do long warm-ups for the wrong reason. In fact, warm-ups are often used to calm pre-race nerves. Riders get to the race early and register, but then they're too antsy to sit calmly in the car and review their race strategy.

Instead, nervous energy pressures them into a long, "pro-style" warm-up. Too often it's unfocused and mainly burns precious reserves. When they get to the starting line, they feel flat rather than fiery.

A WARM-UP FOR TRAINING AND RACING

Here's a 20-minute warm-up routine that you can use for any event. Practice it during the first 20 minutes of each training ride that will include hard efforts or long distance. By beginning

tough workouts with the same warm-up, your body will become accustomed to the routine and what's coming next.

TIME (minutes)	**TECHNIQUE**
0-4	Spin easily in a low gear. Begin at 75 rpm and gradually build to 90 rpm. Keep heart rate below 70% of max.
5-11	Gradually increase gear and effort. Shift up every 2 minutes. Keep cadence at 90-100 rpm. In the last minute you should be breathing steadily, sweating lightly and your heart rate should be about 80% of max.
12-14	Do 3 controlled sprints. Using a moderate gear, stand, accelerate to 110 rpm, sit, and spin up to the point where your hips begin to rock. Then gradually slow until back to 90 rpm. This sequence should take about 20 seconds. Repeat 3 times with 40 seconds of easy spinning between sprints.
15-17	Do a 3-minute interval: Use a gear that you can turn at 90 rpm without pedaling all-out. Stand to accelerate, then sit and hold 90 rpm for 3 minutes. Power output should be equal to a training time trial of about 30 minutes. Your heart rate should rise to your lactate threshold in the last 15 seconds.
18-20	Spin easily in a very low gear. At 20 minutes, your heart rate should be down to 120 or lower, with breathing stabilized and legs feeling lively.

Although this warm-up is based on the successful routines of top riders, it won't be ideal for everyone. Warming up is highly individual. You may need a 60-minute warm-up to perform at your peak, but most cyclists will do better with a significantly shorter session. Experiment to find the length that works for you.

CAUTION! Don't use this routine at the start of recovery rides. It requires too much effort. Instead, gradually increase cadence and gearing until your heart rate is about 70 percent of max. Don't go any harder than that.

At some events, particularly city criteriums, the surrounding roads can be so traffic-choked that warming up on them is dangerous or ineffective. The solution is to warm up on a trainer. This may even be required by the race promoter.

For example, a few years ago, organizers of the Colorado time trial championship faced opposition from residents of the small town where the race was to be held. The locals could tolerate riders on the road chosen for the TT, but they objected to us warming up on town streets. So, we had to use trainers or risk losing the race venue.

Most of us complained at first. How can we get a good warm-up on a trainer? But once we tried it, the benefits became obvious:

- There's no risk of a flat tire from road debris.

- You never leave your car, so help is right there if you have a problem.

- If the start time is changed for some reason, you're within hearing distance of the PA announcer.

- You can use headphones with inspiring music, something that's dangerous while riding on the road.

- You can cope better with weather. If it's cool, there's no windchill on the trainer. If it's hot, cold drinks are as close as your ice chest. Raining? You can wear a poncho as you warm up, or pedal under the tailgate of a van or SUV. At least you'll stay dry until the race starts.

- The warm-up routine outlined above can be done just as effectively on a trainer as on the road.

COOLING DOWN

The final few minutes of training are important, too. After a hard ride or race, don't immediately hop off your bike, panting and sweating. Instead, reverse the initial 5 minutes of the warm-up routine.

I live in a small town, so when I cross the city limit on the way home, I shift to the small ring, take a few deep breaths and spin through the residential streets. There's a small hill half a mile from my house, but I resist the temptation to do just one more hard bit over the top. In fact, I often choose a street that goes around the hill in order to cool down more effectively.

Some riders live atop climbs that make cooling down difficult. One example is my 1996 Race Across America teammate, Pete Penseyres, whose house crowns an 800-vertical-foot hill in southern California. He cools down by standing and "walking" up the hill with a slow cadence in a low gear, keeping his heart rate relatively low.

When my RBR partner, Ed Pavelka, lived in southeastern Pennsylvania, his house was on top of a wall that he came to call “the final indignity.” After scaling it, he’d stay in low gear and spin easily for the final 200 yards to his house.

CHAPTER 3

Power Training

This concept in a nutshell: The recent development of reliable and lower-priced power meters allows us to measure and use training intensity in a whole new way.

For most of cycling’s history, riders determined their intensity by feel. They went “easy” or “ hard” or simply noted their gearing. A long aerobic ride was done in a 42x17-tooth gear and intervals were hammered out in 53x15. Although these were only approximations of intensity, they worked for generations of riders.

With the development of accurate heart rate monitoring in the mid 1980s, training entered the scientific age. Cyclists began downloading their workout heart rates into computers for analysis. Heart monitoring became a staple of aerobic exercise machines and cardiac rehab programs as well as a must for serious athletes.

The newest method of gauging intensity is power measurement. Several products allow cyclists to put a number (watts) on power output using strain gauges on their bikes. The German-made SRM puts strain gauges in the bottom bracket. The PowerTap from Graber Products puts them in the rear hub.

Power can be calculated by other means, too. In a bid to lower the cost, companies have eagerly tested them. The S710, from heart monitor company Polar, measures chain tension and chain speed to calculate power. The Ciclosport HAC 4 doesn’t measure power output directly but instead relies on a mathematical calculation. You input your combined body/bike weight and the computer adds a constant for rolling and wind resistance. It then calculates wattage from the effort required to move your mass at certain speeds and rate of elevation gain.

I’ve trained with the PowerTap, Polar and Ciclosport units. I’ll review them at the end of this chapter. But first, let’s look at why anyone would plunk down enough money to buy another bike just to know wattage output.

WHAT’S A WATT?

Because intensity is the best producer of fitness, measuring intensity is the key to efficient training. But why not simply gauge it by speed or by how hard it feels like you’re working or by heart rate? Three key reasons:

- The intensity needed to produce a certain speed varies depending on the wind, pavement quality and whether the road tilts up or down.

- Measures of perceived exertion can be accurate but require practice and careful monitoring of how you feel.

- Factors such as hydration status, air temperature and fatigue can cause heart rate to vary widely at a given power output.

Power monitoring, on the other hand, is accurate simply because a watt is always a watt regardless of outside factors.

According to Allen Lim, a doctoral student at the University of Colorado who's doing definitive studies in the area, "Power training provides a direct and objective measurement. It's like giving a chef a thermometer. You can bake a pie without knowing how hot the oven is, but it takes a lot more attention and experience. Having a direct way to monitor the process (training or cooking) allows athletes to understand their training and race environment. You don't end up burning as many pies before you figure out the perfect recipe."

In fact, some coaches would argue that power monitoring is the Holy Grail of training because it tells you exactly how hard you're working, day after day. It's objective and foolproof, the sort of hard data that can transform training from art to science.

According to SRM inventor Ulrich Schoberer, "The basic element of riding faster is to increase power output rather than heart rate or lactate. It is simply power. All other values are the second choice."

Even more important, exercise scientists can use power meters in races to pinpoint the demands of competition. How many watts did the winner of Paris-Roubaix generate on the cobbles of the Forest of Arenburg? How many times during the race did he have to achieve that wattage figure? How many watts did Lance Armstrong average when he was climbing l'Alpe d'Huez?

By knowing these figures, riders and coaches can set up training programs that duplicate the demands of racing. Recreational riders can use a power meter in centuries or local time trials to do the same thing.

As Lim says, "We can finally see what athletes are doing in races and begin to manipulate their training so it's more specific."

APPLYING WATTAGE INFORMATION

Simply knowing how many watts you average as you blast up your local killer hill isn't enough. That number is simply a number unless you know what to do with it. According to Joe Friel, a Colorado endurance sports coach and author of *The Cyclist's Training Bible*, a good place to start is by determining your average power or "critical power" (CP) for various time periods.

Friel recommends determining CP for 12 seconds, 1 minute, 6 minutes, 30 minutes, 1 hour and 3 hours. Then you can determine exact training loads for interval workouts.

One way to visualize this is by comparing it to weight training. Let's say that a strength athlete can bench press 400 pounds one time with a maximum effort. So, 400 pounds is his one-rep max (abbreviated 1RM.) Once this has been determined, he can work out at a specific percentage of his 1RM, doing (for example) 5 sets of 8 repetitions at 80 percent of 1RM, or 320 pounds.

Similarly, once you know your CP for, say, 6 minutes, you can do intervals at a given percentage of that figure. If your CP for an all-out 6-minute effort is 400 watts, you might do 3-minute repeats at 80 percent (320 watts). As you get stronger, you can increase the wattage and the duration of the intervals.

Power measuring means that the intensity of workouts can be precisely controlled.

THE RACE OF TRUTH

Power measuring is also great for time trials or non-drafting triathlons where it's just you against the clock (and the wind and the hills). These events require you to accurately dole out energy for the whole distance so you go as fast as possible and finish spent. Go too hard early and you'll slow abruptly before the finish and lose time. Start too slow and you'll finish with energy to spare, well above the best time you could have recorded.

Experienced time trialists apportion energy by feel. They sense exactly how hard they can ride to finish the race exhausted, their last dollop of energy burned in the final 200 meters. However, such knowledge of the body takes lots of time trialing.

Power metering makes success more objective. If you know the average power output you can sustain for the duration of the event, you can simply maintain that level, secure in the knowledge that it's your optimum pace. This works much better than trying to ride at a certain heart rate because of a phenomenon known as "cardiac drift." Heart rate tends to rise as an event wears on, even though wattage stays constant.

Of course, time trialing isn't a steady-state effort unless the course is dead flat with no wind. Even then, you'll go harder when accelerating at the start and turnaround. On most courses, you have to go slightly over your limit on hills and out of turns, then recover a bit on easier sections.

Many riders use a heart monitor to gauge their intensity in these conditions. But because heart rate lags behind effort, by the time you know you're going too hard on a hill, it's too late. According to SRM's Schoberer, "With heart rate, there's a delay in the response to effort, sometimes as much as two minutes. But with power, you can control your effort precisely."

A power meter shows you immediately whether you're below, at or above the wattage that your experience says you can maintain.

COMPARE WATTAGE AND HEART RATE

Of course, knowing your heart rate is still important. One advantage of power measuring is the ability to see wattage and heart rate simultaneously. Even though heart rate is influenced by the environment and other factors, it's still a useful measure of what's going on in your body.

If you know the heart rate usually associated with a given wattage and duration, you can watch for variations and realize when you shouldn't be training hard. For instance, suppose you normally see a heart rate of about 170 while doing 3-minute repeats at 300 watts. Today, however, you're struggling to put out 250 watts at 170 bpm. That's a clear sign you're not fully recovered from previous training. Cancel the interval session and spin slowly home feeling smart, not guilty. Make sure you're rested, well hydrated and your muscle glycogen stores are replenished with high-carbohydrate foods before you try again.

IMPORTANCE OF PERCEIVED EXERTION

Nor does power monitoring mean that perceived exertion is passé. In fact, according to researcher Allen Lim, many pro riders who use power meters have done away with heart monitors. They prefer to check wattage and compare it to their subjective feelings of intensity. This is how Jonathan Vaughters, a big proponent of power measuring, does it.

Says Lim, "Make sure you listen to your intuition when you use a power meter. One of the major benefits is developing a better sense of feel when training and racing."

Once you've "calibrated" your feelings of intensity to the objective measures made possible by a watts meter, you won't need to refer to the handlebar-mounted electronics as frequently.

Knowing wattage keeps you in line when going easy, too. Because intense training is so demanding, you need plenty of easy spinning to promote recovery. But despite the best intentions, it's common for effort to creep up during easy rides until the pace is too hard to allow recovery. Seeing the number of watts you're putting out prevents you from overriding perceived exertion and gradually increasing the effort. It also helps you avoid getting sucked along by a group that's too fast for the day's goals.

PERSONALIZING YOUR TRAINING

You're a unique bike rider with your own physical attributes and liabilities. No one else can decide how you should train. Power monitoring is a powerful tool to help you learn about yourself.

Lim's advice: "Employ the scientific method to answer personal questions about training." These, he says, are the crucial ones:

- Do you produce more power at a higher or lower cadence when climbing?
- How do different pacing strategies in a time trial affect performance?

- What is the relationship between total work done and time spent in varying intensity zones?

- How does time in different intensity zones affect feelings of perceived effort, fatigue and performance?

- What are the specific power demands of key events, and how does competitive power output compare to your power output in training?

With a power meter, you can answer all of these questions, then tailor your training to your own goals and talents.

EFFICIENT USE OF TIME

Power monitors are useful for time-challenged riders. If you have only one hour to train on a given day, it's important to use every minute to best advantage. A power meter makes it possible by telling you exactly how hard to work. No more inefficient guessing.

And a power meter is simply unbeatable for progressively increasing the workload over several weeks or months. I've talked with a number of riders who began using one and saw significant gains. They had reached a high level of power production in previous seasons but had plateaued.

In addition, a power meter converts any indoor trainer into a ergometer. Simply mount your bike and do a precise wattage workout at any time of day (or night) despite outside conditions.

THE DOWNSIDE

Despite all of these advantages, power monitoring isn't right for everyone. I won't fault you if any of these drawbacks are significant enough to stop you from getting into this new technology.

- **Cost**. At this writing in May, 2002, the cheapest power meter was the CicloSport HAC 4 at $400. Recreational riders and some racers may opt to spend the money on other equipment or for travel to events.

- **Complexity.** Experienced riders may be content with simple perceived exertion as a gauge. With experience, it can be nearly as precise as a power meter for most training purposes, and it costs nothing.

- **Pressure**. Some riders object to yet another number that goads them into going at a certain pace. These riders may have tried heart monitoring and decided that they didn't like the constant judgment of their effort.

- **Clutter.** Some riders hate hanging things on their bikes, especially products like the Polar S710 with several wires that must be attached to the frame.

- **Information overkill**. Many recreational riders may not care about fine-tuned performance. For them, power metering is a waste of time and money.

PRODUCT REVIEW: POWER METERS

The German-designed **SRM** has been available to the rich and famous for more than a decade. (Greg LeMond used one in the last year of his career.) It's expensive at $2,500-$4,000 and hard to get in North America.

The strain gauges mounted in the bottom bracket require you to use SRM's crankarms. Pedaling power is measured directly—and extremely accurately, according to laboratory ergometers.

I've talked with several pros who've used the SRM and all were enthusiastic about it. Unfortunately, price and availability put it out of reach for most of us.

Although I couldn't obtain an SRM, I did get hands-on experience with the 3 other power meters currently available to North American riders.

I trained with the original **Power-Tap** for 3 years. After Graber Products bought the brand from Tune, the founding company, I rode Graber's redesigned unit for 4 months.

The **Polar S710** was announced nearly a year before units became available. I tested it for a month before this eBook was published.

Finally, the **Ciclosport HAC 4** came on the market just before deadline. I was able to use it for 3 weeks.

Based on these admittedly too-short time frames for the last 2 units, here are my impressions. (All prices are an average of those in spring 2002 catalogs.)

• Power-Tap

The $950 Power-Tap measures wattage, speed, cadence, heart rate, time, distance and energy expended. The quoted price includes a rear hub, cyclecomputer, heart-monitor chest strap and download software. You need to have a rear wheel built around the hub or buy a wheel from Graber.

> **TIP!** If you use zip ties to secure the Power-Tap's cable, don't overtighten them. Doing so can cut off data transmission to the handlebar computer. To be safe, use electrical tape instead.

The Power-Tap is easy to set up. I simply removed the Ultegra 9-speed cassette from my standard rear wheel and slipped it on the Power-Tap wheel. The sensor mounted quickly on the left chainstay about 6 inches from the hub. Although transmission from the hub to the

sensor is wireless, a wire leads from the sensor to the handlebar-mounted computer. To make the wire less obtrusive, I wrapped it around the rear brake cable, routed it along the top tube, then wrapped it around the front brake cable.

A completely wireless system would be cleaner, but there's too much distance from the rear hub to the handlebar. I didn't notice any interference from heart monitors worn by riding companions.

The Power-Tap display shows wattage and speed simultaneously, along with your choice of time, distance, heart rate, torque, cadence or energy expenditure. It's easy to toggle among these readings as well as between average and max speed and wattage.

Crucial to the design is an interval function. By holding down one control button for 2 seconds, the unit will record up to 9 intervals so you can play back max and average power, speed, cadence and heart rate for each effort.

The download option allows you to create graphs of rides and compare them over time. There's a power-to-heart-rate ratio to track your fitness, and a power-to-weight feature. You can view a whole ride on the graph, look at certain sections or examine individual intervals.

That's all good, but I also found these drawbacks.

- The Power-Tap's rear hub is hefty. It adds about 8 ounces to your bike. At least the weight is at the center of the wheel where it has the least impact on rotating weight and speed.

- If you want to record your power output during a race, you have no choice but to use the wheel with the Power-Tap hub, even if it's built around a heavier training rim. However, you can mount race wheels on your bike and still use the Power-Tap handlebar monitor for speed and heart rate by putting a magnet on your rear spokes and switching to a special mode.

- Early Power-Tap hubs had poor seals that let water in, ruining the unit. Graber redesigned the seals. I've ridden the new version in showers (but not drenching rain) and have had no problems. Other riders in wetter conditions also report that the new seals seem to be working.

• Polar S710

The $640 S710 uses chain tension and chain speed to calculate power. Chain speed is measured with a magnetic sensor on the rear derailleur that counts chain links as they pass. Chain tension is measured with a sensor on the chainstay. The sensor doesn't touch the chain but feels vibration. According to Polar, this is a highly accurate method used in precision scales.

The S710 is easy to put on your bike in one sense: You don't have to replace existing bike

components such as the crankarms with SRM or the rear wheel with Power-Tap. The system zip-ties to the frame.

Because Polar uses two non-contact sensors and digital signal processing to measure power, there are no moving parts to wear out. Polar argues that competing systems employ delicate strain gauges mounted with epoxy that can degrade over time.

You must enter 3 values during installation: chain weight, chain length, and distance from crank axle to rear wheel axle. Default settings are included. The system is consistent if you use them, but better accuracy is achieved by entering numbers specific to your bike—assuming you are precise.

The Polar offers several unique features, including power balance between right and left legs during pedaling. Results are viewable in real-time and in the down- load. You also can see the roundness of your stroke.

The Polar (and the Ciclosport HAC 4) have altimeter functions. With this you can calculate meters-per-minute climbed, a key to the evaluation in chapter 4.

Drawbacks? The S710 has a few.

- The instructional manual is complicated. It took me several hours of careful reading to digest it and install the system. Patience with manuals is admittedly not my strong point, but the Polar was the most complicated of the 3 tested products in this regard. Although the first-time setup was tedious, mounting it again was considerably easier.

- The Polar has so many options that sorting out which to use and which are extraneous is a major task. Of course, if you like data deluge you'll be very pleased.

- Precision is paramount. If you enter a chain weight that's incorrect by 5 percent, your wattage will be wrong by the same percentage.

- Wattage readings can vary by 50-70 watts for the same intensity, depending on whether you're in the big or small ring. The chain has to be the correct distance from the sensor and the "window" is rather small. The shim kit that Polar supplied didn't work well for me. The unit now comes with improved shims.

- The S710 has more wires than a regional electric power station. They clutter the bike and make it hard to clean the frame. The right chainstay sensor has 3 wires. The most problematic one runs to the rear derailleur and requires that you replace a pulley bolt. This wire is wrapped around the derailleur cable, and you have to leave enough slack or the derailleur won't shift properly. Getting it right requires lots of trial and error.

• CicloSport HAC 4

The $400 HAC 4 doesn't measure wattage directly but estimates it from a mathematical calculation. You input the combined weight of your body, clothing and bike. Then the computer

estimates wattage based on the effort required to move that mass at the speed you're traveling and the elevation you're gaining.

The calculation is similar to Jonathan Vaughters' method of determining wattage and VO_2 max from meters-per-minute climbed (next chapter). Data can be downloaded into a PC so you can analyze your workout in a computer training log.

Speaking of meters-per-minute-climbed, this has become a hot performance parameter, as we'll see, so it's quite useful if you ride in suitably hilly terrain. I liked the altimeter, too.

The HAC 4 puts significantly less clutter on the bike than the other units. It has only a spoke magnet and a fork-blade sensor that relays information to a handlebar-mounted heart monitor watch. There are no wires on the bike.

The monitor is easier than Polar's unit to mount on the handlebar. The latter can be tricky to adjust around the brake cables. The HAC 4's hook-and-loop band slips out of the watch, which then snaps quickly and easily into the mount.

On the negative side:

– The wattage figures provided by the HAC 4 are only an estimate. The company argues that it's a consistent estimate and provides reliable comparative figures from one workout to the next. However, there's no pretense that the numbers can be usefully compared to those you'd get in a lab test.

– I found that the power output figures were fairly close to those from the Power-Tap when I was climbing a steep hill. But numbers on the flat were quite low and didn't change much when I accelerated.

RECOMMENDATIONS

Each of these units has supporters and detractors. If you want to monitor your power, which one should you get?

- **Buy the SRM if:** You have a flush bank account, you want state-of-the-art power monitoring and you're willing to mount a new pair of crankarms.

- **Buy the Power-Tap if:** You'd like to spend considerably less than you would for an SRM but still want direct power measurement, relatively simple set up, data analysis and can accept using a weighty rear wheel.

- **Buy the Polar S710 if:** You are comfortable with Polar products and instructional manuals, enjoy figuring out a fairly complicated set-up procedure, and want to analyze each leg's power production and pedaling smoothness.

- **Buy the CicloSport HAC 4 if:** You're on a tighter budget, want the altimeter function and are satisfied with estimated rather than accurate power figures.

CHAPTER 4

Simplified Testing for Wattage and VO_2 Max

This concept in a nutshell: You don't need an expensive lab test to determine 3 important performance numbers—power at lactate threshold, maximal oxygen uptake and meters-per-minute of climbing.

As we've seen, it's important to know how much power you can produce. But power meters cost $400 or more. It would also be great to know your VO_2 max. But laboratory tests cost around $500.

Fortunately, there's a simple test you can do on your own training roads to get this information. It requires only a suitable hill, your bike, a scale, a stopwatch and an altimeter or topographic map. Oh—and an all-out effort, too.

I learned this technique from pro cyclist Jonathan Vaughters at his April 2002 training camp in Denver. Based on sound physiological principles, it produces numbers quite close to those you'd get if you were lab-tested. Here's how it works:

1. Find a tough hill that takes at least 10 minutes to climb. A steep (6-8 percent) and steady grade is necessary because it negates the effects of wind resistance. Hills that take less time to get up mean you'll rely too heavily on your anaerobic energy production system, thus skewing the results.

2. Determine the climb's elevation gain in meters. Use an altimeter such as those found on the Polar S710, the Ciclosport HAC 4 or the $90 Cateye AT100 or $100 Specialized Speedzone Pro cyclecomputers. You can also calculate elevation gain from the contour lines on a topographic map. There's no need to climb for more than 15 minutes for this test.

3. Weigh yourself and your bike while you're wearing riding clothes. Include your water bottles and seat bag if you'll have them on during the test. Once you've determined the total weight you'll be propelling up the hill, convert pounds to kilograms by dividing by 2.2.

4. Warm up well, then time yourself while riding the climb as hard as you can. Begin the test from a standing start like a time trial. Climb with any technique you choose—seated, standing or alternating. The idea is to get to the top as fast as possible.

Recovered? Now you're ready to assess your performance in the following 3 key categories.

METERS-PER-MINUTE CLIMBED

According to Vaughters, this measure is the latest rage among pro riders. “Lance Armstrong was obsessed by it,” he says. Why? Because climbing is contingent on your power-to-weight ratio. Determining meters-per-minute climbed gives you an objective rating of your uphill ability without the need for other calculations.

To do it, simply divide the height of the climb by the number of minutes it took you to get to the top. For instance, if you climbed 186 vertical meters in 10 minutes, your meters-per-minute figure is 18.6.

What does this number mean? According to Vaughters:

19 meters per minute	Survive the Tour de France
22-25 meters per min.	Place top 30 in the Tour
30-32 meters per min.	Win climb of l’Alpe d’Huez

Data for recreational racers isn’t available, but here’s an educated guess: Category 1-2 riders will range from 20 to 25 meters per minute. Masters will do 17-22, depending on age.

If those numbers seem high compared to Vaughters’ values, remember that in U.S. racing, climbs are usually short by European professional standards. The shorter the hill, the easier it is to maintain a high rate of climbing speed. And if a domestic race does have a long climb, it’s usually done just once in contrast to the Tour, where the l’Alpe d’Huez ascent is typically the third or fourth mountain of the day.

AVERAGE WATTS

To calculate your average watts for the climb:

1. Multiply the number of vertical meters in the climb by the total weight of bike and rider in kilograms.

2. Divide the result by the time of the climb in seconds.

3. Multiply that answer by 10 and add 60 (a constant that reflects rolling resistance, chain friction, etc.)

For example, if you climbed 186 meters in 10 minutes and the total weight of bike and rider is 80 kg, your average wattage is 308.

MAXIMAL OXYGEN UPTAKE (VO_2 MAX)

To calculate your VO_2 max:

1. Divide your average watts from the above calculation by an efficiency factor of 72 to get your total oxygen consumption in liters per minute.

2. Multiply the result by 1,000 to get milliliters of oxygen consumed.

3. Divide milliliters of oxygen by your body weight in kilograms to get VO_2 max expressed in the standard ml/kg/min.

For example, if your average watts is 308 as in the above example, and your body weight is 70 kg, your VO_2 max is 61.1 ml/kg/min.

In Vaughters' view, speaking from his experience in European cycling, a VO_2 max of over 70 is outstanding and anything above 60 is excellent.

Remember, these figures are for Vaughters' home testing grounds west of Denver at elevations around 7,000 feet. At sea level, VO_2 max results are about 8 percent higher. So, you flatlanders need values of about 76 and 65, respectively.

CHAPTER 5

High-Cadence Pedaling

This concept in a nutshell: Pedaling cadence is individual. Don't copy high-cadence riders like Lance Armstrong until you determine if that's your most efficient style.

The Lance Armstrong story is compelling for many reasons—his challenging youth as a child of a single mother, his triumph over cancer, his mastery of race tactics after winning early events on bullish strength alone. Indeed, it's remarkable that he even found the sport of cycling in the football hotbed of Plano, Texas.

But Armstrong's most important technical legacy to cycling may well be his high-cadence pedaling. While big gears and a moderate cadence have marked modern pedaling technique, Lance's preferred rpm of 100+ in time trials and 90-100 on steep climbs represented a return to the classic years of the sport. Then, a 52x13-tooth gear was considered huge, and riders broke the hour for 25-mile time trials on a fixed gear of 70 inches (equal to 39x15 on your bike) pedaling at 120 rpm.

Seeing Lance's supple stroke on steep climbs like l'Alpe d'Huez was like being in a time machine and witnessing famous pedalers of the '50s and '60s—Jacques Anquetil or Federico Bahamontes—riders who never looked like they were feeling the pedals as they slid through the wind or flew up steep slopes.

As a result of Lance's success with fast pedaling, many recreational riders and racers have spent inordinate amounts of training time trying to spin faster. The thinking goes: If Lance did it, I should do it, too.

But not so fast. Like most cycling techniques, rapid pedaling is appropriate for some riders but not for all riders. Just because it worked for Lance doesn't mean it will work for you.

> **EXAMPLE!** In January, 2002, I had the opportunity to join the Saturn pro team at its preseason training camp in California. On climbs, I was amazed at the variation in cadence. Some riders sat and spun at 100 rpm while others plodded up the slope in the big ring and a cadence closer to 60 rpm.
>
> You'd think that in a small and elite group of riders, natural selection would guarantee that everyone would pedal at about the same cadence if one cadence were the most efficient. But that certainly wasn't the case.

LIM'S LAW

For perspective on this issue, I talked with Allen Lim, the doctoral candidate at the University of Colorado who has been studying power output in cyclists (see chapter 3). As a result of his studies, he has formulated what might be termed Lim's Law:

"A fast spin isn't a technique for producing power. It's a result of having power."

In other words, Lance didn't spin fast in order to increase his wattage at a given heart rate. Instead, he spun fast because he had so much power that he could afford to ride at a faster cadence, thus sparing his leg muscles and transferring the strain to his cardiovascular system. It's an important distinction.

The heart muscle doesn't fatigue like leg muscles do. Spinning fast on early climbs in a long race meant that Lance had plenty of leg power left when it was needed near the end.

Here's an analogy. Suppose you're riding with a slower companion. You don't want to ride away from him on climbs, so what do you do? You gear down and spin while he chugs up the hill in his usual climbing cadence of 70-75 rpm.

"Wow," he thinks. "This guy (you) is much stronger and it must be because his cadence is faster than mine. I should work on increasing my cadence, too." But in order to spin as fast as you, he has to use a lower gear. He still climbs slowly even though he's pedaling faster.

The fact that you're stronger than your friend makes a high cadence useful. If the situation were reversed and you were the one riding with a stronger companion, you'd be laboring while he spun blithely along by your side.

So, Lance pedaled fast because he has more power than his competitors. To restate Lim's Law, fast pedaling isn't a training technique to help you gain power, it's a byproduct of being powerful.

Jonathan Vaughters agrees. As a former teammate of Armstrong's and once a Tour de France competitor, he has watched the Texan's pedal stroke up close and personal. Says Vaughters, "Lance didn't pedal any faster than other riders when he was in the pack. He only pedaled a very high rpm when he was going hard. He did it because he produced more power than anyone else."

Fine. So how do you determine what cadence is best for you?

TESTA'S CLIMBING TEST

Max Testa, M.D., is a former pro team physician who now directs a sports medicine clinic in Davis, California, owned by Eric Heiden of speedskating and cycling fame. According to Testa, the key to discovering your most-efficient cadence is to pay attention to what happens when you're about to blow on a climb.

"What fails when you're trying to keep up on a climb?" he asks. "Do you shift to a lower gear and spin fast because if you go to a bigger gear and grind your legs die? In that case, you need strength. But if, when you use a smaller gear and spin, your breathing goes out of control, you need more cardiovascular conditioning."

Try Testa's test when you're doing hill repeats. On the second or third time up the climb, when you're warmed up but not yet tired, push as hard as possible. Near the top, at the point when you begin to lose power and your pedal stroke gets ragged, shift to a harder gear and try to maintain the same speed. Pay attention to what happens.

Recover. Then on the next climb, when the going gets tough, shift to an easier gear and try to spin. Compare your sensations and your speed. Done several times, this experiment should tell you whether you're more efficient as a spinner or a grinder. It should also reveal if you need to work on leg strength and power or cardiovascular conditioning in order to become a better climber.

EXPERT EVALUATION

When Testa put me on an ergometer at Colorado's Boulder Center for Sports Medicine, I could feel graphically what cadence my body preferred. I began pedaling at a low wattage and 90 rpm. Every minute, Testa increased resistance by 25 watts while I kept my cadence steady. Soon I was laboring, and a blood draw revealed that I had reached my lactate threshold.

But Testa continued to increase resistance. In order to maintain the cadence, I moved to the rear of the saddle and started muscling the gear. Soon I ran out of steam, my cadence slowed and I blew up.

My reaction to this extreme effort revealed a lot to Testa. “When you went above your lactate threshold,” he told me, “you moved your effort from your cardiovascular system to your muscles. Some riders, with outstanding cardiovascular conditioning, would move forward on the tip of the saddle and spin as they neared their maximum. But because you have good leg strength and power, you moved to the rear and let your muscles take over.”

The doctor’s prescription? I should (1) work on my cardiovascular system with high-cadence intervals; (2) improve the efficiency of my pedal stroke with fixed-gear riding; (3) raise my lactate threshold with 12-minute time-trial repeats at a fast cadence and an intensity about 10 beats below my LT.

Apply this example to your own reaction under stress. Even better, do a similar test with an experienced coach and get a personal training recommendation.

HOW TO USE WATTS

If you have a watts-measuring device and a heart monitor, ride one of your favorite climbs using a high gear and low cadence. Note your wattage, heart rate and feeling of perceived exertion. Recover, then ride the climb again. Keep wattage the same but decrease the gear and raise cadence. Again, note your heart rate and feeling.

You’ll probably need several such experiments over a couple of days or a week to see a pattern. But one will eventually emerge. You’ll see that lower heart rates are associated with a particular cadence at a given wattage. You’ll probably feel better when you find your cadence “sweet spot,” too—more in tune with your body as you’re climbing.

MUSCLE FIBER TYPE

One more important point: Your preferred cadence may be related to muscle fiber type. There’s some evidence that riders with predominantly fast-twitch fibers—sprinters, for instance—do better with a faster cadence. Endurance riders with a preponderance of slow-twitch fibers ride more efficiently at a lower cadence in a larger gear.

In a study conducted by scientists at the University of Wisconsin and the University of Wyoming, 8 experienced cyclists rode at an intensity of 85 percent of $V0_2$ max (about 90 percent of max heart rate) for 30 minutes in 2 different trials. First, they rode at 50 rpm in a high gear. Next, they lowered the gearing and increased rpm to 100.

The riders' oxygen consumption rates, heart rates, power production and blood lactate levels were similar in both scenarios. Slow-twitch muscle cells lost comparable amounts of their glycogen at 50 and 100 rpm, but fast-twitch cells lost almost 50 per cent of their glycogen at 50 rpm and only 33 per cent at 100 rpm, even though the exercise bouts lasted 30 minutes in each case.

This rapid loss of carbohydrate in the fast-twitch cells during slow, high-force pedaling demonstrates why slow pedaling is less efficient. Low-rpm pedaling depletes glycogen from fast-twitch muscle cells because it’s associated with high gears and elevated muscle forces. On the other hand, fast cadences coincide with low gears and less-forceful muscle contractions.

Because fast-twitch fibers are more powerful than their slow counterparts, they activate at low cadences when lots of muscular force is needed to propel the bike. Conversely, more rapid pedaling rates of 80-100 rpm are not too fast for slow-twitch fibers to handle. They can contract 80-100 times per minute, easily within the range of force required to pedal in low gear.

The bottom line: Like so many other aspects of cycling, pedaling cadence is highly individual—perhaps even more than other personal choices in the sport like whether you prefer to climb seated or standing. Your job is to find out what works best for your body, then hone that technique.

CHAPTER 6

‘Stage Race’ Training

This concept in a nutshell: Stage races, tours or consecutive days of hard training can lead to peak fitness.

Pros go flat out every day for 3 weeks in the major European tours. Yet instead of becoming chronically fatigued and overtrained, these events often take them to peaks in performance. In fact, the Tour of Spain in September is considered the best preparation for the world road championship in October.

The same is true for recreational riders on a challenging week-long tour such as Colorado’s Ride the Rockies. Although the intensity is less than in racing, many riders have to dig deep to finish each day. Then, after the tour, they find themselves in their best form of the summer.

This seems like a paradox because modern training theory is based on the “hard/easy” approach—do intense training today, go easy or rest tomorrow in order to recover. Why don’t stage racing pros and hard-riding rec riders collapse in a quivering mass of protoplasm?

The answer is simple: The body is highly adaptable. If you ask it to perform, it will. Of course, you can’t ask very often. And you’d better ask politely. But done correctly, a program featuring consecutive days of hard training is a potent weapon in a rider’s training arsenal.

Let’s look at how pros use stage races to increase fitness, then at how recreational riders can employ the same principles.

THE PRO APPROACH

A professional’s method of riding and recovering from stage races has been honed over the 100 years of the sport’s existence. Now, science has been added to tradition. The result is a standardized protocol.

First, pros wait for their bodies to mature. It's rare for riders younger than their mid 20s to complete 3-week stage races. If they enter, they usually race only the initial, flatter stages in their first or second attempts. This was the approach of two recent Tour de France competitors who went on to become multi-time winners, Miguel Indurain and Lance Armstrong.

Second, pros prepare properly. No rider who hopes to do well in the Tour starts the race with only training rides and one-day events under his wheels. Instead, he'll progress from early season 3-day events to 1- and 2- and maybe even 3-week tours. The body can handle these longer events but only if it's given advance notice of the demands and has time to adapt.

Third, pros save energy when possible. Every stage doesn't have to be raced all-out. It's possible to hide in the shelter of the pack and rest. Riders who have nothing to gain on general classification may sit up on the last climb of the day, losing time but saving energy for subsequent stages, perhaps to help their team leader.

On mountain stages, poor climbers look for the autobus, the group that contains the sprinters and others who struggle on long ascents. These riders have an uncanny ability to go just fast enough to beat the time cutoff and remain in the race. They get maximum rest while waiting for terrain better suited to their talents.

And pros eat and drink a lot. A stage-racing truism is that when you eat today, you're actually eating for tomorrow. If you fall behind on calories or hydration, the deficit may not hit until a day or two down the road. Then you'll bonk hard.

Because of this, experienced stage racers eat a substantial breakfast consisting of carbohydrate such as bread and pasta, as well as eggs or lean meat for protein. Studies of Tour de France riders show that they consume a diet of 55-60 percent carbohydrate. That's a lower percentage than is often recommended for endurance athletes, but because they're eating so many calories (6,000-8,000 per day on average) they still get enough carbo to restore their glycogen levels. They also have room for the protein that helps repair tissue damaged by the stresses of racing.

In addition, stage racers hydrate with water and sports drinks both on and off the bike. They're careful not to miss feed zones during the stages, and they eat as much as they can choke down during the action. Finally, they begin to eat and consume carbo-replacement drinks as soon as the stage is over.

Pros take care of themselves in adverse weather. Stage races, like recreational tours, go on no matter what the conditions. Cold and wet can sap energy, so rain jackets are a must. When it's hot, they open the full-length zippers in their jerseys, drink continually and conserve as much energy as possible early in stages.

On rest days, they still ride, usually from 1 to 3 hours at a steady pace. Often they'll reconnoiter the next day's stage if it's a time trial. And they may throw in a few hard, short efforts to remind their legs that the race isn't over.

After completing a stage race, pros usually take a couple of days off the bike, then spin gently for 2 or 3 additional days. By the next weekend, they're racing again and into their usual train-

ing routine. Assuming they finished the stage race strongly and without injury, they'll reach a new peak of power in about 10 days.

GOLICH'S BLOCK TRAINING

How can you use these pro insights to improve? Colorado-based cycling coach Dean Golich, who works with Carmichael Training Systems, suggests that his riders incorporate the day-after-day elements of stage races into their normal training.

Golich calls it "block training." Instead of alternating hard and easy days, Golich's charges sometimes train ferociously hard (see chapter 8) for 2-4 consecutive days, then rest for 2 or 3 more days by spinning at an easy pace. When they feel recovered, they put in another block of tough training days.

At first glance, Golich's approach seems to be a recipe for overtraining and burnout. But it works. His clients have included U.S. time trial champion Mari Holden and U.S. hour record holder Norman Alvis.

"Pro racers go all-out for three weeks in a row in the Tour de France," Golich argues, "and if they rest properly after the Tour, they're flying."

Golich also points to research that supports block training. In a study done at the University of Wyoming, 8 top cyclists were subjected to 3 weeks of hard training. Each week included 8 interval sessions at maximum effort, a sprint workout and a 5-minute, all-out test. Cycling performance improved significantly during training and increased even more after 2 weeks of recovery.

"Sure, this is hard training," Golich says. "Most people don't train this way. But then again, cycling is a hard sport."

Golich's program isn't just for elite racers. In fact, it makes plenty of sense for recreational riders who have limited time to train. They can get all the intensity they need during blocks of time when they have extra hours for the bike. Then on those days when work or family responsibilities fill up their schedule, they recover by resting or doing short, easy spins.

For example, suppose you can ride long and hard on Saturday and Sunday. Add one more hard workout on Friday evening after work, perhaps on an indoor trainer, and by Sunday night you'll have done a block of 3 hard workouts. During the week, fit in 2 short rides at an easy pace.

This also works great if you're on a 4-day workweek. Train hard on your 3-day "weekend," then rest or take easy spins on the 4 days when you work long hours.

VAUGHTERS' BLOCK TRAINING

Jonathan Vaughters described his block training at the camp I attended in Denver. Essentially, he does 3 days hard, takes a rest day, then does another 3-day hard block. Each block consists of increasing volume and decreasing intensity.

For example, the first day Vaughters rides about 3 hours and includes intervals consisting of hard pedaling for 10 seconds followed by easy pedaling for 20 seconds. He repeats this pattern for 15-20 minutes. (See chapter 16.)

On day 2, he rides about 4 hours with 2 repeats of 20 minutes at time trial intensity, pedaling at about 100 rpm.

Day 3 is longer yet—5-6 hours—at a moderate and steady pace with some climbing.

On the rest day, Vaughters spins gently for 1-2 hours at no more than 60 percent of his max heart rate.

This is pro training. Most recreational riders need far more rest than Vaughters does. Masters-age riders certainly do. If you try this, cut back mileage and intensity and increase rest or you'll soon fall victim to overtraining.

TOURING TO BOOST FITNESS

If pros can use 3-week stage races to elevate fitness, recreational riders can employ week-long cross-state rides, tours or even weekend getaways to get similar benefits.

In 1993, Ed Pavelka and I rode Lon Haldeman's PAC Tour—3,400 miles from Seattle to the Virginia shore in 24 days. That's an average of 140 miles per day with no rest days, and a total of 100,000 feet in vertical gain. It was more than 1,000 miles longer than the Tour de France—and the Tour has 1 or 2 rest days.

And we rode athletically, averaging 19.5 mph for the entire distance, including an easy warm-up the first 25 miles each day and some slower pacelines when feeling sociable or battling headwinds.

Before PAC Tour, my longest career ride had been 140 miles. Now, I was going to average that distance every day for 3-plus weeks. I figured that I might make it to Yorktown but then I'd surrender to overwhelming fatigue. I'd probably need to spend the winter knitting or playing chess in order to recover.

Instead, two weeks after this long, hard tour was over, Ed and I felt big benefits. He broke New York's cross-state record, time trialing the 277 miles from Buffalo to Albany in 14 hours. I felt fine after a couple of weeks of easy riding. That was a surprise, and the long-term benefits were even more shocking. The fitness that I gained changed me as a cyclist. Long rides weren't as hard. My stamina increased. Most importantly, my conception of what was possible on the bike widened.

Those were all good things because in 1996, Ed, Skip Hamilton, Pete Penseyres and I set a senior (age 50-plus) world record for the 2,904-mile Team Race Across America. We rode from Irvine, California, to Savannah, Georgia, in 5 days and 11 hours. It was nonstop, around the clock, 30-minute shifts flat out in rotation. For each of us, it equaled about 65 30-minute intervals at or above our lactate thresholds.

Most riders don't train this way! When is the last time you did 65 12-mile time trials in 5 ½ days?

It was extremely demanding and an incredible experience. Each of us had great morale because we were doing well and didn't want to let our teammates down. But I confess that in the middle of the night in the humidity and hills of Tennessee, I realized just how tired I was.

I expected to be fried for months after RAAM, both physically and emotionally. Yet 3 weeks after finishing in Savannah, I set my personal record for the 40K time trial. I was almost 51 and had been racing that event for more than 20 years.

You probably won't have the opportunity to ride Team RAAM. But I'll bet there's a week-long ride you'd love to do, or maybe a cycling camp where there's coaching as well as plenty of riding. Maybe you'd like to set off for a week with a friend on a credit-card tour, carrying a minimal load by staying in motels and eating in restaurants. Or, you're shooting for the adventure of a lifetime by riding a PAC Tour or similar odyssey.

Is it possible to use these tours to sharpen your fitness? You bet. Apply the lessons I detailed above in "The Pro Approach," plus these tips:

- **Prepare right**. The key to riding distance well on consecutive days is to do some back-to-back long rides in training. Simply go long on both weekend days in the 4-6 weeks leading up to the tour. It's more important to do these consecutive long rides than to log high-mileage weeks in which you ride about the same amount of time each day. The key is to do 2 big rides on 2 days, then back off during the week. (See "Weekend Getaways" below.)

- **Check equipment**. Use your long training rides to dial in everything. The lightweight saddle that's comfortable for a 30-mile hammer session may be excruciating when you sit on it at lower riding intensities for 6 hours. The liner in your shorts might be fine for daily training, but on long tours its shape, thickness or stitching could rub you the wrong way. Work out these issues before the big ride starts.

- **Get organized**. On tour, organize your gear before going to sleep each night. Lay out your riding clothes for the next morning. Pack your rain gear, sunscreen, food for jersey pockets, ID and money. Then you can get on the road without delay when the new day dawns.

- **Establish a post-ride routine**. Some riders like to do crunches and pushups right after reaching the day's destination. These simple exercises counteract the rigor mortis that sets in during hours of leaning on the handlebar. Next, eat about 500 calories of carbohydrate with a little protein to benefit from the "glycogen window." (One rider I've toured with likes to hit the local Subway for a 6-inch turkey sandwich, chips and a big soft drink.) Then, wash out your riding clothes so they'll have maximum time to dry.

- **Set next-day goals**. Each evening of the tour, decide what you want to accomplish during the next day's ride. Will you try to stay with a specific group? Ride hard for the hour before lunch, then easy the rest of the day? Or simply use climbs for work and tailwinds for rest? Have a game plan and you'll get more training benefits from the tour.

- **Eat and drink**. Take a tip from pro road racers and eat your way through the tour. When you're off the bike, ensure sufficient hydration by keeping a water bottle with you. If you're not getting up at least once or twice each night to urinate, you're not drinking enough.

- **Take on-bike recovery days**. When Ed Pavelka and I coach at the annual PAC Tour Endurance Camp in southern Arizona, we have at least one "designated weenie day" and spin gently. This is necessary when piling 620 miles into an early-season week. In 2002, for example, our DWD was the day from Douglas to Sierra Vista by way of Bisbee.

We stopped at a coffee shop in the old mining town to enjoy muffins and cups of the blend of the day. Then we granny-geared over Mule Pass (after the food there was no other choice) and cruised to the lunch stop in Tombstone, where we also took a leisurely walk around the Old West replica town center. Only 20 miles remained to the destination motel. It took us nearly 90 minutes to cover them. After hammering for the preceding 5 days, it sure felt good to spin the small chainring.

> **TIP!** When staying in motels, wash your cycling shorts and jersey in the room sink, using a few drops of the complimentary shampoo. Squeeze out the suds and rinse under the gushing flow of the bathtub faucet. Wring the clothes by hand, then roll them in a towel. Put a foot on one end and wind the other, twisting the towel tightly with both hands. This squeezes out most of the water, helping the clothes dry so they'll be ready to wear the next morning.

WEEKEND GETAWAYS

You don't have to take a weeklong vacation to do a fitness-boosting tour. In fact, stage race training is as close as your front door. Simply ride hard on Friday evening after work, then do a mini-tour over the weekend, staying at a motel or B&B on Saturday night. Advantages include:

- **Adventure**. You'll see roads and towns out of range of your normal rides. Are there long climbs 50 miles away you'd like to try? How about that winding, riverside road that you've heard about? Anything within a radius of 75-100 miles is accessible if you plan an overnight stay.

- **Variety**. Many riders grow tired of the same old roads for training and find it harder and harder to get out there. A weekend tour mentally refreshes you with new sights and challenges.

- **Motivation**. It's easier to ride long when there's someplace you need to go. Rain or headwinds won't stop you when you must get to the motel by dark or back home again on Sunday.

We often associate touring with large loads and unwieldy bike handling. But for an overnight motel ride in summer, here's all you need to carry:

- A multitool and 2 spare tubes
- Arm and leg warmers and a rain jacket
- Off-bike clothes (shorts, T-shirt, sneakers or sandals)
- A stripped-down toiletry kit (men, no need to shave)
- A credit card and ATM card

You don't need a second set of cycling clothes. Wash out your duds in the motel sink as soon as you arrive (use the towel-wringing tip above) and they'll be ready for Sunday's return trip.

The above stuff fits into a large seat bag, so you won't need a rack and panniers. Or, you can opt for a lightweight rear rack (frame- or seatpost-mounted) and rack trunk. Your bike will handle—and climb—in nearly normal fashion.

Camping is less expensive and perhaps more fun, but most riders with fitness as a goal shudder at the thought of laboring on a bike laden with overnight gear. The solution is to adopt the approach used by "light-packing" backpackers:

- Carry a bivouac sack or one-person tent, a lightweight sleeping bag and pad.
- To avoid the weight and bulk of a stove and cooking supplies, eat in restaurants or pack cold food.
- Pack these supplies using a front rack, small panniers and a large seat bag or trunk. With careful choices, you can keep the total load under 20 pounds.

CHAPTER 7

Speedwork for Faster Long Rides

This concept in a nutshell: To ride long distances faster, do short-distance speedwork in training.

Conventional wisdom says that if you include one endurance training ride each week, your time for long events such as centuries will come down.

Unfortunately, improving long-distance speed isn't that easy. It requires going beyond the lactate threshold in training, and this is painful. It makes you breathe hard and perspire. Research and experience shows us that training fast for short distances improves cruising speed for long distances. It helps you ride as much as 2 mph faster for several hours but

without an increase in perceived exertion. And if you raise your average speed from 17 mph to 19 mph for 100 miles, you'll cover the distance nearly 40 minutes faster.

There are other important advantages, too. Speedwork can be done in a much shorter amount of time than endurance slogs, glad tidings for time-challenged recreational riders. And fast workouts are fun. They don't have to be head-down pain fests if you know how to do them right.

WHAT RESEARCH TELLS US

A 20-year-old study from the University of California at Berkeley gives us a clue about how speedwork increases endurance performance. Researchers put 10 rats on a 4-week fast training program. The rats worked out just 5 minutes every day for 4 weeks. On the treadmill, they warmed up for 3 minutes, ran hard on a 15 percent grade for 50 seconds, recovered for 10 seconds, repeated the 50-second hard effort and cooled down for 10 seconds. (How's that for a time-efficient workout?)

Results were impressive—the rats increased their VO_2 max by 15 percent, and the maximum speed they attained in the 50-second repeats increased 25 percent.

At first researchers were puzzled when they found that although VO_2 max and speed had risen so impressively, the concentrations of aerobic enzymes in muscles didn't rise. How could rats use more oxygen when levels of oxygen-using enzymes stayed the same?

Apparently, the rats had enough enzymes before their sprint work but didn't have the neuromuscular coordination to sustain fast running. The rapid repeats gave them the muscular and nervous system abilities to do so. For rats, as for humans, the faster their maximum speed, the greater their aerobic potential.

Now, you may smell a rat in this research. How do we know that rat running translates to human riding? The scientists know that muscles and cardiovascular systems in rats and in humans work nearly the same way. The rats' VO_2 max translated to about 70 ml/kg/min in people—approaching the level of elite human cyclists and runners.

FROM RATS TO RAAM

In case you're not convinced, let's look at a human example. In 1984, nuclear engineer Pete Penseyres was training for the solo Race Across America. He worked full-time and had a family, so his training time was limited. How could he prepare for a 3,000-mile event when he was working a 40-hour week?

Penseyres solved the problem by incorporating workouts into his daily bike commute to work. He lived 30 miles away and often took a longer route home to total 100 miles per day. Most of this was slow, steady riding in the belief that training volume was the key to riding RAAM.

Leaving work on Friday afternoons, Penseyres would ride for 24 hours or about 400 miles to simulate RAAM demands. These rides, too, were done at a steady pace of 15-17 mph. This training paid off when Pete won the '84 RAAM in 9 days and 13 hours.

The next year he didn't race but instead helped his brother, Jim, a Vietnam vet who became the first amputee to finish the grueling event. The winner was pro road racer Jonathan Boyer, who bettered Pete's '84 time. With Boyer expected to defend his title in 1986, it looked like the stage was set for Pete's return and a classic confrontation between an endurance specialist and a Euro racer.

Penseyres knew that to beat Boyer, he had to be as fast as Boyer. So, he changed his training. Instead of long, steady slogs every day, he incorporated 5 speed workouts per week. Two were team time trials of about 15 minutes each. When pulling at the front, Pete went well over his lactate threshold with a heart rate around 170. Riding at the back provided some rest but not much—his heart rate dropped only into the 150s. On 3 other days, he did a training race against younger and more-rested riders. (Pete was 43.) They made it tough for him because they knew what he was training for. He made it tough on himself by riding his 35-pound commuter bike complete with a rack, lights and battery.

The result? Although Boyer didn't show for the race, Penseyres knocked more than a day off his own '84 performance and beat Boyer's '85 time by some 16 hours. In fact, Pete finished the 3,107 miles in 8 days, 9 hours to set an average speed record of 15.4 mph that still stands.

According to Penseyres, the speedwork "did what I intended it to do. It raised my cruising speed by about 10 percent, by at least 1 mph. For the same perceived effort, for the same heart rate, I was going faster. My lactate threshold was higher, so I was comfortable at a faster speed."

EASY SPEED

Great! But how can you incorporate speedwork into your routine?

You could always do traditional interval training as described in the next chapter. But many riders dislike the regimentation of intervals. Even Penseyres, who has become a multi-time national champion masters road racer in his post-RAAM career, has a hard time forcing himself to do structured solo intervals.

Fortunately, there are several simple ways to get the advantages of speedwork without the drudgery of "3 minutes on, 3 minutes off."

- **Wind ups**. On your easy riding days, do several brisk "wind ups." Shift to a moderate gear, get off the saddle and sprint at about 90 percent effort for 8-10 seconds until you're about to spin out. Then sit down and spin a bit faster for another 10 seconds. Concentrate on good form, a round pedal stroke and keeping "quiet hips" on the saddle. This isn't an all-out effort. Instead, focus on pedaling form. These sprints will help your neuromuscular system adapt to going faster more efficiently.

- **Fartlek**. This Swedish word translates to "speed play," another substitute for structured intervals. It's all about going faster in an unplanned way, scattering random harder efforts through a ride. Sprint when the spirit moves you—away from stop signs or when you crest small hills. A good way to initiate harder efforts is to choose a "trigger" before the ride. For

instance, you may decide to sprint whenever you see a certain kind of bird in the roadside bushes or a yellow mailbox. Don't pick something too plentiful!

Longer, time trial-like efforts can be triggered when you roll down a hill and hold a fast pace for a mile on the flats, or when you turn and catch a tailwind.

Keep these efforts fun, unstructured and free-flowing. You'll get outstanding speedwork without feeling forced to work hard.

- **Training time trials**. Many local cycling clubs have time trials once a week or month. Usually 10 miles long, they're a great way to get a dose of speedwork with the excitement of competition to boost your enthusiasm and adrenaline. As a bonus, you can use times to chart your improvement over the season.

- **Club crits**. Some clubs have evening criteriums, too. The advantage of a crit is that you have to sprint out of every corner, getting spikes of intense work instead of the steady-state effort of time trialing. You'll also hone bike-handling skills that are useful in the pacelines of century rides.

- **Group rides**. A club ride is a great way to get some speedwork. Choose a group that's as fast as you or just a bit faster. Typically, these rides feature sprints for road signs, hard jams over hills and lengthy chases when someone goes off the front. They're the next best thing to road racing to help you develop a turn of speed.

- **Short pacelines**. When you train with a couple of buddies, talk them into going hard for 5-10 miles in the middle of the ride. Trade off the lead, taking hard pulls of 1-2 minutes. You'll get a great team time trial workout with enough rest while you're drafting to let you go anaerobic each time you hit the front. As a bonus, this is an effective way to battle the wind on a gusty day.

- **Hills**. Riding in hilly terrain is perhaps the best way to get a naturally intense workout. You can't cheat gravity by sitting in or faking your effort. To get to the top of the hill you have to work hard. Ride hilly routes a couple of times a week and your fitness will improve rapidly. So will your climbing ability.

CHAPTER 8

How Hard?
As Hard as You Can!

This concept in a nutshell: Forget heart monitors or power meters. Go flat out when riding intervals up to 5 minutes long.

Coach Dean Golich is not only infamous for his block training (see chapter 6), he also preaches a heretical approach to doing intervals. He counsels his riders to ignore the usual methods of gauging intensity, such as heart monitors and watts measuring devices. He eschews elaborate training zones based on percentages of max heart rate or lactate threshold.

Instead, Golich argues, every interval should be ridden as hard as you can. What's more, he doesn't want you to ride a 3-minute interval at a steady high pace, calculating how hard to push so you can last the distance. No such luck. Instead, he wants you to start the interval with a sprint and hang on for all you're worth.

"Don't pace yourself," says Golich. "Start each interval flat out. You'll be struggling at the end, but that's okay. That's when you get the adaptation."

WHY DO THIS TO YOURSELF?

Golich likes to invoke the "30 miles per hour rule" which states that if you never go 30 mph, you'll never go 30 mph.

Put another way, if you don't train at race intensities, you won't be able to go that fast in a race. Don't expect to do well at your goal pace, whether it's 30, 25 or 20 mph, if you consistently train at lower speeds. If your goal is 25 mph in a time trial, start your interval with a hard charge off the line, then do your best to hold that pace. As you get tired, your speed will decrease but your effort won't.

"If you do intervals this way, next week or next month you'll be able to hold the speed longer," says Golich. "You'll feel fatigue but it will be temporary. It isn't overtraining, so tough it out."

Gearing is crucial to this type of interval training. If you start the effort in a relatively large gear at a reasonable cadence, say 90 rpm, and you don't shift down, your cadence will get slower and slower as you fatigue.

Most cyclists aren't accustomed to progressively shifting lower during an interval's work session. They equate it with giving in. But for Golich's intervals, effort is the most important thing, then high cadence. Gearing is a distant third—it's only a tool to help you work as hard as you can. There's no shame in shifting down. In fact, it's necessary to keep effort flat out and your knees healthy.

Won't such intensity lead to chronic fatigue? No, Golich argues, as long as you rest properly after these hard workouts.

NO HEART MONITOR

Some riders may hesitate to do Golich's intervals because they're afraid of going too far over their lactate thresholds. They're tied to heart rate training zones. Hard intervals, without feedback from a monitor, make them nervous.

"You don't need a heart monitor for hard training," Golich contends, "because there's little correlation between heart rate and power output. When cyclists look at their heart rates dur-

ing hard efforts and see low numbers, they're supposed to stop the interval session and go home. But when I examine SRM Powermeter data [which measures power output in watts] often they're putting out more power than a day or two earlier when their heart rates were higher. Heart rate isn't a reliable indicator of power."

THREE TRAINING ZONES

Golich recognizes only 3 training zones—easy, medium and hard—determined subjectively.

An easy pace is for recovery days. It's really easy—no pressure on the pedals—great for riding with a spouse or slower friend. A medium pace is defined as the effort you can sustain for an hour. Golich often prescribes 15-minute intervals at medium effort as a way to increase time trialing ability.

SHOULD YOU TRY THIS?

Any program this hard has dangers. Don't attempt "hard as you can" intervals without heeding the following warnings:

- **Get medical clearance** before attempting this or any other form of intense athletic training.

- **Have a solid base**. You need aerobic conditioning for at least 8 weeks based on progressively longer and harder rides. My programs in *Off-Season Training for Roadies* and *Spring Training for Roadies* are ideal for preparing you for the rigors of Golich's intervals.

- **Keep your cadence up**. Save your knees by pedaling at 90-100 rpm throughout each effort. Shift to an easier gear as the interval progresses to keep both effort and cadence high.

- **Limit the workouts**. Train this way only once per week for no more than 4 weeks. Then use a training time trial or other test to gauge improvement. Don't resume these intervals—or increase their frequency—until you're sure your body is coping well with them.

- **Stop in time**. Don't do these intervals within one week of an event you hope to do well in. Plan an appropriate taper (chapter 15).

- **Monitor your enthusiasm**. If you experience symptoms of overtraining such as deep fatigue, insomnia, apathy or loss of appetite, stop hard training and do steady-pace recovery rides until you feel fresh again.

CHAPTER 9

‘Spinning’ for Strength and Power

This concept in a nutshell: Use a “spinning” bike indoors to build strength.

One of the best techniques for building leg strength is low-cadence, high-resistance pedaling. Cranking along at about 50 rpm with significant resistance builds strength in much the same way as high-rep leg exercises in the weight room.

Although this technique is usually associated with off-season training, it’s actually appropriate at any time of year. The Italian pro, Francesco Moser, popularized it when he was training for the world hour record in the early 1980s. He rode long climbs in a 53x12-tooth gear to build the strength necessary to turn a relatively big ratio at over 100 rpm for the 60-minute ordeal.

Low-rpm strength by itself doesn’t mean you can ride fast. For speed, you need power. Strength comes first, and then it’s a simple matter of adding high-rpm workouts for power.

Also, strength workouts are crucial for riders over 50 who want to retain muscle mass. Squats and leg presses in the weight room do the trick—but it’s more cycling-specific to do “squats on the bike” in a big gear.

This training can be hard to do outdoors, though. It isn’t easy to find a suitable road with the proper gradient, free from stoplights, traffic and cross streets. And if it’s chilly outside, knee problems can be exacerbated by the cold.

That’s why it makes sense to do high-resistance workouts inside. The problem is that standard trainers may not supply enough resistance, and your rear tire may slip on the roller under hard effort. The solution is as near as your local gym if it offers indoor cycling classes using “spinning” bikes—stationary bikes with hefty flywheels, a non-freewheeling fixed gear and enough resistance to suit even Moser.

HOME MACHINE

You could also invest in a spinning bike for your home. During the winter of 2001-2, I used a LeMond RevMaster, designed with input from Greg (www.lemondfitness.com). It was a great advantage for high-resistance workouts.

The RevMaster is adjustable for my road bike position, and its stability lets me crank as hard as I want or stand and sprint without concern that it might topple over.

Its biggest advantage over a trainer is that pedaling resistance can vary from none to so much that I literally can’t turn the 40-pound flywheel. It’s easy to do Moser-like 50-rpm drills. Resistance feels fluid, even at high resistance.

A high-quality machine like the RevMaster will set you back around $1,000, but you’ll save health club fees and be able to work out when and how you want at home. If you’re dedicated

to cycling and see yourself training for years to come, a spinner is a sound investment. Just think of it as buying another bike—one that other family members can ride, too.

THREE DRAWBACKS

No cycling solution is without faults, and spinning bikes usually have 3.

First, there's apt to be a wide, padded saddle. I didn't like the one that came on the RevMaster, though it worked okay. It's as easy as on a regular bike to install a different saddle.

Second, spinning bikes usually come with a handlebar that resembles the "cow horn" aero bars used by time trialists in the late '80s. This shape is not ideal for general training, and it doesn't let you dial in your precise road position. To solve this, the RevMaster has an adapter for installing drop bars. It works great and makes the unit much more road-specific.

Third, there's no way to tell exactly how much resistance you're using. Resistance is controlled by turning a knob that moves a brake pad against the flywheel. Although you can count knob rotations, without a consistent starting point you get an estimate at best.

In reality, though, I find that this doesn't matter much. I use a heart monitor while pedaling the RevMaster and simply check my pulse against my perceived exertion just like riding on the road. It worked fine, although a spinner that tells resistance in watts would be a useful improvement.

THE WORKOUT

Okay, I've talked you into going to the club (or your basement) once or twice weekly to build leg strength. Here's how to do this workout.

> **CAUTION!** Don't train this way if you have a history of knee problems. Make sure your saddle is set at the correct height. If you experience knee pain, stop the workout.

1. **Warm-up carefully**. You're going to combine high resistance with low cadence, so get your knees ready for the task. Do the warm-up in chapter 2 or something similar.

2. **Start with low resistance and short efforts**. Don't proceed from the warm-up directly to big-gear grinds. Instead, begin with brief seated sprints at 90 percent effort with a resistance you can spin. Do 3-5 of these, increasing resistance a half turn of the knob each time. Lengthen sprints from 10 seconds to 30 seconds.

3. **Include one-leg training**. Unclip a foot and rest it on a chair or stool. Pedal with the other leg, trying to stay smooth. Alternate legs every couple of minutes. At first, your stroke will quickly deteriorate as you tire. But soon you'll feel smoother and more powerful. This workout is easier on a spinning bike than on a trainer (or on the road) because

the heavy flywheel and fixed gear provide momentum. As a result, you can use more resistance and get more strength-building benefits.

4. **Muscle the pedals**. The real meat of this workout is 1-3 intervals of 3-5 minutes each. Choose a resistance that you can barely turn at 50 rpm. (Cadence is crucial, so count each time your right foot hits bottom for 15 seconds and multiply by 4 to get revolutions per minute.) This isn't a cardiovascular workout! Don't let your heart rate get closer than about 10 beats below your lactate threshold. You definitely shouldn't be panting and gasping. It's a muscle workout, not training to improve anaerobic power.

CHAPTER 10

Cardio-Resistance Workouts

This concept in a nutshell: Combine intervals on an indoor trainer with upper-body weight training for a workout that boosts both strength and lactate threshold.

I get dozens of questions for my "Ask Coach Fred" column in the weekly *RoadBikeRider.com Newsletter.* Many are about finding enough time to train. Particularly, riders have trouble fitting in workouts on the bike along with the upper-body resistance training they know they should do several times a week.

Resistance training is important for reasons other than helping us ride faster. It helps us retain muscle mass that would otherwise be lost to the aging process. A good weight-training regime is also important for bone health.

But, readers lament, how can we find time to lift, ride, go to the grocery store and mow the lawn? Time on the bike for serious training, not to mention social rides and fun solo cruises, is woefully short for most cyclists.

One promising answer lies in research done by Gary Sforzo of the Graduate Program in Exercise and Sports Science at Ithaca College in upstate New York. His study shows that a high-intensity combination of weights and indoor cycling can increase muscular strength by nearly 25 percent *and* significantly improve VO_2 max.

Additional research by other sports scientists confirms Sforzo's finding and shows a significant increase in power at lactate threshold—probably the single most important factor in cycling ability.

The workout is done by alternating the exercises of a standard upper-body weight-training routine with hard intervals on the trainer.

I know what you're thinking: Get on the trainer in the summer? That misery is usually reserved for winter days when riding outside is impossible. But there are good reasons for

hitting the cylindrical road even when the weather is beautiful. Let's look at Sforzo's program and then examine why you should consider implementing it, even at the height of the outdoor season.

THE PROGRAM

1. Warm-up for 15 minutes on the indoor trainer with the routine detailed in chapter 2.

2. Get off the bike and do light calisthenics to loosen your upper body. Include abdominal work—several sets of crunches or other exercises you prefer.

3. Do 5 upper-body exercises. At home with minimal equipment, you might do pushups, pull-ups, upright rows, bent rows and triceps extensions (the last 3 exercises with dumbbells). If you go to a gym, bench presses, lat pulldowns, dips, seated rows and triceps extensions are popular choices. (Note: At a gym, reserve an exercise bike for 45 minutes so you can implement the next part of the program.)

4. In standard weight-training protocol, you do one set of an exercise, then rest for several minutes while your muscles reload before you do the next set. But in this program, you don't lounge around resting between sets. Instead, you immediately hop on the trainer and crank for 2-3 minutes.

5. Choose a gear or a resistance that allows you to maintain a cadence of about 90 rpm. Your heart rate should rise to about 85 percent of maximum during the last minute. Your rating of perceived exertion should be about 8 on a scale of 10. The idea is to work hard but not be so blown that you can't immediately do another set of upper-body strength work in good form.

6. Continue to alternate one set of each resistance exercise with a 2-3-minute interval on the trainer. At the end of the workout, you'll have done 3 sets of the 5 exercises (15 total sets) with each set separated by a cycling interval (15 total intervals). You'll be tired!

> **CAUTION!** This is effective training, but it's hard. "All the subjects in the study thought it was a great workout and worth the effort," says Sforzo. But you need a physician's approval before you undertake this or any other intense training, and you also need to be aware of the signs of burnout and overtraining, such as deep fatigue, insomnia, apathy or loss of appetite.

Limit this workout to twice a week at most. Once weekly will be sufficient for most riders. Improvement should come quickly. After all, how often do you perform 15 intervals totaling 30-45 minutes of hard effort? This is a "high cost" workout in the sense that it demands a great deal of recuperation ability. If you combine it with a hard ride or race on the weekend and a couple of fast or hilly weekday rides, you'll be fried in no time.

So, go easy in the beginning. The first time you try this workout, do only one set of each exercise alternated with a cycling interval. That's a total of 5 sets of weight exercises and 10-15 minutes of hard pedaling. The next couple of times, increase to 2 sets of each exercise and 10 trainer intervals. If you're still having fun, you can consider moving up to the full 3 sets and 15 intervals.

RAPID RESULTS

For time-challenged cyclists, this is an effective workout to do once a week during the season, especially when weather or other obstacles preclude riding outside.

For instance, if it's raining on your scheduled interval day, do a cardio-resistance workout instead. If a meeting at work runs late and scotches your hill workout, do this training in the evening at home.

You should see improvement in as little as 4 weeks—increased strength, more power on hills and better time trialing speed. In addition, improved power at lactate threshold will raise your cruising speed during long rides.

One final point: You don't have to use heavy weights to get benefits from this workout. You're aiming for strength, not big muscles, and strength doesn't necessarily show. As Jonathan Vaughters notes, "Most pros don't have strong-looking physiques. We look like Yoda off the bike."

CHAPTER 11

Painless LT Training

This concept in a nutshell: "Play" at high-intensity training to relieve the drudgery of intervals

As I've said often times in this series of *For Roadies* training books, lactate threshold (LT) is a magic number.

Generally defined as the heart rate (or wattage) you can maintain for an all-out effort of 30-60 minutes, LT is key to performance on a bike. The power you can generate when going as fast as you can in a time trial or on a long climb dictates your cycling ability.

The other physiological measurement that's often invoked is maximum oxygen uptake (VO_2 max). However, this is not very trainable because genetics imposes a "ceiling" on every rider's improvement. Also, the limiting factor in cycling ability isn't the amount of oxygen your tissues can process. Rather, it's the amount of power you can generate at a given percent of oxygen consumption.

Some great cyclists have had relatively low VO_2 max numbers. But their ability to generate significant power allowed them to compete very successfully against riders whose oxygen uptake was higher but whose efficiency was less.

LT, on the other hand, is highly trainable. Using the proper workouts, you can improve the percent of maximum heart rate you can sustain, and improve the amount of power you generate at a given heart rate. You can also boost your body's ability to process lactate. This lets you venture over the threshold where lactate is accumulated, but rid it from your tissues quickly. These improvements mean big gains in useable speed and power.

Fine—so how can you boost your lactate threshold and reap these wonderful benefits?

The answer, of course, is hard work. As I've mentioned, there's an emerging consensus that endurance athletes should spend large amounts of training time—some say as much as 25 percent of total on-bike time—at heart rates (or power production rates) ranging from 10 percent below LT to slightly above.

That's a lot of time to dwell in painful territory. And it's made even tougher by the mental demands of pushing yourself to such an extent. Imagine spending 1 hour in every 4 riding as hard or harder as you do in a time trial you really want to win. Ouch!

Fortunately, there's an easier way to reach LT levels in training. It changes pain and suffering into something closer to fun. All you need is to find ways to go hard without goading yourself to go hard. Sound like a contradiction? Not really.

Let's take running as an example. Suppose your coach orders you to run 6 miles with 40 short sprints scattered throughout. These sprints must be nearly all-out. You'll go anaerobic and then recover only enough to do another one.

This workout doesn't sound like fun. You may be able to handle it occasionally—but 2 or 3 times a week for the whole season, or your whole career? Forget it.

Now let's suppose that instead of doing the grueling workout, you were told to play a game of full-court basketball. The effort would be similar to the loathsome running workout. Studies show that NBA players run about 6 miles during a game and accelerate dozens of times while maintaining heart rates at or above their lactate thresholds.

But guess what? Basketball is fun. You'd have such a great time that you'd barely think about how hard you were working. The game would fly by,

In the same way, you can design workouts on the bike that elevate your heart rate to LT and above without the physical and mental ordeal of structured intervals. Here are some ways to get this "basketball effect" on the bike.

GAIN WITH LESS PAIN

- **Fast groups**. Make an effort to hook up with riders who are as fast or slightly faster than you. Train with them once or twice a week. The effort required to stick with the group on

climbs and hang in during chases and sprints will equal a tough structured workout. But the mental effort is less demanding because your mind is occupied with group dynamics and bike handling. You'll know you're working hard, but you'll have little time to dwell on it.

The group doesn't have to be large. In fact, just one training partner can be enough as long as you have the same agenda. A spirited 2-man time trial along with competition when hills or designated sprint lines approach mean you'll each get a great workout. In fact, it may be harder than in a big group because your partner will see to it that you don't hide in the back—especially in a headwind!

- **Training races**. Some bike clubs have a week-night racing series, usually criteriums. Fun, but they won't teach you climbing tactics or how to ride in an echelon on a long, windy road.

So, talk your clubmates into making part of the weekend ride a "race." Warm up by riding for an hour until you arrive at a country road loop that's about 15-20 miles around. If it has stop signs or lights, make a rule that everyone has to obey them. You could also use a shorter circuit that has no traffic controls, but riding around in circles isn't as much fun as using a longer loop.

Re-group at the start of the race loop and begin. All tactics are fair—the idea is to see who can get away or win the sprint at the end just like in a regular race.

Training like this expands your ability to "read" a race. It's great for your fitness, and the miles will go by fast because you're having fun and competing.

- **Club time trials**. Some riders hate time trials. In a road race, they can draft in the pack. The pace is easy part of the time. But in a time trial there's nowhere to hide. The secret to success is to ride flat out for the distance. If you rest, you lose.

Time trials put you right at your lactate threshold. Or, in the case of TTs lasting less than an hour, slightly over lactate threshold. That's prime training intensity. So, it pays to psyche up and get out there for club time trials. They're good for you! Use the adrenaline of competition to ease the pain of intense effort. You may even find that you have a talent for the concentration required for top performances against the clock.

- **Hills**. Climbing is automatic intensity. If you have a hilly route, ride it twice a week. Bear down on the upgrades. Ride some in a large gear at a fairly slow cadence. On others, shift lower and spin faster. Sprint the short ones and apportion your energy up the longer one. Stand for the first climb, remain seated for the second, alternate on the third.

Hills are hard work. But when climbing is your goal for the day, ride as many as you can. This natural pain is easier to tolerate than intervals mandated by a watch. Besides the valuable time spent at your lactate threshold and beyond, riding hills builds leg strength and develops your climbing technique. You'll finish these workouts feeling the satisfaction that comes with getting the most out of your training time.

- **Serendipity**. The best way to include painless intensity in your training is simply to take advantage of every opportunity for riding hard. Be alert for impromptu situations when your legs beg to go fast—then let them go. Examples:

  – **Race a thunderstorm**. Have you ever been 5 miles from home when an innocent-looking cloud threatened to open up? Or gotten caught in open country with lightning flashing on the horizon? You know what to do—jam like crazy to get home before the storm catches you.

    Use these "tactical retreats" as great training. This doesn't mean to purposefully start your ride when a thunderstorm looms. But take advantage when you hear the rumble. It just might save you a serious bike-cleaning session, too.

  – **Chase a rider**. When you see another rider ahead, it's natural to pick up the pace. You wonder, "What's this guy have under the hood?" Give in to your competitive instincts and give chase. If you catch your target, don't blow by without at least saying hi. After all, he probably didn't even know he was being chased.

    Keep an eye on your back porch, too. If you notice a rider behind, you might be the prey. Nonchalantly pick up the pace and see how long you can hold him off. Whether you're the pursuer or pursuee, this game can give you a shot of adrenaline and several minutes of beneficial time-trial-like intensity.

  – **Motorpace a passing vehicle**. Motorpacing (following closely in the draft of a car or motorcycle) is a risky and advanced training technique that I don't recommend. There are too many opportunities for error and serious crashes.

    But occasionally you'll get passed by a slow-moving piece of farm equipment or a heavily loaded truck. Being very careful, you can accelerate, linger briefly in the vehicle's draft to get up to speed, then move back to the edge of the road. Keep the fast pace as long as possible while the harvester pulls away. Don't forget that the driver doesn't know you're behind and could suddenly slow or turn.

  – **Sprint away from dogs**. If you have aggressive Bowsers on your training routes, use them instead of avoiding them. Turn them into training partners. When approaching a mutt's yard, prepare to sprint by selecting an appropriate gear, gripping the bar drops and steeling yourself. Pick up the pace. When Fido comes boiling out from the porch, get off the saddle, accelerate hard and sustain the sprint until you're safely out of his territory.

    Again, use caution. If the dog sees you early, you might need to work on your bike handling, too, in order to keep him away from your front wheel. Always glance back for overtaking traffic. If the dog is on an uphill, you won't be able to outsprint him. His name might as well be Cipollini. You'll need to use standard dog-thwarting techniques, such as sternly yelling "No!" or "Bad dog!" to give him pause. Once he's behind or keeping his distance at the side, pour on the coals. Most dogs are making a game of it, too, and aren't really intent on having you for a snack.

- **Pound off a hill**. Descents never last long enough. Just when you get your speed going, the road flattens. But don't shift to the small ring and spin. Instead, stay in top gear and keep your cadence over 90 rpm as long as possible. You can ride at high intensity for several minutes with a descent-induced boost at the beginning.

- **Win with a tailwind**. Headwinds create an opportunity for intense riding, but battling a gale in your face is rarely much fun. On windy days, choose a circuit about 4 miles around so you won't have to fight the headwind for long periods and you can treat the tailwind as a form of motorpacing. Rev up your big gear, go as fast as possible and work on leg speed.

Pay attention and you'll find other opportunities to enliven your training rides with intense sections that make hard work seem more like play.

CHAPTER 12

Using Centuries to Boost Fitness

This concept in a nutshell: Make road cycling's classic event, the century ride, a key part of your training plan.

Most riders view century rides as goals in themselves, events to be ridden almost like a race. They train *for* centuries rather than viewing these hundred-milers as a way to prepare for other objectives.

A century can be both—a great goal and a superb training device. It's a long ride, for one thing. And a century can be as competitive as you want to make it, either against the other guys at the front or against yourself as you push for a time under 5 hours or your PR. In fact, I think centuries are one of the best training tools in a rider's arsenal.

EXAMPLE! Germany's Erik Zabel has won the Tour de France's green jersey (honoring the best all-around rider) a record 6 times. Obviously, he's a rider who does everything well. He's among the world's top sprinters, he can time trial when he has to, and he gets over the climbs although not with the specialists.

You'd think Zabel might have a complicated training formula, but he doesn't. He's done the same off-season program for 10 years, consisting primarily of base miles at a moderate intensity with sprints when

he feels like it. In fact, Zabel is famous for putting in a

huge early-season foundation—around 6,000 miles most years before the racing schedule even starts.

So how does Zabel go so fast when he races if he doesn't go fast in training? Isn't a training program of slow miles exactly the opposite of the approach I've put forth?

The answer is simple. Sure, Zabel rides lots of slow miles in training. But he never stops racing. He does six-day track races in winter, and he rides February's early-season events. He doesn't need to ride hard while training because he gets all the intensity he needs while racing.

In the same way, you can use century rides as "races" to boost your fitness and help you achieve cycling goals later in the season. Here's how.

BEFORE THE RIDE

- **Build your base**. Don't do a century without adequate base miles. (Remember Zabel's huge foundation.) It's okay to ride your first century on training rides of 60 or 70 miles—most first-timers just want to complete the distance. But if you want to get a PR or use the century to best advantage, it pays to give it the respect it deserves. This means at least 8 weeks of gradually increasing long rides on weekends. Ideally, you'll work up to rides of 75-90 miles with speedwork during the week.

- **Taper**. Treat the century just like an important race. Use the tapering procedures in chapter 15 for at least a week before the event. You won't get maximum benefit from the ride if you aren't rested and raring to go.

- **Eat and drink**. Perhaps the biggest mistake a rider can make is trying to lose weight in the few weeks before a big event. "If I were just five pounds lighter, I'd be able to climb with the front group," he says and promptly begins to limit food portions.

Inadequate calorie intake is the primary cause of fatigue and poor performance. In fact, some experts say that overtraining is almost always caused by not eating enough carbohydrate to restock the muscles with glycogen after hard rides. The basic rule: Eat a lot to ride a lot.

The same goes for hydration. Down plenty of sports drink and water in the days before the event. Keep a bottle on your desk at work. You should be urinating 4 or 5 times a day and getting up at least once each night to empty your bladder. If not, you're probably going into the century dehydrated. A loss of even one percent of your fluid weight can erode performance.

PLAN YOUR STRATEGY

Formulate a plan for the century well in advance. The least-effective way to do the ride is by winging it, figuring that you'll adapt to situations as they occur. You won't get maximum benefit that way.

To make your plan, ask yourself these key questions:

1. **Should I ride solo or in a group?**

If you're training for ultra-distance cycling, non-drafting triathlons or time trials, it may make sense to ride the century by yourself, avoiding help from other riders. But for most other goals, it's better to join in. And, after all, you can ride 100 miles solo anytime without paying an entry fee.

2. **How do I select a group?**

You can ride a century with your clubmates. In fact, some race teams form their own packs, discouraging anyone not wearing team colors from joining in the paceline. Advantage: You know whom you're riding with, so it's safer.

Most riders simply jump onto pacelines that seem to be going the right speed. If the group is actually going too slow, you can ride off the front, solo a while, and wait for a faster train to come rolling by. Jumping on and joining in makes the situation more race-like.

The drawback is when you have no idea of the group's riding skills. Some people may be strong enough to stick with the paceline but lack knowledge and experience, which can lead to mistakes with painful consequences. Identify these riders and avoid them. This is particularly important in crosswinds when echelons form. Wheels will overlap, so one mistake can cause contact that takes several riders down.

3. **Will I use aid stations or ride non-stop?**

Stopping at aid stations means you don't have to carry as much fluid and only an emergency supply of food. Pause briefly and stock up as needed. Plus, this breaks your effort into several chunks. You can ride hard to a stop, rest a bit while filling your bottles, munching some cookies and visiting the portable toilet, then resume your pace to the next stop.

On the negative side, stopping nearly always means the end of a fast-moving group. Not everyone stops or stops for the same amount of time. And no matter how fast you hurry through, it'll take several minutes for your legs to loosen once you're moving again.

The alternative is to ride the century non-stop. If you have the ability to finish in the 5-hour range, you can carry enough to eat without arranging for someone to meet you and provide hand-ups. Three energy bars and a couple of energy gel packets should be enough.

It's tougher to carry enough fluid. In warm-weather centuries, you should start with 2 large water bottles (about 28 ounces each) on the bike. Plus, wear a backpack-style hydration system that holds at least 70 ounces.

All this makes for a lot of weight, but it does get lighter as the ride wears on. If you run out of fluid or food, you can always abandon your plan and stop briefly at the final aid station. Otherwise, you'll bonk, finish exhausted and degrade your fitness rather than improve it.

One more point: If you're hydrating sufficiently, you can't ride a century without urinating. Male riders can learn to do it off the bike. It's relatively easy once you get over the ingrained psychological barrier. But it's not something you should do with other people in view, and it can be mighty unsanitary. For these reasons, many guys prefer to make a quick stop along the roadside or at an aid station.

Females have no choice but to stop. Seana Hogan, a multi-time winner of the women's Race Across America, could compete with the men—until she had to stop to urinate while the guys didn't. Over the course of a 3,000-mile transcontinental race, substantial time can be saved by answering the call of nature on the roll.

4. **How will I apportion my effort?**

The classic way to ride a fast century is to go at a brisk pace for the first third, go hard in the middle third, and go for broke in the push to the line.

But century courses may not play so neatly into this strategy. For example, the big climb may come early, requiring you to work hard only 90 minutes into the ride. Or you may latch onto a fast paceline from the start. In order to hang in and make good time, you must push harder than planned.

Every century is different, so it's important to identify your goals. Do you want to try for a PR? Then classic pacing is probably best. Do you want to increase your fitness for mass-start racing? Then the fast/slow pattern of pacelines works well. Do you want the benefits of hill work? Then push the climbs so you're hovering on the edge of your lactate threshold, then recover on the descents.

By the way, a fast time doesn't necessarily mean you worked as hard as possible. If you go extremely hard on hills or in pacelines, then roll along at an easier pace between climbs or until another paceline comes along, you may finish slower, but much more tired, than if you keep a steady, moderate effort. You'll get a better training effect out of the inconsistent pace.

5. **How will I recover?**

Working hard in a century is only part of the recipe. Rest and recovery after the event is at least as important for improving. Check chapter 15 for recovery suggestions.

CHAPTER 13

Hill Circuits for Better Climbing

This concept in a nutshell: Designate a tough hill circuit and use it only for climbing workouts.

There's no doubt that hard climbing is one of the best ways to get fit. Gravity forces you to work hard. And this hard work is easier mentally than flat-road intervals of similar intensity. Hills give you a goal you can see—the top.

Because hills make for tough riding, most cyclists avoid them or at least limit them when they choose the day's training route. Unless you're a rabid climber, you probably opt for a flat or rolling course. Nothing wrong with that—except you're missing out on the considerable extra fitness you get from climbing.

A great solution is to identify the hilliest circuit in your area and designate it for climbing workouts. I'm not sure why, but having a route that's labeled "For Climbing Days Only" makes it less onerous to ride.

CHOOSE A COURSE

The ideal hill circuit is 3-5 miles long with one hill that takes 5-10 minutes to climb and at least one "sprinter's hill" of 100-300 yards.

No such loop in your area? You can also use a stretch of road that has appropriate hills. Simply ride the hills in one direction, hang a U, and return. Out-and-back courses make training seem more regimented, but they work.

In some areas, suitable roads may be too heavily trafficked for safe training. In this case, look for dirt roads, which may also provide steeper climbs. Rig a mountain bike with drop bars to duplicate your road bike position, or use a cyclocross bike or your winter training bike.

No hills at all? In the worst-case scenario, look for a bridge or highway overpass that you can repeatedly ride in both directions. Gruesome, but better than nothing.

WORKOUTS

Save your climbing circuit for days when you want to climb hard. Don't ride it casually. If you associate it with hard work, you'll be primed to make a strong effort when it's time to ride there. It's a little like Pavlov's dog, but instead of salivating on cue, you'll be slobbering as your hammer over the hardest hill.

- **Ride the circuit both ways**. Variety isn't this workout's primary attraction. You want to develop a blue-collar routine of work on cue. But riding the circuit both clockwise and counterclockwise gives you different gradients because most hills are steeper or longer on one

side than the other. If you have an out-and-back course, you'll automatically see both sides of each climb.

- **Get a training partner or 2 to ride with you**. Solo slogging up climbs very quickly becomes a mental challenge. It can drain your enthusiasm. When that happens, your workouts get slower and less effective. So, find some like-minded masochists to share your hill circuit. Competition will heat up the pace, stop you from dwelling on every second of your effort and boost your rate of improvement.

- **Use different climbing techniques**. Do the ascents in a variety of ways—big gears, small gears, seated on the tip of the saddle or at the rear, standing or sitting, with a still upper body or pulling rhythmically on the bars with each pedal stroke. Over time, you'll find the techniques that work best for you in different situations.

- **Don't overgear**. Unless you're doing specific, big-gear/low-cadence intervals, don't let your cadence drop below 80 rpm on these climbs. If your loop has very steep hills, you may need a lower gear than you usually employ. In this case, buy a training wheel and cassette with the bigger cogs. Change to your "climbing wheel" before each hill workout.

- **Practice standing**. Heavier riders usually climb seated. When legs don't have to support bodyweight, more energy can go into getting up the hill. But regardless of how much heft you're hauling, it pays to stand some of the time—for variety, getting over steeper pitches and to give your butt a rest.

> **TIP!** Here's a standing technique from pro superclimber Jonathan Vaughters, who set the record for the ascent of France's infamous Mont Ventoux:
>
> "When the pedal nears the forward horizontal position, your knee should be almost locked. Then, let your body weight fall so the leg muscles aren't involved as much. Stand tall on the bike. Let your hips move up and down slightly as you shift weight from one leg to the other. This is a subtle change from most people's standing climbing techniques, but it can make a huge difference."

- **Ride the circuit only when you're fresh**. You won't get anything positive out of the training if you force yourself to hammer when your legs are dead.

- **Hydrate and eat**. Make sure you carry enough food and fluids to see you through the workout. If you ride for 45 minutes to get to your circuit, then spend another hour in the hills, you still have to ride back. If you emptied your bottles and didn't bring a snack to eat after the final climb, you'll be bonked before you get home.

Studies show that you need about 300 calories per hour to ride long and hard. That's equal to an energy bar and bottle of sports drink every 60 minutes. Of course, you probably shouldn't

eat anything solid within 2 hours of this hard training. Switch to your energy drink as you ride out to your circuit.

- **Don't keep a record of average time or speed**. They're all but meaningless for this training. When you push hills hard, you have to ride the descents and flats easily to recover. Better to time yourself on the uphills to track improvement while ignoring your total-ride numbers. Beware, though, that speed on climbs can be misleading on a windy day. It can vary considerably for the same power output.

If you want the best means of tracking improvement, use a watts meter and check average wattage after each climb. (See chapter 3.)

CHAPTER 14

Get Dirty

This concept in a nutshell: Roadies can learn smooth pedaling—and a lot more—by riding a mountain bike.

Time was, road riders and mountain bikers were at opposite ends of the cycling continuum.

You know the stereotypes: Mountain bikers were hairy-legged Neanderthals with plodding, square pedal strokes spitting and grimacing up dusty climbs at 40 rpm. Roadies were elegant and imperially slim, slickly pedaling fast, perfect circles.

Now the apparent deep division between the road and the dirt has all but vanished.

Elite mountain bike racers spend as much as 80 percent of their training time on road bikes in order to build their aerobic power. Tinker Juarez, the American mountain bike icon who rides for Volvo-Cannondale, says he's on a road bike 5 out of every 7 training days. Several top mountain bike racers, such as Australia's Cadel Evans and Spain's Miguel Martinez, have abandoned dirt to race for European pro road teams.

On the other side of the coin, riders who formerly wouldn't dream of letting their (skinny) tires touch dirt have bought mountain bikes and discovered how much trail riding can improve their ability on the road.

In September of 2001, shortly after the events at the World Trade Center, I attended the Mountain Bike World Championships in Vail, Colorado. By observing the riders and chatting with them, it was apparent what roadies can learn from their off-road brethren. Examples:

- **Steady pacing**. Mountain bike races require around 2 hours of effort at lactate threshold. Go too fast early and you blow up. Go too slowly and you'll be so far behind you'll never get into contention.

At the worlds, American Alison Dunlap parceled out her energy on early laps, saving just enough to mount a last-lap charge for the gold medal. This is the same skill you need for road time trials or hammering your way to a PR in a century. Remember that Dunlap got her start on a road bike. She still competes in several road races each year.

- **Bike-handling skills**. Mountain bikers push the limits of traction and steering because they're less afraid of falling than roadies. Off-road, speeds are slower and landing on dirt doesn't hurt as much as landing on pavement.

In Vail, America's Walker Ferguson got the bronze medal in the under-age-23 race even though he had to come back from an early crash. "I got a little excited, fell into some bushes 15 feet below the trail and lost about 20 places," he said. "I had to settle down and work my way back up."

- **How to love a dirty bike**. Most roadies hate to get their bikes messy, so they won't ride in the rain or on roads made muddy by farm vehicles. But you can't ride off-road without getting your bike dusty, muddy or both. Mountain bikers quickly learn that it's easy to clean a machine and make it as good as new. It's no different for your much-loved road bike, so don't be afraid to ride it in the slop.

Mechanics at the worlds hosed down and re-lubed dirty bikes, taking only 10 minutes to make each one look like it had just come off the showroom floor. Even the spacers between cassette cogs were clean!

SMOOTH STROKES

A big benefit of off-road riding is how it helps you perfect a fast and supple pedal stroke.

This seems counterintuitive because we associate mountain bikers with slow-cadence grinding up nearly unridable climbs. But riding on slippery dirt surfaces requires a smooth pedaling action all the way around the circle. If mountain bikers push too hard on the downstroke, the rear wheel loses traction, which costs momentum and time.

In fact, a study done at the U.S. Olympic Training Center showed that pro mountain bikers had smoother and more efficient strokes than roadies—and even pursuiters on the track. On the steep climbs at Vail, it was fascinating to watch top riders smoothly pedal up the rocky chutes.

Roadies have the advantage of riding on a relatively smooth surface. If they don't apply power evenly through the whole pedal circle, it isn't especially noticeable at the rear wheel. But on dirt surfaces, any power surge makes the rear wheel slip. It's the perfect biofeedback mechanism. An unrefined pedaler proceeds up the hill in a series of rock-spewing lurches, wasting power all the way.

Uneven power is also noticeable on the Slickrock Trail in Moab, Utah. Skilled cyclists can ride near-vertical pitches because the rock provides exceptional traction. But the steeper the climb, the more perfectly round a pedal stroke must be. The penalties for a slip are a nasty crash and substantial amounts of skin sandpapered off by the sandstone.

As a result of immediate feedback, elite mountain bikers have developed a smooth spin with almost no conscious effort. It's a skill that will serve every roadie, too.

STEPS TO PERFECTION

To refine your stroke by riding your mountain bike on trails, first you need the right equipment. Clipless pedals, supportive shoes and the right tires for surface conditions are crucial.

Once you're properly outfitted, find a dirt climb about 200 yards long. It should be steep, and ideally the surface should be loose but without big rocks, water bars or logs.

First, try climbing the hill in a fairly big gear while pedaling with hard, jabbing downstrokes. Notice how your rear wheel slips? Now ride up again, but this time concentrate on making each stroke round by applying power evenly. You'll know if you're succeeding because your rear wheel will keep its grip. When you can climb the hill in a big gear at about 50 rpm without breaking traction, you've got it.

Next, use a lower gear and increase your cadence on the climb while maintaining smoothness. As your cadence increases, it gets progressively more difficult to keep pressure on the pedals through the whole 360-degree circle.

But the more you practice, the more accustomed your nervous system becomes to applying steady power. The goal is to be able to climb at a brisk and efficient cadence of around 80 rpm with nary a slip. Doing so says all of your power is being used to get up the hill.

> **TIP!** Skilled off-road riders have learned how to use their upper-body strength to pull on the handlebar, thus adding power while still keeping pedal strokes round and smooth.
>
> Mountain bike coach Skip Hamilton teaches his riders to climb technical terrain with considerably more upper-body movement than is often recommended. He suggests climbing in a gear that's one cog harder (smaller) than usual while lightly pulling on the bar in time with your pedal strokes and allowing your shoulders to rock a bit.

BIKE HANDLING

Riding off road hones bike-handling skills. There's nothing like sliding on loose dirt through corners to make you feel at home when your rear wheel skids on wet pavement.

One of the best ways to learn is to follow better riders. In mountain biking's infancy, that's how we all did it. There weren't any instructional books or tradition. We simply rode, pushing our limits and observing riders who were smoother and faster.

Now you can find articles on how to pull every technical move imaginable. But guess what—learning from better riders is still the most effective way. Watching as your hero rides around a switchback, tackles a rocky section or bunny hops a log imprints the technique in your brain. Then all you have to do is imitate his or her moves—and practice.

Find good mountain bikers in your area to serve as your role models. Look for them in cycling clubs or on group rides. Then here are ways to learn from their example:

- **Play follow the leader**. My descending skills improved markedly after I followed Skip Hamilton down a singletrack near Crested Butte called, appropriately enough, Deadman's Gulch. Skip is a top off-road technician. He floats effortlessly over obstacles, seeming to defy gravity. In trying to keep up, I crashed immediately.

After dusting myself off, I figured out how to follow at about 40 feet, focusing on the trail ahead but keeping Skip in my peripheral vision. Then I simply imitated what he did. I followed his line, adopted his relaxed, cat-like stance on the bike and mimicked his speed. It was like magic. His skills became imprinted on my brain. I became a Skip clone. Try it and you'll see how well it works.

Follow good riders on climbs and technical sections, too. Imitate their gearing, cadence and line through obstacles. Often problems stem from pedaling at the wrong cadence or not setting up correctly for the next turn and ramming the front wheel into something and stalling. Good riders get all these things right.

- **Ask for tips**. Don't be shy. Ask for help. Nearly all good riders feel flattered when asked to share their techniques. This includes pros when they're out riding on the local trails. They remember when they started and how they learned from others, too.

When at the Volvo-Cannondale team camp in Arizona, I made it a point follow Olympic mountain biker Tinker Juarez on the trails and ask him questions whenever we stopped for a breather. (I needed a lot more extra breathing than he did.) Tinker was gracious and highly articulate. It was obvious that he'd thought long and hard about the sport's techniques.

- **Watch a pro race**. You don't have to ride with top pros or coaches to sponge up their skills. Go to a race and find terrain on the course that mirrors what's difficult for you. If you stall on technical climbs, spread your picnic by the meanest uphill section. Going over the bar on tough downhills? Locate the nastiest drop-offs and watch the action closely. You'll be amazed at the racers' agility and balance, but you'll also see that their skills aren't superhuman. They're within reach once you understand what they're doing with their bikes and bodies.

- **Go to a camp**. Expert instruction is a quick way to get better. A coach will demonstrate skills, watch as you try various moves, and cajole you into improvement. When you get coaching in a group of like-minded riders in a great mountain biking area, it makes the whole experience that much more effective.

- **Watch race videos**. No pro races nearby? No vacation time to attend a camp? No problem. Simply plug a mountain bike race video into your VCR, look and learn. Rewind the

tape so you can study a certain move repeatedly. Use the “pause” and “frame-by-frame” functions to examine techniques in detail. Visualize yourself riding the same trail and handling the technical sections with the same relaxed assurance.

Soon, other riders will be asking you for tips.

These skills, honed on dirt, transfer directly to the road. They’ll make you smoother, stronger and more powerful on hills or in big-gear situations on the flats. And they’ll keep you upright in perilous situations. You’ll be more confident on pavement because of the time you spend off it.

CHAPTER 15

Tapering for Top Performance

This concept in a nutshell: To peak for a big event, reduce training volume the week before but maintain (or increase) intensity.

Athletes do better in important events if they’re well rested. Rest gives the body time to replace glycogen stores and it gives the head time to get psyched for hard effort.

Pioneering studies with swimmers by sports scientist Dave Costill showed that when they reduced their usual training load from a massive 10,000 yards per day to a more modest 3,200 yards/day over a 15-day period, their times improved by almost 4 percent while their arm strength rose nearly 25 percent.

So, what’s wrong with us?

Cyclists have traditionally ignored such findings. Road racing has a stage race tradition of hard men riding day after day with slices of raw beef in their shorts to ease oozing saddle sores and cabbage leaves under their cotton hats to protect their frying brains from mid-summer heat. Our heroes come from the major tours. Rest day? Okay, so let’s go ride 60 miles.

But it’s smarter to listen to recent studies that point the way to an effective method of tapering, one that is easy to employ and remarkably successful.

A SCHEDULE THAT WORKS

- **Continue to ride**. Don’t simply lie on the couch to rest. According to Jonathan Vaughters, “Tapering doesn’t work well for elite cyclists. If I don’t ride every day, my legs feel blocked. My most important training for a stage race takes place in the two weeks before the start.” The same usually holds true for recreational cyclists who ride regularly.

- **Reduce your mileage**. Although you want to continue riding, you need to cut mileage substantially to get a tapering effect. About 7 days before your important event, cut your average mileage by about two thirds. So, if you've been averaging 200 miles per week, slice it to 65-70.

- **Continue interval-type training**. But reduce the number of intervals each day. Here's how the week before your event might look. After warming up for about 15 minutes, follow this procedure:

Day 7	5x3 minutes at slightly above lactate threshold
Day 6	4x3 minutes at slightly above lactate threshold
Day 5	3x3 minutes at slightly above lactate threshold
Day 4	2x3 minutes, fast
Day 3	1x3 minutes, really fast
Day 2	Day off or light pedaling for 30-60 minutes
Day 1	Event

This tapering protocol reduces your overall workload because of the drastic mileage decrease. You have more time to recover and less strain on your legs.

But the intervals guarantee that you retain the muscle enzymes that help you process lactate. The fast riding also means that your neuromuscular system will be accustomed to going fast when you ask it to during the event.

This type of taper works because it combines rest with intensity. It allows recovery but encourages speed.

You can fine-tune the intervals for the event you're aiming for simply by increasing or decreasing their length. If your target event is a 40K time trial, do intervals 5 minutes long at race pace and intensity. For a criterium with lots of high-speed jumps out of corners, you'd do better by starting with 10 short, hard sprints on Day 7 and reducing the number of sprints by 2 each successive day.

> **CAUTION!** Don't make the mistake of doing too many intervals too hard during this taper. You want your legs to remember how to go fast, but you don't want to tire them in the process. So, if your target event is a century, the time trial intervals of 5 minutes described above would be plenty. Don't start with 8 or 10 intervals of 10 minutes each even though the event distance is much greater.

TRAINING TAPERS

It's smart to taper even if you don't have an important event you're pointing to.

Most training plans have a 3-week "build period" of gradually increasing volume and intensity, followed by an easy week where both factors are decreased by about one third. Then they're increased by about 10 percent in the next 3-week training block before another "rest" week.

Tapering this way ensures that your body gets enough recovery to assimilate hard training efforts. It's also a great way to try different tapering protocols to see which one works for you—and in which situations.

A taper is useful, too, after you've had an uncommonly tough week on the bike, such as the high mileage of a tour.

Here's a personal example to show how this works. In January and February of 2002, I averaged 8 hours a week on the bike (including trainer time) along with another 6 hours per week of crosstraining—snowshoeing, hiking and weight lifting. Bike time included several rides of 3-4 hours when Colorado's weather permitted.

I needed the long rides because I would be coaching at the PAC Tour Endurance Cycling Camp in southern Arizona the second week of March. I'd be riding a loop that covered some 620 miles (about 35 hours) in 7 days, including climbs, headwinds and brisk pacelines.

I enjoyed the camp but was tired afterwards—a deep fatigue in my quads when I walked up stairs, a disturbing tendency to take naps in midafternoon and an even more troubling predilection to fall asleep in the middle of watching NCAA tournament basketball. If I can't stay awake for great college hoops, I know I'm fried.

Here's how I organized my recovery:

March 16	Last day of the tour, 86 miles from Sierra Vista to Tucson with 3,000 feet of climbing.
March 17	No ride. Drive home, 13 hours in the car.
March 18	No ride. Catch up on chores and get back to work for RoadBikeRider.com.
March 19	1:20 ride at a moderate pace with a couple of short sprints.
March 20	1:45 ride with a hard 10-minute climb and a few short sprints. 1:00 walk. Light weight training.
March 21	1:20 ride with 4 hard jams of about 30 seconds each.
March 22	2:00 ride at a moderate pace

Notice how I cut back mileage drastically, at least compared to the camp week. Notice also how I didn't merely spin around but included some intense-but-short efforts. I limited most hard work to sprints to open up my legs. When I did a longer hard effort (10 minutes uphill) I limited the intense work to just one climb.

After this taper week, I wasn't as comatose, my legs had regained their life and I was ready to resume normal training. If I had stayed off the bike all week (or hammered too hard), my recovery wouldn't have been as rapid or as effective.

CHAPTER 16

Special Techniques of the Pros

This concept in a nutshell: Pro riders have favorite—and often unusual—workouts that give them an edge and may work for you, too.

I've been writing about this sport for 25 years. I've heard about (and tried) nearly every training technique imaginable.

But when you look at training dispassionately, it really comes down to a few relatively straightforward techniques:

- Build a good base of endurance miles
- Include enough intensity to hone your fitness
- Get plenty of rest

Oh, and don't forget to choose your parents wisely so you have the required genetic characteristics for success!

It's simple, really, though not as simple as the classic advice, probably apocryphal, attributed to Italian *campionissimo* Fausto Coppi: "Ride your bike, ride your bike, ride your bike."

In fact, in my more cynical moments, I often conclude that all training for cycling can be condensed into two words: "Pedal harder!"

So, it's a relief to find that top pros often employ somewhat unusual approaches to training. They aren't afraid to try something out of the mainstream if they know—from experience coupled with trial-and-error—that being a bit of an iconoclast helps them be better riders.

Below are 7 special techniques gathered in 2002 from Jonathan Vaughters at his training camp in Denver and from my 4 days of riding with the Saturn Cycling Team pros at their preseason camp.

Even if these workouts aren't appropriate for you, I hope they inspire you to think outside the box. Use them as a spur to develop effective alternative training of your own.

VAUGHTERS: 10/20 INTERVALS

Europe-based roadman Jonathan Vaughters is one of the top climbers in the pro peloton, with a record-smashing ascent of Mont Ventoux in his list of wins. He's also a strong time trialist.

Vaughters maintains that "cycling isn't an endurance sport; it's a power sport." To demonstrate, riders at his camp did a 5-minute steady-pace effort at about 24 mph. Then we rode the same course but went very hard for 10 seconds and "floated" easily for 20 seconds. We repeated this pattern for the full 5 minutes.

Average wattage and speed were the same for both rides. But perceived exertion was different. The fast/slow pattern was much tougher. That's how cycling—and especially racing—is, says Vaughters. You go hard to stay in the paceline or get up short hills or close gaps. Then you soft pedal in the pack for a short time before you have to hammer again.

New riders who come to the sport from, say, marathon running are amazed at the difference in intensity. Running tends to be a steady-state effort while bike racing and group training are anything but.

This is especially true in Europe. As Vaughters observes, "American and European races both average about 40K per hour. But in Europe they go 25 kph for a while, then 65 kph, then 30 kph. In the U.S., you get a 40 kph average by going 40 kilometers per hour."

Intensity varies in recreational riding, too. You cruise on the flat, jam on a hill, coast in a tailwind and then work hard when you turn a corner into the wind.

How can you accustom your body to these pace variations?

Vaughters recommends 10-20 minutes of alternating 10 seconds hard and 20 seconds easy. Start the hard efforts at only 80 percent of the effort you think you can maintain. The first 5 minutes will seem too easy, the next 2 or 3 minutes will seem hard and the final minutes will seem interminable.

Vaughters suggests doing this workout once per week during the winter when you're leg weight training. He does it in the month before he starts serious racing to get ready for the abrupt nature of the peloton's accelerations.

VAUGHTERS: FAT-BURNER WORKOUT

Do you bonk on long rides even though you keep ingesting carbs? If so, you haven't trained your body to burn fat efficiently.

Vaughters won the 2001 Saturn Cycling Classic in Colorado, a 140-mile, 7-hour race with 14,000 feet of climbing at high altitude. He needed only some sports drink, an energy bar and

a couple of carbo gel packets. “Some of the other riders were eating turkey sandwiches!” he laughs.

How do you train your body to ride on stored fat? Vaughters suggests doing a 3-hour ride at a steady, brisk pace so your glycogen stores are depleted. Then eat a moderate dinner that’s relatively low in carbohydrate. The next morning, don’t eat breakfast. Instead crawl out of bed, get on your bike, warm-up and do 45 minutes hard at about 85 percent of max heart rate. Cool down, spin home and have a big bowl of cornflakes. You’ll crave carbs like never before.

This workout is hard, but it will teach your body how to run more efficiently on fat reserves.

VAUGHTERS: LEG WEIGHTS PLUS MILES

A crucial early-season training question is how to incorporate leg workouts in the weight room with the endurance you must build. Vaughters suggests the following weekly plan:

Monday	Rest day.
Tuesday	Ride 45-60 minutes, ending at the gym. Weight train for an hour, including 5-6 sets of heavy leg presses. Ride home.
Wednesday	Spin 3 hours at an easy-to-moderate pace.
Thursday	Repeat Tuesday’s workout.
Friday	Repeat Wednesday’s workout.
Saturday	Do leg presses in the morning and either race or do a hard training ride, preferably with a group, in the afternoon.
Sunday	Ride 4-6 hours at moderate intensity.

Recreational riders won’t have time to do the mileage Vaughters does. But his pattern of lifting and riding can be duplicated. Simply reduce the time spent on the bike and in the gym.

Remember that you won’t ride well during this training. “I rode a local criterium in Boulder while doing this routine,” Vaughters laughs. “Everyone wondered why a European-based pro was riding in the middle of the pack. They didn’t know that I’d done six sets of hard leg presses and then ridden until the race started.”

KLASNA: HILL RUNNING

Running and cycling don’t mix very well. Several studies show that running doesn’t improve cycling ability, although training on a bike can improve running.

There's an exception, though. Running *uphill* apparently has a positive effect on cycling ability because it's powered by the same muscles—quads and glutes—that are used in the pedal stroke.

Even so, most pro cyclists have been reticent about including much running in their programs. One exception is Trent Klasna, named North American male rider of the year for 2001. Klasna says he loves running trails and does it often during the off-season, feeling that his cycling is helped.

How about during the season? Can trail running be useful then, too? Sure—once or twice a week, for anyone but serious racers, it's a great change of pace and gets you away from pavement and traffic. As Klasna observes, "It's easy to get into a zone when running but much harder on the bike because you have to watch for cars."

In terms of training time, running is faster and more efficient than cycling—great for busy athletes. But before you plunge in, heed these tips:

- **Choose good shoes**. Supportive shoes are a must for running in general, and this goes double for the rough terrain you'll encounter off-road. Because trail running has become popular, most shoe manufacturers offer models with good traction and protection. Go to a running store, tell them what you intend to do, and listen to their recommendations. Some stores have a treadmill so you can actually run in different shoes to find one that works for your degree of pronation or other gait peculiarities.

- **Start gradually**. Beginning a running program can be painful as your muscles get accustomed to the pounding, especially on downhills. The solution is to break in very gradually. Try alternating 100 yards of running with 300 yards of fast walking. Gradually alter this ratio. After about a month of working out every other day, you'll probably be able to run 5 miles with minimal or no walking.

- **Pick good trails**. Find trails in city or state parks. Sometimes, vacant land contains trails cut by motorcycles or mountain bikes. Look for dirt roads, canal bank access roads and rail trails. If you're lucky, you live near a state or national forest with a number of hiking trails that you can run.

The ideal terrain is rolling—short hills of 50-200 yards with corresponding downhills. This makes it easy to safeguard your quads and knees by walking down after running up. Here in the Rockies where I live, most trails go straight up for many miles. I run the vertical pitches and walk the easier ones. Then going down, I do the reverse—walk the steep grades and run on the shallow ones.

- **Combine riding and running**. If you must travel to suitable trails, ride instead of drive. Use your beater bike, chain it to a tree, run the trail out and back, and cool down by spinning home. That's how it was done in Boulder, Colorado, by Davis Phinney, the winningest road racer in U.S. history. You'll need pedals with toe clips and straps so you can wear your running shoes. Also, plenty of fluids in bottles or a backpack hydration system.

KLASNA: OFF ROAD ON A ROAD BIKE

Most of us cringe at the thought of riding our pampered road bikes on an unpaved surface. Those loops we'd love to ride but have a 200-yard dirt section to navigate? Forget it—too dusty, and the paint might get chipped.

But riding off-road on skinny tires is the best bike-handling exercise imaginable. It teaches you how to control skids, and to ride lightly so you don't bang up your wheels or get a pinch flat. Riding in the dirt requires a relaxed upper body and a fluid hold on the handlebar—crucial techniques for surviving in a pack on the road.

Another big benefit is the fun factor. Riding off-road is radically challenging. It greatly expands your training terrain and gets you away from traffic.

Trent Klasna, a superb bike handler, is a big fan. He actually seeks roads that begin paved and turn to dirt. Another advocate is former pro and 7-time Tour de France finisher Ron Kiefel. He still rides the dirt roads around Boulder on his Serotta road bike.

Here's how to do this type of training:

- **Use an old bike and durable tires**. Klasna rides his team-issue LeMond on the dirt—but he isn't paying for it. Most of us non-sponsored riders will do as well on an old, expendable bike with sturdy wheels and touring tires. A cyclocross bike works great, too.

- **Use low gears**. The bike should have big rear cogs and preferably a triple crankset so you can ride up steep hills with your fast road cadence. Road wheels with narrow tires don't have much traction on loose surfaces. A smooth spin is much more efficient than the big-gear grind you can get away with on a mountain bike with knobby tires.

- **Use easy trails or dirt roads**. This is not the right time to ride the hardest singletrack in the area. Save the gnarly trails with big rocks, ledges and drop-offs for a mountain bike ride. Road bikes work fine on moderate trails, but you risk trashing your equipment and getting injured if you tackle technical terrain. Honor your comfort factor. If the trail seems too difficult, it probably is.

- **Emphasize technique rather than speed**. Road bikes are extremely fast on easy singletrack. But speed isn't the purpose of this exercise. Instead, hone your bike-handling skills and have fun. Slow and easy does it.

SWEET: SPRINT PROGRESSION

It's often said that sprinters are born, not made. You either have the required number of fast-twitch fibers in your quadriceps or you don't. If you don't, you'll never truly be fast no matter how hard you work.

Australian road sprinter Jay Sweet doesn't believe the conventional wisdom. He duked it out with the fastest European sprinters during his 4-year tenure on the BigMat team before joining Saturn. Yet coaches told him he'd never be a successful sprinter because he was too

small and didn't have enough muscle mass in his glutes and quads to generate pro-level power.

Sweet didn't believe them. Instead, he developed a specific sprint training progression to teach himself to go fast. I'll let Jay explain it while I add a few comments about how you can implement it.

- **Sweet: "Sprint training begins in the winter. I put in a lot of miles."**

Even though sprinting is a high-intensity/short-duration activity, cycling still requires endurance. If you aren't in the lead group at the end of the race, the best sprint in the world is useless.

Fabled sprinter Mario Cipollini won the Milan-San Remo classic in 2002, on his 10th try, because he had built the endurance for a 170-mile race. Sweet, too, develops his stamina with a big base of endurance miles.

- **Sweet: "Next, I do power sprints in a larger gear and strength work on hills."**

Another factor in Cipollini's win was his ability to get over the Cipressa and Poggio climbs with the contenders. Sweet trains hard to develop the strength to stick with the all-round riders over climbs up to 5 kilometers long.

Power sprints of 10-15 seconds in a large gear at a cadence of 90-100 rpm develop fast-twitch fibers almost like weight training. Climbing at a lower cadence (50-60 rpm) in a large gear is another way to convert strength to power that's useable on the bike.

- **Sweet: "As the racing season nears, I do long endurance sprints of 30 seconds."**

Endurance sprints teach the body to reach high speed and then hold it as long as possible. Start with a hard jump out of the saddle, get the gear turning, sit down, spin it up and keep going at full effort for 30 seconds. This is tough work, so do only one set of 3-5 endurance sprints per week.

- **Sweet: "For tune-ups before races, I like fast sprints of 10 seconds on and 50 seconds easy in a smaller gear."**

Sprinting is about repeatability. It's not just the last sprint for the line that's important. Sprinters have to accelerate many times in the miles before the finish line to stick with their leadout men and retain their position in the pack.

Repeated short sprints with minimal rest intervals develop your ability to jump hard again and again. One way to do it in training is to count telephone poles. Sprint the distance between 2 or 3 poles, spin easily for 4 poles and then repeat.

- **Sweet: "Right before an important race I'll motorpace, working on sprinting around the motor and then recovering in its draft."**

Okay, here's one drill that works for a pro but probably not for recreational riders. Motorpacing in the draft of a car or small motorcycle is dangerous. It requires a skilled driver and a traffic-free road.

A good substitute is tailwind sprints at a high cadence. Sprint for 10 seconds, ease off and let the wind maintain your momentum, then sprint again. You get the advantages of motorpacing without the danger. And in most sections of the country, windy days are easier to find than a good motorpace driver!

BESSETTE: TIME TRIAL TRAINING

Saturn's Lyne Bessette was named North American woman rider of the year in 2001. Renowned as a climber, this Canadian is also a top time trialist.

Most TT specialists now focus on keeping a high cadence. Although time trialing technique traditionally emphasized big gears and a lower cadence, the move to faster pedaling was fostered by Lance Armstrong and his successful time trialing at 100 rpm or higher.

But while it pays to keep your cadence up during a competitive TT, training with higher gears and a slower cadence helps build the power necessary to turn moderate gears faster. With all the buzz about high cadence, some riders haven't done the necessary strength work to go fast.

Bessette likes to combine big-gear strength work *and* high-cadence training in one workout. She explains her routine:

"I shift to a big gear of 53x12 or 11 and go 20 minutes hard on rolling terrain. I don't shift at all, so I'm working on strength going up and leg speed going down."

Here are 3 points to consider if you try it:

- **Choose the right course**. It should be gently rolling, about 5 miles long, with light traffic and no stop signs or lights. Come as close to this as you can.

- **Choose the right gear**. Gearing is individual. Bessette may do fine in a 53x11-tooth but you may not. Match your gear to your strength and the terrain. Even on the uphill sections, don't let your cadence drop below about 70 rpm. And don't do this workout if you have a history of knee problems.

- **Spin on the downhills**. This is the fast-rpm part of the workout. It's tempting to work real hard going up hills in a big gear and then recover on the descents, letting your cadence and effort drop. Resist this temptation! Don't go so hard on ascents that you're blown when the road tilts down. Keep your cadence high and work on your spin. Think about good pedaling form. This is a strength workout but it's also great for developing leg speed.

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