Bicycle Maintenance Guide and Riding Tips

Components

Wheels consist of the following components:

- The **hub**, containing an axle, the quick-release inside the axle, and two or more bearings holding the rotating hub body with the flanges that hold the spokes. The quick-release is an ``inner axle'' with a nut on one end and a lever on the other, and two conic springs that simplify installation. The small ends of the springs point to the center of the hub. The nut should be tightened such that closing the lever is hard but can be done with one hand (how is that for an imprecise unit of measurement :-) A loose quick release can cause the rear axle to shift in the dropouts when accelerating hard, causing the tire to rub, or in the worst case can work itself even looser until you are in danger of losing the entire wheel.

  There are two kinds of hubs, obsolete freewheel ones where the sprocket assembly contains the coasting bearings and ratchets that screws onto the hub itself, and cassette hubs where the bearings and ratchets are built into the hub and the sprockets are fixed. Do not under any circumstances use the former type; they contain a bearing that runs near the center of the hub that can bend the axle. The latter type has bearings on both ends where they can't bend the axle. A bent axle can bend or break the right dropout of the frame, and you'll have to write off the entire frame! It happened to me twice.

- There are usually 36 **spokes**. Some people prefer 32 for reasons that are not clear to me, or even 28. Tandems can benefit from 48 spokes. Staying with 36 spokes offers the widest selection of hubs and rims. There are double-butted spokes that are narrower in the middle where there is less load, bladed spokes, wavy spokes, and other exotica. Double-butted spokes make sense (spokes always break at the neck or where the threading begins), the rest is fairly useless. Bladed and wavy spokes are also more difficult to install because they twist and make it hard to gauge tension. Spoke thickness is usually measured in ``gauge''; smaller numbers indicate higher diameter.

  Spoke length is important, but computing the right length is a black art. Generally, all spokes of the front wheel have the same length. Sprocket-side (right) rear spokes are shorter, outer (left) rear spokes are slightly longer because the right rear hub flange is close to the center of the hub. When buying replacements bring an old spoke. Up to a millimeter too short doesn't hurt, but spokes that are too long can puncture the inner tube.

  Wheels can be built radial, 3-cross, and 4-cross. Radial means that spokes run straight to the rim without crossing; 3-cross and 4-cross refer to the number of

times a spoke crosses other spokes. 3-cross is standard. There is no reason to use radial wheels except aesthetic reasons; it reduces the strength of the wheel and makes the ride rougher. Obviously, each of these spoke patterns requires a different spoke length. By the way, always use steel spokes and brass nipples.

- There are many types of **rims**: rectangular profiles (like Mavic MA-2 or Campagnolo Delta), aero profiles (like Campagnolo Omega), and anything in between. High-quality rims are machined to avoid the normal seam where the rim joins; this seam can catch the brake pads and cause uneven wear and braking behavior. Don't buy black-anodized rims; the anodization will be quickly worn away where the brake pads rub against it.
- I swear by Campagnolo rims. Mavic is ok, but look at their high-end double-butted rims - the holes are apparently punched, not drilled, and if you hold them just right you can see small discolortaions where the metal was deformed. This weakens the rim, and just now (9/99) two spoke sockets were torn from my rim at such points, leaving huge holes. Campagnolo rims are drilled and finished perfectly. My current favorite is the Moskva 80.
- Inside the rim, **rim tape** protects the inner tube from the spoke ends. There are two types, adhesive textile tape and tough hard plastic. Both work equally well but the hard plastic is difficult to remove without tools while the textile tape may expose the inner tube to spoke holes if chosen too narrow. Aero rims are stiffer but are more difficult to install because spoke nipples have a tendency to get lost. Always use aluminum rims, steel rims brake dangerously poorly in wet weather despite brake pad manufacturers' claims. Make sure the rim does not just have spoke holes drilled into it but some kind of steel sleeve that protects the hole.
- **Inner tubes** come in butyl and latex, in various weights. 100-gram butyl is best. 60-gram butyl is too vulnerable to snakebite punctures, and latex leaks air and can rip off the valve if the tire slips for any reason. Choose a valve stem that is threaded all the way to the tip without any smooth parts because pumps tend to hold poorly to smooth valve stems. Generally I prefer inner tubes made by Specialized.

  There are two types of valves, Presta (French) or Schrader (like those used on cars). Presta valves are narrower and are always used for racing bicycles; Schrader valves are often found on mountainbikes. Presta is easier to pump because one doesn't have to work against a spring. Don't forget to unscrew the nipple before pumping. The maximum pressure allowed depends on the tire; it is printed on the side of the tire.

- **Tire liners** are Kevlar belts that are inserted between the inner tube and the tire to prevent punctures by sharp objects. More on that below.
- **Tires** for road bikes should always be bald (smooth, untreaded). It may be counter-intuitive but they have higher traction. Fatter tires make for a smoother ride on rough roads or when touring loaded; narrow tires deform less and waste less energy. I prefer 20mm front and 23mm rear tires (but watch out, different manufacturers seem to rate their tires differently).

There are Kevlar-beaded (foldable) and Kevlar-belted (puncture-proof) tires. Puncture-proof tires aren't, because the belt is too narrow. On the contrary, it seems to be hard to laminate smooth Kevlar to the outer rubber layer, I have had tires come apart. My latest trip to France (2001) saw two brand-new Vittoria tires with Kevlar belts come apart after a few days, which first pulled the tire into an S curve and then developed a fuzzy hole. I do not buy Vittoria tires anymore, and some shops have stopped selling them.

Make sure the side wall is strong enough. My favorites are foldable non-belted Avocet road (not Criterium) tires; they last practically forever and still have a rubber that is soft enough to afford traction on wet roads. Recommended. Too bad that they only make the wide versions anymore.

Preventing Punctures

Inner tubes puncture for two reasons: either a sharp object penetrated the tire or worked its way between tube and tire, or the wheel "bottomed out" and the tube got pinched between rim and tire. The latter usually causes a pair of telltale "snakebite" punctures.

Punctures caused by sharp objects such as nails, wires broken off from street-cleaning machines, and glass can almost always be prevented with a Kevlar tire liner. At this point I used to recommend ``Mr. Tuffy's", but recent experiences have shown that they cause way more flats than they prevent because the hard edges rub against the tube until it blows out. No amount of sanding and melting with a lighter has fixed this. They used to have a soft version that worked well, but the current version, recognizable by the black stripe, is *dangerous*. Don't buy! If you must use them, cut the end straight off and only soften the corners a bit; don't cut a long soft curve because it's the sides that eat into the tube.

Snakebites are caused when hitting an obstacle such as a pothole hard so the inner tube gets pinched between the rim and the obstacle. Tire liners help very little here. The best prevention is to inflate the tube to exactly the pressure printed on the side of the tire at all times, and rechecking the pressure at least every other week because butyl inner tubes leak air. Latex tubes are nearly puncture-proof but leak air at a frightening rate.

Do not use light-weight tubes. Some of them weigh 60 grams or less, but are very prone to punctures. If you use tire liners, occasionally check for pieces of glass that became lodged in the tire; they can work their way into the tire if left in long enough. Look as if you knew what you are doing when cutting away at your tire with a knife point. Do not use ``Wrench Force" tubes, they have inferior valves that break easily when installing.

Repairing Punctures

You need two plastic tire levers, a pump, and either a repair kit or a new inner tube. Let all air out of the tube and push the tire towards the center, away from the rim, all around the wheel. Insert the spoon-shaped part of one tire lever between the rim and the tire at

the place where you suspect the puncture, scoop the tire out of the rim, and hook the other end into a spoke. Very carefully insert the spoon end of the lever only as far as needed to prevent pinching the tube. Repeat two spoke holes away from the first with the other lever. Repeat until you can pull the tube out of the tire.

If you are on the road and have a spare tube, it is usually best to install it and fix the punctured tube at home, in a warm and dry place. This requires removing the wheel by releasing the quick-release lever in the axle. In the case of the rear wheel, shift to the smallest rear sprocket first. Mountainbikes sometimes require unscrewing the quick-release nut partway because of ridges in the dropout that prevent accidentally losing a wheel when the quick-release comes loose.

Small holes can be fixed by glueing a patch. I have never managed to reliably patch a hole more than a millimeter or two in length. If the hole is large, an air bubble will form under the patch and find a way out. Snakebites require a large patch that covers both holes. Pump up the tube to find the hole. Let nearly all the air out of the tube again, clean and dry the tube around the hole, and use the sandpaper to roughen the area. File off seam protrusions. Apply a thin coat of glue that is larger than the patch. Patiently wait until it dries, which takes a couple of minutes (impatience is rewarded with a patch that comes loose soon). Apply the patch and press on hard at the center and all around the edges. Continental patches seem to be the best.

To reinstall the tube, inflate it so it just barely holds its shape. Insert the valve and push the tube into the tire there. Working away from the valve, push the tube into the tire while slightly pushing it towards the valve. Alternatingly work from the left and right of the valve to prevent the valve from being pulled in one direction. If the tube is so long that a loop remains after it is fully installed, don't squeeze it in but pull it all the way out again and retry, this time pushing it harder towards the valve. The goal is to keep the tension of the tube constant along the circumference of the wheel. It's easier than it sounds. If you have a tire liner, always keep it centered, and place the overlap of the liner ends at the side opposite from the valve.

Push the open end of the tire into the rim beginning at the valve, taking special care that the tube is not trapped between rim and tire, and work away from the valve. Usually it is hard to push in the last bit on the opposite side. First try pushing the tire towards the center of the rim while pulling it towards the remaining loop. If this is not sufficient, let all air out of the tire.

If all this fails (and only then), you need the tire levers again. Put a little bit of air into the tube so it holds its round shape and insert the spoon-shaped end of a tire lever between tire and rim, but with the "wrong" side up - not hooking into the rim but with the inner side of the curve towards the tire. This makes it harder to push the tire in but reduces the risk of pinching the tube. Begin near the ends and work towards the middle of the section not yet pushed in. You can use the hook end of the other lever to keep the tire from pushing out of the rim at the other end.

Sometimes the wall of the tire gets punctured. This is dangerous because the tube will form a bubble there that can explode with a loud bang. Torn tire walls are unfixable but you can keep the tube inside by inserting a folded dollar bill or some other denomination of your choice. Paper money is incredibly strong and will last years if the hole is not too large.

Fixing a Rubbing Wheel

If your rim rubs against the brake pads in a few places, the wheel needs to be retrued. This can be done safely only if the rim is undamaged; if it was bent, for example by bottoming out on a curb, the procedure still works if the damage isn't too great but it won't last long - spokes may snap or unscrew.

I am assuming that you are using aluminum rims. If you have steel rims the procedure is the same but takes much longer because not only the spokes near the rubbing spot are involved but any other spokes too.

First, use chalk to mark the range that is rubbing. In that range, either loosen the spokes on the rubbing side or tighten the spokes on the other side. Compare the tension of the spokes in that area to the tension of spokes elsewhere to decide which of the two is right; if you can't feel a difference do both. Use a spoke wrench to adjust all spokes in the rubbing area; the ones in the center of more than the ones where the rubbing area begins and ends. Never turn the nipple more than one quarter turn at a time. After adjusting, grab every crossing pair of spokes on both sides with your hand and pull them together hard (this releases tensions built when spokes are twisted). Test whether the rubbing spot got smaller, and repeat the procedure until the problem is gone.

There is usually no point in tuning the wheel better than one millimeter, that is, to less than a sideways wobble of 1mm relative to the brake pads. It often helps to move the brake pads closer together than normal to identify wobbles.

Replacing a Rim

Bicycle wheels need to be properly adjusted for smooth riding and to prevent the rim from rubbing against the brake pads. The most common cause for misadjusted wheels are accidents and lack of maintenance. A rim with a dent or other damage is practically impossible to realign; any attempt to do so by pulling it back into shape will cause broken spokes, or spokes that continuously unscrew and go slack. Replacing a rim is much easier than building a wheel from scratch.

Buy a new rim with the same number of holes and the same inner diameter. The inner diameter is smaller for some "aero" rims. Avoid black-anodized rims because the anodizing will rub off after a while. Always use aluminum rims, never use steel. Steel is hard to true and brakes poorly even with special brake pads.

Place the old wheel flat on a table and tape the new rim to the old one, making sure that the valve holes line up. Also make sure that the spoke hole pattern lines up if the holes are alternatingly offset left and right from the center. Next, loosen all old nipples but do not completely unscrew any of them. Beginning with the spokes ending at the flange facing up, unscrew the nipple and move the spoke to the new rim, one at a time. A few turns of the nipple suffice. Apply a small amount of grease to the threads before screwing on the nipple. Continue with the remaining spokes until none are attached to the old rim, which you can now remove. The wheel will be very floppy at this stage. To avoid losing nipples in the rim, screw the wrong side one turn into a spare spoke, which you can the use as a handle.

If the old rim was built with the correct spoke lengths (which are different on the left and right side for the rear wheel), the threading of the spokes was completely covered by the nipples. Now carefully tighten all the nipples until the threading is just barely hidden. This must be done carefully because it ensures lateral trueness. All spokes will still be rather loose after this. I use a power screwdriver. Next, beginning at the valve, tighten every nipple with a spoke wrench by one half-turn, in sequence, until you reach the valve hole again. Repeat until all spokes feel about as tight as they were in the original wheel. For rear wheels, tighten the spokes on the sprocket side much more than the ones on the outer side to keep the rim in the center. This sort of happens automatically with the above method because the sprocket-side spokes are shorter than the outer ones, but it helps to complete the sprocket side before beginning with the outer side. Get a feel for the spoke tension before taking apart the old wheel.

The wheel is now tight but not true. Install it on the bicycle and turn the wheel to see where it rubs against a brake pad. If it does not turn at all or rubs in too many places, loosen the brake cable so that the brake pads move away from the rim. In places where the brake pads rub, tighten the opposite spoke until it no longer rubs. Always tighten neighboring spokes too. Never tighten a nipple by more than a quarter-turn at a time before rechecking. If a spoke seems to become much tighter than its neighbors, loosen the spokes on the opposite side (i.e. ending at the hub flange on the rubbing side) instead of further tightening. When the rim no longer rubs against the brake pads, move the brake pads closer together and repeat, until there is about one millimeter between the pads and the rim on either side, on average.

During trueing, periodically pull every pair of neighboring spokes on one side together as hard as possible with one hand. This releases tension that builds up in the spokes during trueing because tightening nipples also twists the spoke. It may help to pluck spokes and comparing the pitch of the sound, but I find this method hard to use and inaccurate.

After the wheel is finished, reinstall the rim tape, the tire, and the tube, inflate, and ride around the block a few times, then recheck the wheel by releasing tension again and checking trueness. Traditionally, tires are mounted such that the label is at the valve on the right (chain) side of the bicycle.

Handlebars

The Components

Since I ride road bicycles, I prefer **drop handlebars**. When seen from the side, they form an U lying on its side. They afford many different hand positions: on the flat top part, holding the brake handles, on the ends, or between the ends and the handles. With some, the curved part is nearly semicircular; I prefer the kind made by Modolo and others where the curved part has another straight section directly below the brakes. It's not so convenient to grasp a curved part of the handlebar. Some handlebars have one or two grooves that help installing brake and (for Campagnolo Ergopower) shifting cables. In comparison, straight handlebars like those usually used on mountainbikes only afford a single hand position, and a fairly unnatural one with the palms facing down that makes my hands hurt after a while.

The handlebars are held in the center by the **stem**. On road bicycles, the stem is angled downward to compensate for the angle of the steering tube of the bicycle frame, such that the top of the stem that holds the handlebars is horizontal. There are stems that angle upward, but this raises the handlebars and forces the rider into a more upward position that increases wind resistance.

There are various types of **aero bars**, also called **triathlon bars**. The most common types are clamped to the top of the handlebars. There are many different types. My current favorite is Syntace, despite the prices that border on extortion (little required pieces of plastic need to be bought separately at unreal prices). They clamp on the thick inner part of the handlebars, leaving more room for holding the top of the handlebars, they have a very low height and comfortable and adjustable armrests, and they have just the right length and a steep front that doesn't require bending the wrists too much.

Are aero bars necessary? This depends on the kind of riding you do. I began using them when I had a 19-km ride to work every day into a persistent headwind. They also offer an edge when it's my turn at the front during group rides. They are not useful for short trips, and they can be dangerous in the city because it takes longer to reach the brakes, and because they move the center of gravity forward and increase the danger of the rear wheel losing contact with the ground when braking. They cannot be used when climbing hills. They should never be used with old-fashioned brake levers with brake cables coming out of the top because it's easy to get one's gloves caught when reaching for the brakes.

Adjusting the Handlebars

The lower part of the stem should be long enough to raise the top to about the level of the top of the saddle, or a few centimeters lower. Lower position decrease wind resistance but put more strain on the neck muscles. The top of stem is not normally chosen to be higher than the top of the saddle. The length of the top part of the stem should be chosen depending on the length of the top tube of the frame; usually it's longer for people with a long upper body compared to the length of the legs. Care should be taken to choose a solid stem that does not flex when pulling hard on the handlebars, like when standing to get up a steep hill.

Some people recommend to adjust the drop handlebars such that their ends point to the center of the seat tube of the frame (the one that runs from the bottom bracket to the seat post). This makes me feel like I am sliding off the ends, so I adjust mine to be almost horizontal, angled downward very slightly. The straight section in the curve allow am angled hand position anyway. This angle must be chosen before anything else is installed.

The brake levers are adjusted next after choosing the angle of the handlebars. They should be installed such that they can be comfortably held with your hands on the brake lever body, and they can be reached easily when the hands hold the curved part of the handlebars. For me, this means that the rubber body is about horizontal, installed at the forward-most (vertical) section of the handlebars. This must be done before installing the handlebar tape and cutting the cables; it's very difficult to make adjustments later. Do not use "security brake levers" that have an extra lever that extends back towards the stem; they brake poorly and give a false sense of security.

The aero bar angle is also pretty much a matter of taste. I prefer the aero bars angling slightly up towards the front end. Any larger angle would hurt my forearms resting on the armrests.

Handlebar Tape

The handlebar, and many aero bars, need to be wrapped with tape. The tape should have an adhesive strip running along the back, and should be a soft foam or cork material. I have found Cinelli to be the best; unfortunately it's expensive. Real cork does not last long. The cheap material that looks like artificial leather is uncomfortable. Choose a dark or mottled color that won't look dirty quickly.

Before wrapping the tape, install any brake and shifter cables that run to the brake handles or the bar-end shifters, using the grooves in the handlebars if available. Tape the cables to the handlebars with electrical tape to they don't come off all the time during wrapping.

Wrapping begins by attaching the short strips to the metal strap that holds the brake levers to the handlebar. Fold back the rubber coating of the brake lever body. Next, cut off one edge of one of the long handlebar strips so it tapers towards the end, remove the end of the backing to expose the adhesive strip, and begin wrapping at the end of the handlebar (not at the center near the stem). Wrap clockwise on the right side and counter-clockwise on the left side, seen from the rear of the bicycle (this prevents unwrapping when holding the handlebars on the top later). Wrap under tension, but not enough to stretch the tape significantly. The loops should be spaced such that the adhesive strip is just barely on the handlebar, not on the previous loop of the tape. I tend to space the loops more closely near the end and wider near the stem.

When you reach the brake lever, make sure that the last loop folds against the brake lever body. The next loop extends all the way to the other side of the brake lever body. Some people recommend to then fold the tape to run back along the lever to the lower end and then back over the previous loop than spanned the body, only in the other direction so it

crosses the previous loop, but I find it makes the brake lever section too fat and wastes too much tape. Then complete wrapping the tape to the place where the handlebar gets wider near the stem, taper the ends again, and seal the end with electrical tape or the adhesive strips in the handlebar package. I usually have to re-wrap the last part after the brake lever a few times to get the length just right.

If you have aero bars that clamp on the narrow part of the handlebars, not the wide part near the stem, remember to leave enough of the handlebars untaped to install the aero bar brackets. When folding back the rubber brake body coat no part

Brakes

Brakes are obviously the part of the bicycle that deserves the most attention. There are several different types:

- **U brakes**, named for their shape, are used on racing and most other road bicycles. There are various variants like centerpull brakes (Campagnolo Delta, an excellent brake but just too expensive), and sidepull brakes. The smaller they are the better they work because less material means less flex. There are cheap U brakes that would fit around your arm that you can watch bending when you brake. Good brakes are Shimano 105 and up, and any Campagnolo brake. Quick-releases help removing the wheel; Shimano integrates them into the brake and Campagnolo integrates them in the brake lever. You can ride Campagnolo levers with Shimano brakes but vice versa is difficult.
- **Cantilever brakes** are most often used on mountainbikes and hybrids whose tires are too fat to fit an U brake. I do not like cantilevers because they are hard to adjust and require continuous readjustment as the brake pads wear down. They tilt against the rim, which means that unlike U brake pads, cantilever pads do not touch the rim at a constant angle, so the angle must be readjusted frequently. Unfortunately, loosening the one single nut that secures the brake pad makes the whole assembly come loose and you have to adjust some six degrees of freedom all at once. Some people use spacers to adjust the pads while they press the spacers against the rim.
- **Magura brakes** replace cantilevers with two hydraulic cylinders that push the pads straight against the rim. Like regular cantilevers, they need a **brake booster**, a flat U-shaped piece of steel that connects both brake halves to keep them from pushing the fork apart. Maguras work really well; if they weren't so expensive I'd vote for throwing out all cantilevers.
- There are other forms, such as Shimano V brakes, but I have no experience with them. Hub brakes are often used on cheap bicycles; there are also high-quality hub and disc brakes that are useful for tandems which are much harder to stop. Hub and disc brakes have the disadvantage that they brake the hub, and a lot of force needs to be transmitted to the rim through the spokes.

There are a variety of brake pads that vary in softness. If the rubber compound is too hard, it doesn't brake well, especially in wet weather); if it is too soft, it wears down too

quickly. Since rubber tends to get harder with time brake pads should be replaced at least every couple of years. I prefer Campagnolo or Aztec. Some brake pads are longer than others, but I have not found this to make a difference. Some brake pads are designed for steel rims, but they don't make steel rims safe - never use steel rims because they are difficult or impossible to brake in wet weather. Good brake pads are not cheap, but this is about the worst place to save money!

Do not use ``safety levers" that extend from the brake levers of cheap road bikes towards the stem (that holds the handlebars in the center). They aren't safe because they flex and brake poorly.

In road bike shift levers of the kind used for drop (racing) handlebars, the brake cables connect to the inside of the handle and run along the handlebars under the handlebar tape. The older type where the brake cable connects to the upper tip and arc up and then back down to the brakes are dangerous because you can accidentally catch the cable with your gloves, especially if you have aero (triathlon) bars.

For tips on installing and adjusting brake levers, see the chapter on handlebars.

Gear Shift Levers

Again, there are a number of different types:

- **Down shifters** are mounted on the down tube (that connects the front tube with the bottom bracket). They are on their way of becoming obsolete, but are still the cheapest option. They are inconvenient because they require reaching down, which is difficult to do when braking or accelerating hard or riding in difficult situations. A variant that is mounted on the stem is found on very old and cheap bicycles.
- **Bar-end shifters** are mounted at the ends of drop handlebars. I haven't used them much and find them less convenient than Ergopower and STI brakes because I don't often keep my hands at the handlebar ends where I can't reach the brakes. They are popular on touring bicycles.
- **Campagnolo Ergopower** is a system for drop handlebars that integrates the shifting levers with the brake levers. This means you can control everything without moving your hands. There is one lever mounted behind the brake lever that tilts sideways to shift down, and a thumb button on the inner side of the body to shift up. Up to three gears can be shifted down, and any number of of gears can be shifted up with one lever action. The levers become less noisy and hard with time. Both brake and shift cables run along the handlebar under the handlebar tape. This is the system that I prefer. They also come with Campagnolo's spare parts availability - it's not going to be a problem to buy a replacement for broken spring three years from now, when Shimano won't even *remember* what they sold six months ago.
- **Shimano STI** is similar to Ergopower, but there is no thumb button. Up-shifting is done by pushing the brake lever sideways. This is why I prefer Ergopower - it

makes me feel more in control because the brake lever doesn't go in all directions when I hold it with two fingers to be ready to brake. Also, STI has cables connecting to the inside tip of the lever that are not tucked safely out of harm's way like with Ergopower.

? Other types are available for mountainbikes. I have not used them.

On road bikes, the shifter cables run along the down tube, on the left side to the front derailleur and on the right side to the rear derailleur. There is a plastic insert under the bottom bracket that guides the cables. Cables must be bought to match the shifting system used. Ride-on makes special coated cables that run somewhat smoother than regular cables, but don't really justify the price. Normal cables should be oiled before being inserted into the housing.

Shortening the housing is difficult and requires a special tool, or at least a sharp fine metal saw. The housing should be held by a vise. Saw it off very close to the vise grips, then file the sharp edges and smooth out the inner plastic tube. Use metal caps on the ends. Cables are usually too long; cut them with a sharp cutter and either put a cap on the end or solder the end (but don't use too much solder or they won't fit through the housing caps). Uncapped unsoldered cables fray.

Chainwheels, Cogs, and Chains

In front, there are either two or three **chainwheels**. The innermost, smallest chainring is intended for spinning up steep hills. It's also called ``granny gear'', presumably to indicate who would need one. Me, I prefer two chainrings on road bikes because I don't have to worry about overshifting, because I have to worry less about extreme chain lines, and because I haven't yet met a mountain that was not easier to climb without a granny gear. The problem with the chainline is that a chain should not run from an inner cog to an outer chainwheel or vice versa.

There are cassettes with eight or nine **cogs** on the rear hub (for hub types, see the chapter on wheels). Cassettes with five, six, and seven cogs are obsolete. At the time of this writing (May 1997), nine cogs is still an extremely expensive option that limits the choice of vendors and requires a special narrow chain. In most cases, the number of cogs must agree with the type of shift levers; it cannot be upgraded without also replacing the shift lever. Usually cassettes from one vendor cannot be mixed with shift levers from another vendor. There are some exceptions, for example Sachs is said to work with Campagnolo.

Chains must be the single most neglected part of the typical bicycle. It seems that every other bicycle I see has not been lubricated for years. Unlubricated chains squeak pitifully, make pedaling *much* harder, and destroy chainwheels and cogs. The problem is that rust and other particles get between the bolts and sleeves of the chain and wear them down, so that the chain gets loose and hence very slightly longer. This means that the distance between two chain links no longer matches the distance between two chainwheel and cog teeth. When this happens only one link connects with a tooth, all others are loose because of the slack. This one tooth takes the entire force and gets worn into a ``shark fin'' shape.

If this shape is pronounced enough, the chain won't even roll off smoothly off the cog or chainwheel; instead the chain will be grabbed by the shark fin.

The insidious part of this is that you don't notice it until the cogs you use most are already destroyed. Replacing the chain will seem to make matters worse because now all links of the chain get hooked by all the shark fin teeth of the cog simultaneously, which will make the chain skip. This makes the cog unrideable. The only option at this point is to replace all the worn cogs together with the chain.

To prevent this from happening, it is important to lubricate the chain frequently, at least every three weeks or so, more often when riding in wet weather. Before lubricating the chain, it must first be cleaned with an old T-shirt. You can run the chain through the fabric, but it's really better to clean each link individually. It will only take a few minutes. You should also clean the cogs, chainwheels, and especially both pulleys in the rear derailleur. Then, lubricate the inside liberally, and run the chain through at high speed for some time. Then, wipe off all excess lube. This is important because only the lube inside the chain will do any good, the rest just attracts dirt and increases wear. Ride around the block and wipe off excess lube again.

There is much debate about the best chain lube. You can't go wrong with synthetic bicycle chain oil, perhaps containing suspended Teflon or other lubricating particles. Don't use regular (WD-40 or other) machine oil because its viscosity is too low to stay in the chain for very long, and don't use motor oil because motor oil is designed to work in certain (hot) environments only. Grease doesn't work too well because it won't reach the critical parts, you'll wipe off most of what you apply. This is even more true of wax. Don't use gasoline to clean your chain, it will remove the factory grease packing of the inner surfaces and you'll never be able to restore them sufficiently. Chains are not that expensive.

Replacing a Chain

To replace a chain, push a pin out of the old chain and measure the new chain against the old to make sure it has the same number of links. If you have to remove links, remove them at the end without the bolt sticking out. If you have to break a chain with the intent to reinstall it, push one bolt towards the outer side of the bicycle until the link just barely holds together. Bend the chain to disengage the broken link. It's virtually impossible to re-insert a bolt pushed out all the way. To install a chain, join the chain and push the bolt in until it is flush with the link plate, then push it back from the other side until it's as flush with the plate on that side as all the other links. Then, bend the chain sideways until it moves freely. A stiff link makes the chain skip when riding. You need a special chaintool for pushing bolts.

The chain length should be chosen so that all gear combinations are possible: if the chain is on the largest chainring and the largest cog, the rear derailleur should still have some play, and if the chain is on the smallest chainwheel and the smallest cog, it should not touch itself near the upper pulley in the rear derailleur. Of course you won't normally ride

these extreme gears because of the poor chainline. If these conditions can't be met, consider changing the pulleys or chainwheels, or the rear derailleur capacity (i.e. use one with a longer cage). As a rule of thumb, the rear derailleur should be roughly vertical (both its pulleys are exactly below the axle) when the chain is on the largest chainwheel and the smallest cog.

In case of doubt I prefer a shorter chain because this increases its tension and makes it less likely to bounce and hit the chainstays (the frame tubes that connect the bottom bracket and the rear dropouts). On mountainbikes ``chain suck'' can become a problem when the chain bounces so much that it gets caught between the chainstay and the chainwheels. You can bolt little gizmos to the chainstay to prevent this, but I have seen these gizmos to cause more chainsuck problems than they solve because *if* the chain gets stuck anyway it gets stuck so tightly that it requires tools to make the bicycle ridable again. I am generally wary of little add-on gadgets.

Selecting a Gear Range

Bicycle newsgroups are awash with little programs to compute gear ranges, ``gear inches'', and stepping recommendations. I'll take the practical approach.

First, the ratio of front steps to back steps is important. The standard chainring set is 42-52 (teeth). I think of this as 24% step (1-(52-42)/42); if you shift on the big chainring the bicycle goes 24% faster at the same cadence (pedaling speed). The differences for the rear cogs is much smaller. For example, my usual cassette has cogs 13-14-15-16-17-19-21-23. This works out to 8-12% steps, so together with a 39-53 chainwheel set (36%) a front shift is equivalent 3 or more rear shifts. This is unusually large.

If the front-to-rear shift ratio is 1, you have too few distinct gears because for most front shifts there is an equivalent rear shift. A ratio of 0.5 is called ``half-stepping'' because front shifts insert another gear between most rear gears, at the expense of frequent double shifts. A ratio of 1.5 is called ``alpine''; it offers most of the fine gearing of half-stepping but extends the range at the ends, at the expense of even more shifting. My rather extreme ratio of 3 has a different goal; I rarely shift in front and use the small chainring for normal riding and climbing and the big chainring for high-speed downhill or flat-terrain riding.

Modern chainwheels and cogs cannot be combined arbitrarily, they are designed to work together to help the chain move from one cog to the next with small indents and protrusions that ``take over'' the chain and precisely chosen places. Effectively, one chooses a rear cog cassette by choosing the extremes, such as 13-23 or 14-32. This decision depends on the type of riding:

- Choose a small range such as 13-23 for flat-terrain riding, and for group riding. When riding in a group, you can't control the speed unless you are in front, so finely stepped gears allow maintaining the optimal cadence for any speed.
- Choose a large range such as 14-30 for mountain climbing. Since the smallest chainring in a two-chainring set is usually 39, you need a large inner cog. I do not

like three-chainring sets because they complicate shifting and spinning up hills at absurdly low speeds and high cadences are actually more work than to pump a higher gear.

Cadence, or pedaling speed, is an important factor here. It is measured in revolutions per minute. Suppose you ride a road bike with a wheel circumference W of 2130 mm at cadence C, using a front chainring with F=42 teeth and a rear cog with R=17 teeth, your speed at C=100 is

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(C * 60) * (F / R) * (W / 1,000,000) = 31.6 km/h
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For mph, divide by 1.6. Beginners tend to ride at cadences of 60 or 70 rpm but you should aim at a cadence of around 90 or 100 rpm because it takes less strength and is easier on the knees. High cadences require clipless pedals (a term that means click-in pedals such as Time, Look, or Shimano SPD) because they allow you to apply constant force at all times, rather than stomping the pedal on the downward half of the circle. A bicycle computer that measures cadence is useful to train yourself to use a given cadence, but once you got used to it you won't need the cadence computer any longer.

Pedals

There are basically three types of pedals: pedals with clips and straps, ``clipless'' pedals that a cleat on the shoe clicks into, and pedals with neither.

Clips work best if they are made of plastic and have two prongs that the strap threads through, to prevent them from bending sideways. The strap should be twisted one full revolution inside the pedal to keep it from shifting. The lock at the strap end should be near the outer clip end, such that the other end of the strap points up, where it is easy to grab and tighten when riding. Tightening is unfortunately necessary frequently. It is also often necessary to untighten the strap manually before removing the shoe, especially if the shoe has a cleat with a horizontal groove that fits into the rear pedal edge. This, imho, makes clips dangerous because you may not get out in time in an accident.

Clipless pedals come in a variety of shapes. The two most popular ones are Time and Look, which require a large cleat that makes it hard to walk with the shoe, and Shimano SPD and Ritchey, whose cleats are recessed in the shoe to make it possible to walk normally. There are various clones and other more exotic systems. Racers prefer Time/Look because they hold the shoe more tightly while Shimanos seem to get more float and play (they call it ``freedom'') with every new generation.

Clipless pedals have two advantages that make them useful for anyone except the most casual riders:

- They allow applying force during the entire pedal cycle, especially while the pedal is moving up. You will develop an entire new set of muscles that help you pull up the pedal while you push down the other (learning this takes concentration

on pulling; pushing works by itself). This improves speed and acceleration significantly. It takes some practice to also push or pull the pedal while it is at the top or bottom point of the cycle. The purpose of the exercise is a ``round'' pedaling cycle, which reduces knee stress, makes it possible to climb steeper hills, ride in tight groups, and generally improve performance.

? They also keep the rider in contact with the bicycle. Losing contact with the pedals when hitting a pothole or other obstacles, or when riding fast over cobblestones can easily cause a crash. If there is a crash, the pedals disengage practically automatically. There is virtually no danger of being hurt because the pedals fail to disengage. (Clips with tightened straps, on the other hand, can twist the ankle in nasty ways in a crash.) I have crashed several times in many different ways and never had a problem.

Personally, I prefer the Shimano/Ritchey system simply because I have clipless pedals on all my six bicycles and never ride without cleated shoes. Riding to a grocery store and amusing the audience by helplessly staggering about like a penguin because of the cleats is not my idea of convenience. If I raced competitively I would probably feel differently about this.

Shoes

Shoes must fit the pedals. There are various kinds that accept cleats. They all have a very stiff sole with mounting sockets to attach the cleat to. The shoe should fit well, it should be neither too wide nor too narrow because the feet don't get much exercise while riding and can easily go numb if the shoe doesn't fit. Since good contact with the pedal is essential, they should fit snugly; choose one half size less than you would for a walking shoe.

Adjusting the cleat should be done very carefully because riding with the feet at an unnatural angle hurts the knee. Most people need to adjust the cleat so that the heel points in (of course not enough to touch the crankarms). Most people also prefer to mount the cleats just under the ball of the foot. This takes some experimentation and riding on the block to test adjustments. Don't be careless, knees take a long time to heal...

The soles of the shoes should not be flat but curved up near the toes because they can't bend during walking, being of tough carbon fiber plastic. The attachment point of the cleat must withstand quite enormous force. I have broken five out of six Shimano shoes at that point, three out of four Diadora shoes, and no Adidas shoes. Two of the Shimanos failed catastrophically, I ripped the cleat out of the sole while riding. This is dangerous. One of the Shimanos failed in another nasty way: since the top of the shoe was not very stable, twisting the foot would no longer disengage the pedal! This is even more dangerous. It seems that lately they got better, the newest model has held up for over a year. The Diadoras failed benignly, despite the broken sole they stayed ridable (but of course I replaced them anyway). My Adidases have survived much longer than any of the others and show no signs of failing, but they just recently lowered the quality (by removing padding) and increased the price, so they are no longer attractive. Today I ride

cheap Performance shoes - all shoes seem to break after a while regardless of cost so I go with $40 specials.

Derailleurs

Most modern frames have a socket welded to their seat tube that the front derailleur is bolted onto. Most front derailleurs also come in a version that can be strapped to the seat tube if the socket is missing. The derailleur should be adjusted such that the cage is parallel to the chainwheels, and just barely clears the tips of the teeth of the chainwheels as it is shifted back and forth. There are two screws in the body of the derailleur that limit the movement of the derailleur. This prevents overshifting, which would throw the chain off the chainwheels.

Rear derailleurs are available with three different cage lengths (i.e. the distance between the pulleys). The length is called the capacity, and is measured in teeth difference: add the numbers of teeth of the largest chainring and the largest cog and subtract the numbers of teeth of the smallest chainring and the smallest cog. You can exceed the specified capacity of a rear derailleur by a couple of teeth but not more, or the chain will become stuck in unpleasant ways. For standard road bikes, my feeling is that you should stick with the shortest (racing) cage and adjust your chainrings and cogs because longer cages reduce shifting accuracy and make the chain bounce more easily on rough road surfaces. Many high-end rear derailleurs are available only with short cages.

It is absolutely critical to adjust the limit screws of rear derailleurs precisely. If the chain overshifts and falls off the smallest cog, it may block the wheel. If it overshifts at the other end, the derailleur might get caught in the spokes, which will probably crush or snap the derailleur in half and bend the dropout of the frame. A good mechanic may be able to bend the dropout back into shape (this requires special and very expensive frame alignment tools) but this is an excellent way of destroying frames.

Rear derailleurs must match the shift levers, or the gear spacing clicks built into the shift lever won't be translated to the correct cog distances by the derailleur. The result is a rattling noise in some, perhaps most, gears. There is an adjustment screw where the shifter cable enters the derailleur body. Adjust it so you can smoothly shift between the middle two cogs, then test with the whole range. After each adjustment of the screw, shift at least once. I have found it to be impossible to adjust until the chainline looks (and sounds) right and then do the next gear. Always keep shifting during adjustment. This is actually a simple procedure.

Don't bother with special sealed-bearing pulleys. Pulley friction is not a problem, and if the width of the new pulleys doesn't match the width of the original pulleys, the ends of the screws that hold the cage together might either hold the cage together poorly, or worse, stick out and catch the spokes with the usual catastrophic effects. Instead, clean the pulleys regularly, the accumulated gunk makes a much bigger difference. By the way, the back plate of the cage must be installed with the bigger end pointing down, or the chain will keep falling off the lower pulley.

Saddle

Saddles are important because if you choose the wrong one you'll be sore. Make sure it has a narrow nose and a standard-width back. If the nose is too wide it will rub the insides of your thighs. Avoid extra-narrow mountainbike saddles; they allow mountainbike riders to slip your weight easily behind the saddle on steep downhills but the loss of contact area can become painful quickly. There are wider saddles for women, whose pelvis is shaped differently.

Surprisingly, feeling the padding of a saddle for softness does not say much about whether the saddle is comfortable. Saddles usually consist of a hard shell, padded with foam with a flexible plastic cover. The thickness of the foam padding does not make a lot of difference for comfort because there are only two small contact points where bone meets the saddle. Even gel padding is only marginally better than foam. It's more important whether the plastic shell is completely rigid, which is not good, or whether it is flexible and held in shape by the two rails that the saddle is mounted on, especially if these rails are themselves flexible.

Some people swear by leather Brooks saddles, which work by the same principle except that the leather stretches more than plastic and so the rail mounting needs to be re-tightened occasionally. The leather needs to be rubbed frequently with oil at first so it is soft enough to change its shape to adjust to the shape of your pelvis, and must be protected from rain. Once you get past the initial months it's said to be the perfect saddle, but I prefer not to go through all the trouble.

One of the best saddles I have used is the regular racing Flite, which has next to no padding but a flexible shell and soft Titanium rails. I normally avoid the Titanium hype but this is a really useful application. Titanium is much softer than steel. Unfortunately you can't adjust the tension, so after a couple of years it sags and becomes unusable.

My favorite is the Selle Italia Turbo Matic 2, with its distinctive yellow/black rear end. It;s the best of both worlds, and I have done many long tours with it.

The saddle height is very important. If it's too low, you have much less strength when pedaling, and if it's too high you'll rub your thighs sore. Adjust the height until you can pedal backwards with the heels of your shoes on the pedals, with fully stretched knee but still touching the pedal when the pedal is in the bottom position, without rocking your hips. The position must be exact to about five millimeters (1/5 inch). I prefer the standard angle where a bar laid on the nose and back of the saddle, parallel to the top tube, is horizontal, but some people prefer the nose slightly up or down.

Riding computers

There are lots of bicycle computers available. They all offer

- Current speed

- Average speed
- Maximum speed
- Total distance: the distance since installing the computer
- Trip distance: the distance since pressing the reset button
- Trip time and wallclock time

This much is standard, but also consider the differences:

- Some computers continue computing average speed and trip time when stopping while others suspend. This means that average speeds are usually not comparable, at least in town.
- Some computers retain total distance, wallclock time, and wheel diameters when exchanging batteries while others don't.
- Mechanical stability and battery life is also an issue.
- A backlight is wonderful when trying to read the display at the end of the day in a campground.
- Cadence helps developing a proper pedaling speed. 100 rpm is much less tiring than the 70 rpm beginners prefer, and easier on the knees too. After developing the proper cadence the feature becomes useless and adds an extra wire.
- Wireless computers don't need a cable running down the fork but require a clunky sensor with its own battery.
- Temperature is neat.
- Altitude is important when riding in the mountains or hilly terrain but it seems the technology is still immature, see below.
- Some computers support multiple wheel diameters, useful if the same computer is used on a road bike and a mountainbike.
- Does it use a reed sensor or a sensor ring? Reed sensors work with a small magnet clamped to a spoke. They are more sensitive to vibration and can drain the battery when the bike happens to be parked with the magnet next to the sensor. Sensor rings are more precise but require a longer cable all the way down the fork.

Avocet vs. Cateye vs. Casio

Here are my experiences with two high-end computers I own, the Avocet 50 and the Cateye CC-AT 100. The Avocet 50 is being replaced with the 55 as I write this but I haven't seen one yet. Both computers support altitude using a barometric pressure sensor.

- **Avocet 50**
  works well when measuring altitude. It ignores small climbs under 10 meters, which makes it very precise. In the Alps and other mountains I have ridden in the displayed altitude matches the posted altitudes, and after returning to the starting point shows the original altitude to within a few meters. It seems unaffected by temperature and weather changes.

  Unfortunately it eats batteries. It needs a new pair every six months, and loses all data when replacing batteries. After the batteries are about half-empty, altitude

measurement becomes extremely erratic, once I climbed 200 meters while the bike was leaning against a wall. The casing is very brittle, when dropped it can come apart and scatter components everywhere, especially the batteries (they included two spare lids). And this is for the late production model, not one of the first which were completely unusable. I had mine exchanged four times on warranty.

The software is excellent, however. Every function can be reset separately. The combination of features on the display is dubious (why not current speed + trip distance in the same mode?) and it ignores button presses in quick succession, but basically it's well-designed. It has no temperature and no backlight. There is a cadence option.

? **Cateye CC-AT 100**
It's ugly and clunky, and the altitude measurement is broken. The altitude display jumps by 5..7 meter every few seconds, less often in the "fixed" newer model that also has a trip altitude function. These errors are accumulated in the total altitude gain, which makes for very impressive totals even in perfectly flat terrain. However, with a fresh battery these problems mostly disappear, then it again becomes more unreliable as the battery wears down.

The user interface is stupid, one button is largely unused while the other must be pressed for two seconds to access important submodes. The combination of data on any given display is better than on the Avocet though.

It is also mechanically stable, unlike the Avocet. It does stop working in heavy rain. Counts can only be reset all at once. It has temperature and backlight, but no cadence option. Like the Avocet it doesn't support 24-hour wallclock mode.

? **Casio ALT-6000**
This is not a bicycle computer, it's a watch. Actually it looks like a crashed flying saucer. I bought it to see if there is a reliable way to get altitude readings on a tour. It's a failure.

It shows both barometric pressure and altitude, numerically and in a little graph. Pressure readings work fine in a shop window but when you actually wear it the graph dissolves into a cloud of disconnected pixels. The altitude graph is sort of fun to watch, but serious measurement errors throw off the autoranging. Its long-term history may have some anecdotal value. It has a terrible user interface and forgets the graph when switching modes. It also shows the temperature average between your wrist and the back side of the moon. Or something.

Don't buy this. It's an expensive useless toy for kids and has no real value.

The first two computers need to have their wheel diameter set precisely so they know the distance that corresponds to one wheel revolution. To measure this distance, make sure

your front wheel is installed with the correct tire, and pump it up to the desired pressure. Mark a spot on the wheel with chalk and align it with a mark on the floor. Sit on the bike and ride forward in a straight line for one full wheel revolution, and mark the spot on the floor under the chalk mark. Measure the distance between the two marks on the floor to the closest millimeter, and enter it into the computer. Some computers require some calculation instead of accepting the distance directly.

Heart rate monitors

Regular computers measure bicycle statistics; heart rate monitors measure your pulse. While this seems like a very marginal option, strictly for professional athletes, it actually tells more than the current speed of the bicycle. I am familiar with the heart rate monitor made by Polar. It consists of a chest belt and a display unit that can be installed on the handlebars or worn at the wrist. The connection is wireless.

The heart rate is surprisingly variable. It can jump up and down rapidly as exertion changes. It can jump from 90 to 180 or vice versa in much less than a minute - and it takes longer after a long ride. Watching the heart rate allows the rider to keep his pulse in a safe zone and avoid extremes. For example, I avoid exceeding 160 beats per minute in flat terrain because I wouldn't be able to keep it up for an entire ride, while exceeding 190 is not unusual for short bursts of speed. Just rolling along at 120 or 130 is relaxing. I monitor my heart rate much more closely now than my speed because it lets me plan my rides better.

Of course I am talking about 100+ km rides. There is not much point in wearing a heart rate monitor when riding to the grocery store around the corner. But I do recommend them to long-distance riders. On a recent 300km ride on a single day I adjusted my speed to my heart rate, starting with 120 bpm. I had to revise this later until my target rate was 150 bpm near the end of the ride. I have done long rides before but never felt so confident that I could finish the ride safely.

I recently (5/2000) got a new Polar M52 heart rate monitor that also derives fitness informtion, calory measurements, and training schedules from heart beat variability. It is a wonderful toy. I can't verify the calory estimates but they seem plausible. The fitness test seems dubious though - I have improved from 52 to 57 within two weeks of moderately hard riding, much faster than the manual claims is possible, with an intervening result of 44. (The numbers must be looked up in a table.) A friend got 72, way off the scale. It has two annoying flaws, in addition to a chaotic user interface: training cannot be stopped and resumed for a pause because stop mode quickly times out and aborts the measurement, and although the belt-to-computer signals are encoded the code lock is inevitably lost and is pretty much impossible to reacquire, which makes the computer pick up signals from other people. Occasionally the heart rate display is wildly inaccurate for short times.

GPS Satellite Navigation

I am the proud owner of a Garmin 38 GPS receiver. GPS means Global Positioning System, a network of 24 satellites that broadcast signals that permit computing the position of the receiver to within 100 meters in theory and between 30 and 200 meters in practice.

When using the Garmin 38 for cycling you'll spend about half the time fantasizing that a piece of paper with the words "Poor GPS coverage" written on it would make a very cost-effective replacement for the receiver - lightweight, no batteries, with most of the functionality. After turning the receiver on, it takes between four and fifteen minutes to get an initial fix. It needs to receive at least three satellites for a fix, but I often saw it get lost when receiving six, scattered all over the sky, while the horizon was visible all around. Trees, buildings, and other obstacles block satellite reception. Once it does get a fix, it is fairly good at maintaining it, but this is still not reliable. In cities it is mostly useless because there is no clear view of the sky. It took forever to get a fix on the Eiffel tower, but I think I'll find it again anyway. The Garmin 38 is a pretty useless device and I stopped using it.

Recently (June 2002) I bought a Garmin etrex Legend receiver. It is basically similar to the 38, but receives 12 satellites simultaneously, has a coarse built-in map (either Europe or USA), and a large number of improvements. It's also much smaller and runs on two AA batteries (I use 1700 mAh NiMH's). Unlike the 38, the etrex is quite reliable and useful. It's not much better at receiving satellites in difficult situations such as high tree cover, but it keeps track of so many simultaneously that it's easy and practical to get a fix. It often has accuracies down to 4 meters! Like the 38, its track log feature has a voracious memory hunger and should be changed from *auto* to 100 meters or so. Recently I recorded an entire tour with 500-meter accuracy.

Hence, I change my recommendation - dump your single-satellite Garmin fossils and get an etrex. Not perfect but a nifty and useful machine.

Taking Good Pictures

When choosing a camera, get one that does everything by itself and fits into the waist pouch. Wide-angle lenses are best. Don't bother with replaceable lenses, no matter of how you feel about point-and-shoot cameras. Make sure the battery is fresh. Do not take them to the beach if there is a risk of sand or water getting into the camera. I used to use a Nikon AF-600 with the Panorama switch glued in the off position. Its only problem is that it is so small that many of my pictures show the strap or a finger...

You'll enjoy the pictures only if you take some care composing them. It is impossible to take a picture of a landscape panorama, for example - all you'll get is a picture that is divided into a blue and a green half with some indiscernible tiny detail at the boundary. Here are some rules I use:

- Don't make postcard pictures. The pictures should help to remember the trip, not impress your friends. Prefer pictures of things of personal significance. A picture of your hotel room will prove more valuable than one of the Eiffel tower.
- Make sure any picture has both foreground and background. The foreground element should have an identifiable size to give a reference point - a person or bicycle will do, perhaps plus a tree or street light.
- There should be an element that connects foreground and background to give a sense of perspective and depth. A road or the edge of a forest work fine.
- There should be a focus element in the center of the picture. If there are two interesting elements make two pictures instead of combining them into one with a big void in the center.
- The foreground should be darker than the background to increase the depth impression.
- Choose a point of view when the sun is to one side, not behind or in front of you (unless you want to make an effects shot); the shadows give structure to flat surfaces.
- If the scene has some very bright spots, point the camera to an evenly lighted area and let it do its light measurement there. My Nikon does the measurement when the button is pushed halfway in and takes the picture when it is pushed all the way in. Otherwise the picture will be all dark and mushy except for the bright spot. The lab will mercilessly overexpose dark pictures to reach an average light level.
- It's extremely hard to make a picture that shows the steepness of the road you are on. Don't even try to point the camera down or up to show the incline; keep the view axis horizontal.
- The first few pictures of a roll of film should not have bright colors or unusual brightness because the lab uses them to calibrate the development machinery. Also, the first and last picture are often lost or taped over by the lab.

The picture above is an example from my Marmolada tour. There are riders in the foreground who give a size reference, a road distorted by perspective, dark trees in the foreground with a tall one in the center, and a brightly lit mountain in the background that almost seems to float. It happens to be a downhill but one can't see that.

I have replaced my old chemical camera with a digital still camera (Sony F55E). The choice between chemical and digital is not one of storage medium. The digital camera is a completely different device because it encourages taking snapshots at any opportunity. I now take at least five to ten times as many pictures because they are so wonderfully easy to take, review, delete, store, and process. No more guesswork, waiting for prints, extra expense for additional prints, and stacks of paper printouts. Bring one to a party and everybody starts posing and having fun. Digital cameras are a true revelation.

Professional photographers, and aspiring amateurs, will tell you that point-and-shoot chemical cameras and digital cameras cannot take serious pictures. This is true if you are a professional photographer but it is nonsense for people like me who want to take high-quality snapshots with little preparation and posing. I have digitized well over a thousand old chemical photos, and let me tell you, chemical photography is the pure horror. Film

ages, gets scratched by the camera, the lab, and in storage, and it inevitable attracts dust that gets embedded in the emulsion. Another thing I never stopped to think about: chemical cameras cannot compute a white balance, so most pictures will have incorrect blue (sunlight) or yellow (incandescent light) tints. Take a close look at older film and you will be shocked, and amazed how the lab could possibly get decent prints out of such information garbage.

(That said: of course I realize that film has a higher, S-shaped dynamic range while digital cameras have a narrower ramp range, so shadow and highlight detail gets lost more easily. Film also has a somewhat larger color gamut, although it may discolor with age while digital images never change. However, this is getting us into the domain of professional or semi-professional photography, where light composition is an art, and it doesn't invalidate my statements about nonprofessional photography.)

Take my advice: do not use a professional, adjust-everything-manually camera if you just want to take snapshots. The pictures will be *worse* unless you are a whole lot more meticulous and willing to spend much time to prepare each shot and adjust the camera than I am. If you must stick with chemical cameras (they are still *much* cheaper), use a fully automatic camera with a good lens; if you want to get good pictures get a digital camera with a good and not too small lens! I am being serious. You can still make mistakes with a digital camera, of course, but at least you'll see your mistake immediately, and once taken a picture never degrades or gets scratched. And, to repeat this important point, a good large lens is much more important than whether it has two, three, or four megapixels.

My Sony F55E came with a ridiculous 4 MB memory stick. Over time I bought a 32MB, 64MB, and 128 MB memory stick. Recently (July 2002, after three years) it broke because the flexible printed cable of the swivel lens tore, so I bought a Canon S40. Sony has chosen to replace all their good designs with poor ones. The new Sony P9 has a cheap Sony lens instead of Zeiss so it has a *worse* effective resolution than the F55E, despite recording twice as many pixels. Also, I am truly tired with Sony's overpriced proprietary memory sticks, and I wanted CF cards. Half the price per byte, and available with eight times the capacity. Sony is off my lists.

The Canon lens is very good. Also, it has a viewfinder, longer battery life, a 3x zoom, it boots faster, has many useful manual focus, time and aperture control, fine-tuned flash, series and panorama functions, exposure histograms, and lots more. The Canon makes beautiful pictures in very difficult lighting situations that would leave the Sony totally helpless. I no longer have to partially cover the flash with my finger to avoid over-exposure; the Canon is just brilliant with subtle fill-in flashes. I love this camera.

(Silly digital camera trick of the week: they are sensitive to infrared light, so you can use them to test IR remote controls and IrDA ports.)

You'll see two types of riders on the road - those wearing regular street clothes when riding, and those wearing specialized bicycle clothes. (The latter include a subspecies that

looks like a moving billboard.) I started in the first category but have been completely converted to the second. This chapter considers each piece in turn.

The fundamental principle for bicycle clothing is layering. If the weather gets colder or wetter, one does not choose a thicker material but adds more layers. The advantage is that this makes it easier to adjust to changing temperatures without having to carry a complete set for every temperature range, and it is faster to adjust by opening or taking off just one layer. Bicycle riding requires much more attention to just the right clothing - too warm is just as bad as too cold.

Another principle is tight fitting. A baggy jacket not only acts like a braking parachute but also lets cold air get closer to the skin, which makes the wind feel much colder because sweat evaporates directly on the skin. One function of bicycle clothing is to keep the skin dry by transporting sweat to the outside, where it can evaporate without cooling the body too much and without soaking the clothing.

Pants

- **Shorts** are made from flexible lycra material sewn together from multiple panels, sometimes with different colors. The seat and front is padded with leather (hard to find and not useful) or synthetic chamois. Sometimes the padding contains gel cushions, but this is a bad idea because they do not let sweat evaporate to the outside, and they do not even improve comfort noticeably. Shorts come in male and female versions that are cut differently, and have different padding. Bicycle shorts are not used with underwear because that would defeat the advantages.

  The advantages of bicycle shorts are that they are flexible, padded, and seamless. Regular pants may constrict your thighs (which expand when you ride), and they will chafe the inside of your thighs where they rub against the saddle, especially if they are loose-fitting because they bunch up. I never ride anywhere without bicycle shorts.

  Make sure that the waist and leg hole size fits. Shorts must fit tightly but may not constrict the waist or the thighs (sometimes leg holes are far too small). Waist straps are useful but not necessary. The legs should have rubber threads sewn in at the leg ends. It usually looks like multiple thin white rings stitched into the inside. Do not buy pants that just have a single rubber ring sewn into a fold, they slip.

- **Long pants** come with and without padding. The ones with padding are like shorts with long legs, and the ones without are worn over regular shorts. I prefer the latter because I don't need as many of them, because I can take them off when it gets warmer, and because I have found the padded variant to slip easily. Pants must be close fitting, and must be long enough to pull up at least over your navel (you don't do that normally but if you can't they will slip). I prefer pants with a cord at the waist that keeps them up better. (I have found such cords to be unnecessary in shorts.)

Long pants have the same advantages over street clothing as shorts, with an additional one: in wet weather street clothing becomes heavy, inflexible, and clings to the skin. Bicycle pants remain flexible, and although they get wet they don't soak up water, and the reduced evaporation and the fact that there is no air between skin and pants make them feel *much* warmer despite the fact that they are made from much thinner material.

Long pants come in various thicknesses, from the thin lycra material used in shorts to thicker lycra with a fuzzy inside, and as fleece. I have them all: the thin ones for warm weather down to about 10 degrees C, the thick and fuzzy ones for temperatures above freezing, and the thick fleece ones for anything lower than that. (Fleece does not work well in rain.) Some of them have zippers in the lowest part that makes them easier to get over the feet (or even shoes); the material is flexible but pulling too strongly will tear it.

? **Rain pants** go over long pants and are made from waterproof material. They are very uncomfortable on skin because they are basically sturdy plastic bags. All the ones I have tried begin to leak after a few minutes, and they get in the way when riding. I recommend against them. The only marginal advantage is that the spray from rear wheels without mudguards does not soak the back of your pants but I have found it to be almost as effective to stuff a plastic bag between shorts and long pants.

Shirts

? **Jerseys** are special shirts made from lycra or other synthetic material. They come in long-sleeved, short-sleeved, and sleeveless variants. Most have three pockets in the back that are very convenient for spare tubes, bananas, keys, and other small items (but not paper, because it gets sweaty, or large plastic items that block sweat evaporation).

Although it may sound unpleasant to wear a plastic shirt, the big advantage of jerseys over T shirts is the fact that they transport sweat from the skin to the outside very efficiently. It takes *very* hard effort (or a backpack) to get a jersey sweaty, while a T shirt would be soaked very quickly. This is especially important in wet weather because a soaked shirt feels much colder than a jersey. The sweat transport is less effective for very thick jerseys, so it is important to choose the right one and not ``overdress".

To some degree temperature can be regulated by stuffing the jersey into the pants (which is not normally done) or adjusting the zippers. I prefer jerseys with long zippers. All jerseys have a rather high collar in the back to prevent a sunburned neck, and some can be zipped up the neck in front to protect against cold headwinds.

- **Undershirts** such as the ones made by Odlo are a very effective addition to jerseys. They can be worn underneath the jersey in cold weather, which works better than choosing a thicker jersey. The material is amazingly thin, which means they can be rolled up to a very small bundle and carried in a jersey pocket. They do not work so well if worn without a jersey over them, and they need more frequent washing because they soak more easily.
- **Fleece jackets** work well in cold weather. I have never found a combination of undershirts, long-sleeved jerseys, and a fleece jacket to be too cold even below -20 degrees C. Bicycle fleece jackets have water-repellant panels in front where one is exposed to wet headwind, and are more close-fitting than non-bicycle fleece jackets. As always, air pockets reduce the effectiveness. I am very happy with my Cannondale fleece jacket.
- **Rain jackets** come in cheap plastic bag versions that seem to get as wet inside as outside because of sweat, and expensive ones from Goretex that allow some degree of sweat transport from the inside to the outside. The Goretex version is worth its price because it keeps one dry if one does not ride too hard. The cheap plastic bag jackets work better when they have slits in the back, and if they are smoothly rubberized inside and not just tightly woven because otherwise they only last for a few minutes in the rain. Good rain jackets reach very low in the back so you can sit on them to protect from spray from the rear wheel.

Shoes

- **Shoes** are mostly chosen to work with the pedals (more about this in the Drive chapter). Things to look out for are tighter than normal fit (the foot should not shift), compatibility with the pedal system, and a thick and molded (not flat) sole. Avoid excessive padding that can take forever to dry after riding in the rain. I prefer long velcro straps because they are easier to open and close, and if they are long enough and tied through a buckle they are no less stable than laces.

  One problem with bicycle riding is that the feet get no exercise, which means that it's easy to get cold feet in cold weather. Thin inner socks help somewhat, Goretex outer socks help more (and also keep the feet dry). Boots work best.

- **Boots** that are pulled over the shoes have two functions: they keep the feet warm, and in wet weather they keep them dry (not completely, especially if holes for pedal cleats are cut into the soles, but dry enough to stay warm). They come in many variants. I have found Carnac and other sewn plastic and lycra types to perform poorly because water gets in through the seams. In my experience Adidas neoprene boots are best by a wide margin, they are tight, have a thick sole to walk on, and stretch somewhat. Boots work better in the rain if long pant legs are pulled over them because the pant leg otherwise acts like a wick.
- **Socks** must be close-fitting and have a shaped sewn sole. Don't use sixpack-type socks that can bunch up when riding. As usual, in cold weather it works better to wear an inner and an outer sock; the inner one should be thin and made of cotton,

and the outer may be cotton or Goretex. Wool doesn't work as well as cotton or Goretex, and is usually so thick that the shoes are too tight.

Gloves

? **Gloves** are important because riding can cause sore hands, no matter how softly padded the handlebars are. Riding too long without gloves can even be dangerous because it can damage the median nerve that runs in the webbing between index finger and thumb, which causes numbness that can take extremely long (weeks or months) to recover. Bicycle gloves have special padding that protects the hands.

Short gloves (with the finger ends cut off) should be made of a thin lycra top and a soft leather palm. The area between index finger and thumb must be padded with extra layers of leather. The palm has extra padding consisting of foam sewn between leather layers. There are also gloves padded with gel pads but I do not think the extra expense is justified.

Long gloves come as five-fingered gloves and ``lobster claws'' that are split between middle and ring finger only (this reduces surface area while still allowing two fingers to reach the brakes while the other two hold the handlebars). Long bicycle gloves have extra antislip padding, but in a pinch ski gloves work too. My favorite vendor is Roeckl.

Helmet

? **Helmets** must protect the head against impacts, so the primary concern is stability and close fit. Most helmets now have a thin hard shell that protects the foam against the sun and cuts. Good helmets also have a web molded into the foam that keeps the helmet from disintegrating on impact (I once had a helmet held together by this web after a crash, it really works). There should be plenty of air holes and thin padding strips. Avoid helmets with padding strips in front, where they can get soaked with sweat and cause sweat to run into your eyes. Different vendors sell different shapes; if one doesn't fit well and needs the thickest set of pads to stay in place buy from another vendor. For example, Bell helmets seem to be wider than Giro helmets.

Always tighten the strap until you can just barely open your mouth all the way. It needs readjustment every once in a while. Helmets that slip due to loose straps are no protection! Make sure that you can't pull the helmet back when the strap is closed.

Some people attach mirrors to their helmets and swear they won't punch through their eyeballs in a crash. They don't work for me because I ride road bikes, and all I can see in the mirror is my shoulder. It may work better for more upright riding positions.

Glasses

- **Glasses** protect the eyes against the wind, sun glare, and small objects such as bugs, and sand and gravel kicked up by other riders or cars. Always use plastic lenses that cannot shatter on impact. I used to recommend Oakleys, and the glass is still very good, but the frames are cheap and break easily and it is impossible to buy replacements; they have some ridiculous mail-in policy. The often-repaired Oakleys I have now will be my last ones. (Note: with great satisfaction I have thrown them away now, and replaced them with $14.95 glasses from Performance. What an improvement!)

  Cheap glasses are sometimes not be perfectly planar and distort light, or are not perfectly clear. This is very hard to judge in the shop because when they are new they are polished perfectly. Try to get some where you can attach different glasses to the same frame, you may need both gray shades and clear ones. I do not like orange or yellow ones; they are supposed to increase contrast but I have a hard time judging whether that is oil or water on the road in front of me...

  Do not buy lenses coated with ceramics, like Alpina ones. True, they have no static electricity problems, but they scratch easily, are very hard to clean because they grab the cloth, and they become less clear with age.

  If you wear prescription glasses, your options are severely limited.

Summary

So, do the advantages justify the expense and peculiar look of specialized bicycle clothing? If you ride more than a couple of kilometers a day, and have a high-performance bicycle (as opposed to a gaspipe clunker), definitely. I find riding in regular street clothes uncomfortable, and even painful, and it would take away much of the fun of riding a bicycle. If you want to buy just a single piece to try it out, get padded shorts. It doesn't have to be Pearl Izumi, a $30 sale will do nicely.

A word about prices: I haven't found significant price differences for bicycle components in different European countries and the US, except that locally made components are sometimes (Specialized) but not always (Campagnolo) somewhat cheaper. Clothing is an exception, it seems that end-of-summer sales go down to half as much in the US than here in Germany. At standard retail prices though, at an approximate US$/Euro parity, the USA tend to be more expensive than Europe.

Finally, after all that maintenance, we might actually want to ride the bicycle to have a chance to get it dirty and do the maintenance all over again. This chapter is even more subjective than the others; it contains some rules I have found useful but that may not work for everybody. I rode in many places in the world and have found some basic rules that work for me.

Riding in Town

Now this depends very much on the town, but I have found that it is safest to ride assertively but not aggressively. This means:

- If there is a bike lane, use it, unless it's unusable because of glass, potholes, or parked cars. If there is a bike path, don't use it, unless it's visible from the road at all times (especially near intersections). Accidents mostly happen at intersections when car drivers watch for cars but not for bicycles when turning right. In Brandenburg, use bike lanes if possible because roads are narrow and drivers are dangerous. Also, bike lanes are usually newer than the roads and have a smoother surface.
- Always keep at least one meter between you and parked cars. You never know if a door suddenly opens, or if you have missed one of those hydraulic platforms installed in the back of lorries that are just at eye level when raised - I have this mental image of the upper part of my skull slipping across the lorry floor while the rest of me rides on. Drivers are required to place flashing lights or red cones on the edge, but I won't bet my life on it.
- Don't ride at the right edge of a lane. Ride in the center or at least about one third into the lane. This tells drivers that they must change lanes and they can't just squeeze by closer than the 1.5 meters required by (German) law, recently increased to 2 meters (OLG Hamm). The rare maniac will still pass too closely but at least you'll have room to escape.
- Don't weave into and out of a lane. If there is a gap in the line of parked cars in the right lane, don't use it and stay in your lane. It may be dangerous to return to that lane, and car drivers may not give you an opening.
- Only pass to the right of cars stopped at a light or elsewhere (legal in Germany) if this doesn't force all these cars to pass you first thing afterwards. It'll annoy them and you don't want lots of annoyed people to shoot one ton of steel each past you. This doesn't mean that you have to play the traffic jam game that seems to please car drivers so much that they play it every day. I draw the line at about five cars; if there are more I pass unless there is a narrow stretch of road ahead. If I wait behind stopped cars I always stop in the center of the lane, to prevent cars from boxing me in.
- In a situation where a car might turn and cut you off because they haven't seen you, some people recommend making eye contact with the driver. I don't think that is good advice because you can't make the driver look at you - and if he did, there would be no danger. Instead, watch his front wheel. You'll notice when he slows down because the front of the car dips a little, and you'll see a turning wheel long before the car actually turns into your path.
- It may be hard, but be friendly. Let that car that followed you patiently pass when there is a chance. If there is a whole line of cars backed up behind you, stop and let them pass at the next opportunity. Don't pass buses as they prepare to reenter traffic. In short, don't make anybody mad - they have all the kinetic energy on their side, and you are not going to "educate" anybody.

- Use lights at dawn, dusk, and night. An LED flasher makes you more visible because it catches the eye between all those lights in a city, but it also makes it more difficult to pinpoint your position. Ideally, use both regular and flashing taillights. Very strong headlights gain you a lot of respect because at a distance, people think you are riding a motorcycle. Most of this isn't legal but I'd rather be alive than legal...
- Don't ride on sidewalks, parks, and pedestrian zones where riding is not legal, or if you must, ride at walking speed. Pedestrians are unpredictable (especially if you ring your bell, don't even try), and you'll annoy or endanger a lot of people for a few seconds gained - precisely what we always accuse car drivers of.

The best front lights I know are made by Lupine. They are massively expensive but I consider my health more important, and these guys really know what cyclists need. Among other things they manage to put a three-level menu structure into a penny-sized control panel sporting one button and four LEDs that lets you program light levels and battery control. Unfortunately it is now hard to find because it seems to violate some traffic regulation, and Cateye has sued them. One thing is certain, I won't ever buy Cateye again - a company that must rely on its lawyers rather than the technical quality of their product to push competitors out of the way isn't someone I'd trust when buying equipment!

Bicycles have the advantage of being able to go anywhere and be parked anywhere, unlike cars. 30% of the car traffic in downtown Berlin is looking for a place to park, and the average speed between entering and leaving a car is 17 km/h (which isn't even bad as big cities go, in Paris it's 11 km/h), for example. While a stolen bicycle is usually less of a loss than the damage done when a car is broken into, a bicycle is much easier to steal unless properly locked.

Forget spoke locks, cable locks, combination locks, or simple chains. I prefer motorcycle locks by Abus or Trelock that consist of a steel cable protected by interlocking rings. The idea is that you need two sets of tools, a saw for the rings and a bolt cutter for the cable. Of course, you need to lock the bicycle to something that is at least as solid as the lock. Some of those bike racks are ridiculously easy to disassemble. Those motorcycle locks reach around most lampposts, and they can comfortably be worn around one's waist. U-lock holders rattle. The keyhole of the lock should face down if it's on one side to make it harder to reach for people with drills, and it should not lie flat on the ground so that a hammer could be used.

Riding Long Distances

The key to long-distance riding is preparation. You will need:

- A repair kit, at least one spare inner tube, a pump, tire levers, allen wrenches, a spoke wrench, a cellphone or coins, and money to take the train if all else fails. Riding long distances means that it is impractical to walk home.

- Plenty of food and water. Don't under-estimate this. You need to eat and drink all the time, *before* you feel hungry or thirsty. If you don't your thighs will feel like they are on fire and in the worst case you may get tunnel vision and collapse. People normally never reach the point of running out of fuel in their daily life but it's a real danger on long bicycle rides. I will fall apart after about 80 km without food, so I eat and drink at least every 20 or 30 km. Don't start in the morning without breakfast either.

  I take plain water (anything else gunks up the bottles) in one or two large (0.75 l) clear-plastic bottles, Power Bars or similar energy food, plus some whole-grain sandwiches. Do not take chocolate or other sugar-based food. On seriously long rides also take some salted nuts because sweating depletes minerals. Plus, of course, the staple of bicycle riding - bananas.

- Maps, of course. If you ride in a group you may get separated, or you might take a wrong turn and lose your bearings. The best scale is between 1:100,000 and 1:250,000. A compass is necessary in foreign countries.
- Clothing. If there is a chance of rain or cold weather, wear neoprene boots (imho, Adidas are best). They don't hurt if you don't need them but they'll keep you warm and dry. Since you don't normally move your toes while riding, cold feet are much more of a problem when riding than when walking. Also bring a raincoat and wear layers of clothing that let you adjust to the weather (Odlo shirts, for example, are very thin and lightweight but warm if worn underneath). Multiple or thick wool socks have never worked for me, they just make the shoes fit poorly.

Another key to long-distance riding is to deliberately ride slowly. It's enough to ride two or three km/h slower than you would ride normally. This takes constant conscious checking because your legs will want to go back to your "regular" speed. It's surprising that such a small speed reduction makes such a big difference, but 3 km/h less than normal extends your range enormously while 3 km/h more than normal will render you comatose.

Riding in a Group

With group I mean a peleton, a tight group of riders that follow some rules to optimize efficiency. A group achieves a much greater speed than a single rider with the same effort. It does require that all riders are in roughly the same shape. Small differences can be compensated by letting stronger riders spend more time in front, which takes the most strength because they are the only ones who feel the full force of the headwind.

When I ride in a group we ride in two columns. Everybody keeps a distance of about 1/2 wheel diameter to the rider in front to catch as much of the draft as safely possible. When the riders in front get tired, they accelerate a bit, go to the sides (one a bit ahead of the other to avoid having four bicycles side by side), and let the group ride through the gap. (Obviously this works better if there is an even number of people.)

Some groups regulate how long people stay in front, and some use a rotating peleton where the left column is slightly slower than the right. The right rider in front shifts over to the left column after a (very short) time in front and falls back. This makes it hard to talk though.

- The key to riding in this way is keeping the speed absolutely constant. A gap of 30 cm at speeds of 40 km/h does not leave a lot of room for error. This means that
  - you watch the rider in front of you while keeping your eyes on the road ahead; never stare at the wheel.
  - never, *ever* brake without announcing it with the agreed-upon hand signs well in advance, it's better to break out of line than to brake in emergencies.
  - accelerate and decelerate very slowly if the terrain changes; remember that the group doesn't reach the incline or dip all at the same time.
  - don't suddenly stand up because that shifts the bicycle backwards as your center of gravity moves forward.
  - it helps to put a hand on your neighbor's shoulder when turning to look back to avoid swerving.
- Similarly, it's important to always ride in a straight line because the front wheel of the rider behind you might overlap your rear wheel. If you make a sudden move to the side, you could kick his bicycle out from under him. If the rider in front of you does this to you and your wheels touch, steer into him *hard* - the worst that can happen to him is that you displace his wheel, but the alternative is crashing and having the rest of the group run over you.
- If you are in front, use hand signs. Otherwise, immediately duplicate the hand signs of the rider in front of you even if you can't see the obstacle yet. We use the following signs:
  - point with your index finger at potholes or other obstacles, even if they seem harmless because they might surprise riders behind you. Remember, they usually can't see much of the road in front of them. Call out "hole", "glass", or "tracks". Railroad tracks are dangerous.
  - if you need to shift the paceline because the road narrows or you need to pass bicycles or parked cars, wave your palm behind your back towards the side you want them to go.
  - raise your hand if you plan to stop or brake. Never brake without announcing it first.

  Remember that when you are in the front position you take responsibility for the entire group. You are their eyes, and you have to think ahead for all of them. For example, don't blast through yellow lights because the last riders will be forced to run a red light.

- Before getting seriously tired in the front position, accelerate, move to the side, and wave the following riders through. Always wait for a wide stretch of the road. Don't do this at a dangerous or difficult place such as a steep incline, dip, or curve. Don't wait until you are completely wasted - you will have to accelerate to

catch up when everybody passed you, and the following riders may want to go faster than you did.

- If you are in the second row and the front row begins to fall back, do not accelerate. Maintain the previous speed until the group has reassembled into two columns.
- Always stay abreast with the rider next to you.
- Don't ride too closely to the edge of the road or parked cars. If you miss an obstacle or a car door opens, there will not be enough time for the entire group to react.
- Choose the rider you will be riding next to - if he is stronger than you he'll give you hell when you are in front; if he is weaker than you he will want to leave the front just as you begin to enjoy yourself.
- Also choose the rider in front of you carefully. If he can't keep his speed constant you'll be on full alert all the time to compensate his speed changes to keep the entire paceline from fluctuating. Also you will need to keep more distance for safety which reduces the advantage of drafting; you'll feel more headwind. It's best to choose the most experienced rider. Riding in the right column is slightly easier, but riding in the left column offers room to escape in emergencies.
- In my experience, if the group splits for any reason when some riders race ahead or others fall back at a difficult section such as cobblestones, always stay with the front group even if it's much harder than staying with the slow group. The reason is that the slow group will have to catch up while the front group takes it easy to allow them to catch up, and when the group is back together there will be those who just got a chance to relax and those who had to catch up, and guess which one is better. Having to catch up for any reason takes more strength than anything else, especially because you usually won't have the benefit of drafting somebody to avoid or reduce the headwind.
- Speaking of cobblestones (we still have a lot of these here in Brandenburg): ride as fast as you can without bottoming out on the rim. Your forearms may go numb, but riding slowly will make for a bumpier ride. If there is any risk of cobblestones, choose a steel bike - our group always gets divided into the steel riders in front and the aluminum riders in the rear. See previous point. This assumes road bikes; fat-tire riders won't have a problem.

When I started riding I was always puzzled how good riders seemed to be completely unaffected by short hills - they just kept riding at the same speed while I was slowing to a crawl. Today I know how it's done: riding longer distances is done with low effort, leaving plenty of reserves for short sprints. Low effort can mean only a few km/h or mph less than usual because wind drag increases so sharply with speed.

Finally, we must address the important question why some cyclists shave their legs (but not their arms or head). This has been vigorously discussed to death on various lists and newsgroups. The conclusion is that there are three reasons:

1. The official one: it significantly reduces air drag by a factor X, where X is very very close to 1.

2. In case of a crash, no hairs will mess up and infect the wound. (The infection will be taken care of by the dirt on the road instead, or by the unshaved arm wound.)
3. Elitism. That guy with the hairy legs is obviously an amateur who cannot be taken seriously. He sticks out like an AOL address on a Linux kernel mailing list.

Personally I think only one of the three explanations holds water.

Packing list

This packing list is definitive. It has been proven on many trips. Every item is essential even if it may look marginal. I never carry cooking gear, you may choose to. Travelling with as little weight as possible is essential. The list adds up to about 11 kg, plus 1.5 kg for the optional tent. The clothes list requires a laundromat about once a week. It includes one non-bicycle outfit. The list also assumes that you, like me, prefer to stay in campgrounds (avoid those without hot showers) or youth hostels.

- **Bicycle**
  - Pedals (I unscrew them when shipping the bicycle)
  - Saddle (ditto)
  - Pump
  - 2 inner tubes
  - 1 foldable tire
  - 2 plastic tire levers
  - Patch kit (make sure glue hasn't dried up)
  - Allen wrenches (4/5/6 mm; 7 mm for older and 8 mm for newer Campagnolo cranks)
  - 15 mm cone wrench
  - Chain tool
  - Spoke wrench
  - Cassette tool to unscrew cogs
  - Spare spokes, one of each length
  - Spare brake and shift cables
  - Lock (key type, not combination; not a simple cable)
  - LED rear light with fresh batteries
  - Swiss army knife (of course)
  - Narrow duct tape
  - Cable ties
  - Helmet
  - Spare Allen screws and washers for the rack
  - Chain lube
  - 2 large (0.7 liter) water bottles
  - First aid (desinfectant, band aids, something against skin irritation)
- **Luggage and personal**

- Sleeping bag (water repellant, inside flap over zippers, black on the outside, lightweight, as small as possible)
- Sleeping bag container bag, stuff with clothes at night to make pillow
- Isolation mattress (full-length therm-a-rest is best by far)
- 5 textile straps, 1.5 meters each, with locks to secure bags and to string them together to make a clothesline between trees
- Rear panniers (reducing baggage is better than front panniers too)
- Waterproof Bag (Ortlieb) that holds everything at night and sleeping bag while riding
- Waist pouch for camera, wallet, keys, maps
- Lightweight personal tent and lightweight aluminum stakes (*not* steel wire stakes), not required in some areas
- Hand-wash detergent
- Two small towels are better than one large towel
- Tooth brush, tooth paste
- Sunscreen lotion
- Battery shaver with cable and power outlet adapter
- Soap bar in a plastic container, shampoo
- Small roll of toilet paper
- Padlock for youth hostel lockers
- Earplugs for sleeping in youth hostels (you and the guy who snored will be the only ones who got some sleep)

? **Clothing**
- Walking shoes or sandals
- Riding shoes with cleats
- 3 padded bicycle shorts
- Unpadded long bicycle pants
- Water-repellent long-sleeved jersey
- Water-tight raincoat (preferrably with rubberized inside)
- 2 jerseys (sleeved or sleeveless depending on area)
- 2 T shirts (one for sleeping in and one for non-bicycle activities)
- 7 pairs of socks, not too thick, short
- 1 pair of tight-woven wool outer socks for extremely cold areas
- Non-bicycle long and/or short cotton pants plus underwear
- Warm fleece jacket
- Bicycle gloves
- Bicycle sunglasses

? **Documents**
- Maps (see below)
- Cash, including small bills and coins (USA: quarters)
- Traveller's checks in small denominations ($20)
- Credit card (Eurocard/Mastercard is best, Visa and American Express is ok, avoid anything else)
- Eurocheque card or ATM card valid in the country (if you have one, traveller's checks are optional), make sure there is enough money in the

account. Avoid using your credit card for ATM withdrawals, the fees can be staggering.
    - Retractable ball-point pen
    - Passport or European ID card as required (with picture), visa
    - IYH youth hostel membership card (if you don't have one, get one!)
    - Proof of health insurance
    - Travels into the USA: hotel address (see below)
- **Miscellaneous**
    - Small automatic camera, film for the entire trip
    - Knife, fork, spoon
    - Plastic bags for storing things waterproof
    - Lighter
    - Small flashlight

The best maps for France are yellow Michelin maps. For Germany, use blue ADFC maps. Both are widely available in book stores. For the U.S. west coast, you *must* have the bible: *Bicycling the Pacific Coast*, Kirkendall and Spring, The Mountaineers, ISBN 0-89886-232-9, $12.95. This book is absolutely essential. You might make scaled-down xerox copies of the relevant pages of the appropriate *Let's Go*, published by Harvard Student Agencies.

Immigration and Customs

EC members do not need a passport for EC countries and most European non-EC countries. I am told that non-EC members should check the visa requirements for each individual country. Entering the USA requires a visa. Germans and others get it at the first destination airport, make sure you get the *green* form. Bring a pen.

The immigration officer will ask for your U.S. address, give him one even if you only stay the first night there. On the customs form, declare food (fruit, sandwiches, anything) correctly, they are very strict about this. You will have to check you baggage at the first airport even if you have a domestic connection flight. By all means avoid New York's JFK airport, it has never worked and never will. Last year my non-stop Delta flight made a stop in JFK and promptly got stuck in the take-off line for four hours. I was lucky.

Beware of Tokyo. Most countries have a baggage weight limit of 36 kg. Japan has a weight limit of 20 kg. Easy to get in, extremely expensive to get out. I once paid $280.

If you buy parts during the trip, think hard before trying to smuggle them past customs back home. I have once imported a bicycle frame, and the customs officers knew *precisely* what kinds of frames Cannondale makes and what they cost, they had all the catalogues. They do not believe shop receipts. You wouldn't believe some of the things I have seen in the customs offices. I am really glad that I properly declared that frame...

Good and Bad Airlines

Airlines to use: KLM, Lufthansa, Air France.

My preference is KLM - punctual, competent, friendly, with good connections and good prices. I also like Amsterdam; it's easy and fast to go from Schiphol airport to Amsterdam Centraal station. I hate being stuck in some boring airport in the middle of nowhere. Lufthansa and Air France are efficient and work well, they just don't manage to give me quite the same feeling that I am welcome as KLM does.

I am sure that there are more airlines that fall into this category, but I have not used them, or not often enough to generalize here.

Airlines to avoid: British Airlines, Delta, TWA.

An unreliable, incompetent, and unfriendly airline can ruin your trip before it starts. British Airways, for example, is lucky if it predicts the departure *day* of its flights correctly. Expect to sit for the better part of the day in some cramped departure area because they can't rebook, can't let you leave (or they will remove your baggage "for security reasons", funny how the other airlines do it), can't give you any information, or, usually, can't be found. You need some enormous amount of business class mileage (the only kind that counts) before you get a card that entitles you to decent treatment, and until then you have to suffer their abuse. Flying Delta is similar, except that in addition to not knowing *when* you arrive you get the additional thrill of not knowing *where* you arrive, absolutely free. TWA does their best to compete, they consider their responsibility for you over when the plane touches the runway. These three airlines are on my blacklist because each delayed me for over 24 hours at least once.

The common denominator here is that employees may be friendly but have no clue what to do if something goes wrong, and consequently prefer to disappear when you need them most, and things go wrong frequently. Who cares if you stay half of the night in the airport, dodging cleaning crews in poorly lit halls, trying to figure out where the bus to the hotel leaves.

Generally, don't use U.S. airlines because they will want to shuttle you through their hubs, which frequently means missed connections. I had to stay overnight in airport hotels several times already. And, I do not warn about an airline here if a mistake happened once, only when it happens more often than not and I become convinced that it's a systematic problem.

General advice: Do not forget to ask the airline - not the travel agent - whether the flight uses aircraft large enough to hold a bicycle. Most airlines (not British Airways) accept advance seat reservations. Order a vegetarian meal if you fly economy because while the other passengers try to eat their rubber chickens or rancid lasagna you'll get (more or less) fresh fruit and vegetables. Don't do this in business class; the food there is ok and if you order vegetarian you may get economy fare! If you fly economy, bring earplugs and eye covers, and get a window seat so you can sleep. I always stay the night before an intercontinental flight awake to avoid jet lag. Exit rows are spacious, but do not get a

window seat in an exit row of a widebody jet (Airbus 320, Boeing 747) because the emergency slide box will leave you almost no space for your legs. Several times already I had to repair the video screen of my (business class) seat because some connector shook loose, so bring tools and some spare wires or paper clips :-)

Shipping Bicycles by Train

You can usually take bicycles with you on the train, except on ICE (high-speed) trains [I hear ICEs accept bicycles now]. In theory space is limited but in practice this has never been a problem for me. For trains that cross borders it's more complicated: some trains (usually the slow ones) accept a limited number of bicycles (between 4 and 60 depending on the train; reservations are strongly recommended) but many won't, so you will have to send them ahead a week earlier. They will tell you it takes three days but always multiply by two. I have once lost a day in Paris because a bicycle was late.

German Railways (Deutsche Bundesbahn) has a very helpful brochure (``Bahn&Bike, Fahrradmitnahme im Fernverkehr'') that lists all international trains that you can use with bicycles (as opposed to sending them ahead), conditions and prices for various European countries, bicycle rental at train stations, and lots of other useful information. German Railways also has a hotline, 0180-3194194, normal business hours only.

I have only once used a train in the US. Prices are unreasonably high, travel times are enormous, and service is very spotty. It's just not an option. The one exception was my Crater Lake tour, where we went from San Francisco to Klamath Falls in Oregon because only small planes that do not carry bicycles land there. It was painfully slow and not very comfortable for sleeping but otherwise a pleasant surprise; I may try it again on future trips.

Shipping Bicycles by Air

To ship bicycles overseas, I used to use a fiberglass box. It has made some 40 trips now and it is cracked in many places. Baggage handlers have managed to bend the 1/2 inch steel rods inside and smashed all four wheels. I have also shipped bicycles in airline-provided cardboard boxes, which seems to work surprisingly well considering the damage to the fiberglass box. I always take off the pedals and the seatpost with saddle, on the theory that this makes it harder to ride it off. I also take off the rear derailleur and tape it to the frame, a bent dropout would be the end of the trip. The handlebars must be turned sideways. (Bring tools to do all this.) Always let most but not all of the air out of the tires or some physics-impaired baggage handlers might do it for you when you aren't looking. If you ship bicycles with the wheels removed, put spacers into the dropouts, you can get them for free from bicycle stores.

Recently I have been sending bicycles without a box because my tours began and ended at different airports. The airline usually requires you to box the bicycle in a cardboard box that they are supposed to have in stock but often don't. If they don't you'll have to ask other airlines or talk them into accepting the bicycle without a box. Bring a wide felt-tip

marker to paint the destination address and your name on the side of the box. There is a risk of having wheels bent, paint scratched, and dents in the tubes, but so far I have been lucky. Allow one hour at the airport for boxing! Believe me, you'll need it.

International flights allow two pieces of baggage, one of which may be a bicycle, if the combined weight does not exceed 36 kg. Tell the airline that you have a bicycle with you, some shuttle flights use small aircraft that don't have room for bicycles.

Panniers

Panniers are bags that hang to the sides of the rear or front wheels. Make sure they are reasonably waterproof and have side pockets for things you'll need frequently, such as maps. The only perfectly waterproof bags I know are Ortliebs, but they have no external pockets to avoid seams. I have agusport Quorums, which come with waterproof covers. My bags are fairly large but can be compressed or expanded by adjusting the straps.

Avoid zippers that are too small, or better, avoid zippers altogether. They tend to tear after a while. Also avoid straps sewn into the bag that hold it to the rack; no seam should carry any load or it will tear eventually. Bolted-on hooks work better. Make sure there is a clamp that holds the bag to the rack; a pothole might otherwise throw off the bags.

Some rear panniers are attached to each other, forming an upside-down U shape. This makes them much easier to carry over one's shoulder. My previous bags (Robens 1000 Kilometer) were of this kind, and also included a detachable backpack (a *very* good idea), but unfortunately they had lots of flimsy zippers and seams and so only lasted some 15,000 km.

I do not like front panniers because I do not like weight on my front wheel that makes steering more sluggish. I prefer packing less instead. If you ride very long distances (>2000 km) in cold or wet areas where doing laundry is impossible, you may need to pack so much that you have no other choice though.

Unless you decide to buy Ortlieb bags, pack everything into plastic bags. This makes it easier to find things, too. I usually pack all clothing into the right bag, and tools, maps, and other items into the left bag. This leaves space in the left bag for food, and it ends up smaller than the right one, allowing a better view from my bar-end mirror.

I always travel with an extra cylindrical Ortlieb bag on top of the rear rack that holds my sleeping bag and other things that absolutely must stay dry.

This is a report of an accident I had in October 1996 in Berlin, and the legal procedures that followed. It may be specific to German law, but I expect that it will be applicable elsewhere too.

After the accident

It had never happened to me before, but on October 5 1996 I got buzzed by a car. Normally cars leave sufficient space when passing, and the first one did that after the light turned green, but the second passed me at an extremely close distance, got in front of me, and braked with squealing tires. All for no apparent reason, no other car was in sight. I was riding at the speed limit (30 km/h, it was a small residential street), about one meter from parked cars.

A car can stop faster than a bicycle because it can safely skid all four wheels, and at a distance of about 30cm there was no chance of stopping in time. I locked the front wheel and flew over the trunk of the car, hitting the edge with both knees and the top rear window edge with my helmet. The driver got out, threatened to sue me, and got the police.

Rule 1: wear a helmet.

In this situation always call the police. It's free and you can't know the damage to you, the car, and your bicycle, and later claims are messy if there is no police report. You'll have to deal with insurances (mandatory for car drivers in Germany), and insurances are in the business of not paying if it can be avoided. Anyway, the police came, collected IDs and reports from everybody involved, including two witnesses (I was lucky here, they saw the car passing and heard the wheels squeal). While waiting for the police, I was asking the witnesses to stay; they were in a hurry but felt it was their responsibility to stay. The police later wrote a favourable report based on the witness reports.

Rule 2: always call the police.

Also, make sure that you get the reference code from the police, information about your opponent's insurance, and the names and addresses of your opponent and the witnesses.

After the formalities were completed, one of the policemen recommended that I go to a hospital immediately. I felt fine, except for pain in my knees and a mysterious inability to ride home. So I walked all the way to the hospital, where they told me that my kneecap was broken into three pieces and I'd have to stay. I guess I was under shock since the accident: everything seems ok but that is just because your brain is censoring all serious damage. After an accident you are *not* able to judge the severity of your injuries.

Rule 3: see a doctor.

In the hospital, the first thing I did was take a piece of paper and wrote down exactly what happened. I figured that the legal procedure may take months (it did) and I'd have forgotten all the details by then. The witnesses, in fact, were later unable to elaborate on their initial reports.

Rule 4: write down what happened.

Well, they cut the knee open, put some screws in, kept me for a few more days, gave me crutches and I was back to work. Bicycle riding was out for several months. They'll want to remove the screws after nine to twelve months; I'll have that done when the summer is over. Anyway, I requested and got a detailed report from the doctors about what was wrong and what they did to fix it. They also said that permanent damage cannot be ruled out, which I thought was important to have in the report.

Dealing with insurances

You'll have to deal with two insurances. Your own health insurance will send a form asking whether the surgery was the result of an accident, and if so, the name of the driver's insurance. My health insurance was obviously getting ready to reclaim the cost.

The more difficult part was dealing with the driver's liability insurance. I figured I'd have no chance without a lawyer. (If you need one in Berlin, try Axel Bosselmann, tel. 8811070.) The lawyer first requested the police report from the police, contacted the witnesses to get more information (without success), and announced claims towards the driver's insurance. He also asked for the doctor's reports, copies of all documents exchanged, and receipts for taxicab rides and other expenses. It took him months to get the insurance to approve the claim.

Rule 5: get help from a lawyer.

Well, I am not sure what I would have done if the situation had been less obvious because I won't be able to reclaim the lawyer's fees from anybody. Still, the money I got so far made the rather low lawyer's fees an excellent investment. I didn't get the bill yet but I was told to expect between DM 250 and 400 (US$ 140..230). Lawyers' fees are regulated in Germany, and working on a contingency basis is not allowed.

Eight months later, the insurance (Allianz, btw) paid DM 6000 (US$ 3450) as an advance on damages (for my injuries, inexplicably there was no significant damage to the bicycle). I did not agree to settling the claims until at least the second surgery. I was told that sometimes injuries cause problems many years later, and I should not finally settle my claim.

The criminal trial

The form the police sent me to report my view of the events contained a note that said ``check here to start a criminal investigation''. Since I could never accept the fact that we kill nearly 10,000 people a year in traffic and injure more than half a million (nearly all of them by cars), I figured I'd do something about an obvious threat to public safety and checked the box.

At the end of May, eight months after the accident, I got the summons for July 8, to appear at the trial as a witness against Mr. Lutz-Günter Hennig, the driver of the car. That was today. After waiting for about an hour (I am glad I brought a *;login:* magazine) the

trial started. At first, Mr. Hennig was alone with the judge, the state attorney, and a scribe; later I and the other witnesses (including one of the policemen) were called in and were told that Mr. Hennig had admitted to the facts stated in the police report and we weren't needed and were free to leave. Of course I stayed until the verdict.

A criminal trial means that it is handled by the state attorney, not by me. I was a witness like the others and didn't need to bring my lawyer or submit any documents. Also, not only did I not have to pay for anything, but I would have been reimbursed for travel and other expenses (I didn't bother).

Mr. Hennig was found guilty of physical injury resulting from negligence (*fahrlässige Körperverletzung*). He was sentenced to a penalty of 20 days' salary, *and* the cost of the trial. (If he had won the state would have paid for the trial.) Also, I expect that the cost of his liability insurance went way up; car liability insurances are pretty good about reclaiming costs with raised premiums. Premiums vary by factors of five or more based in accident history. In addition to all that he probably had to pay civil penalties. According to StVZO §15b, he may also have earned six points in the Flensburg database. When reaching 14 points a driver may lose his license, with 18 he *will* lose his license.

All in all, this worked out very well. I am still stuck with a knee that is not fully functional (still can't climb as I used to), but it was made extremely clear to my opponent that his behavior was not acceptable. With a bit of luck he won't be able to afford a car now, which means he won't be able to again contribute to those accident statistics.

(Today, two years later, the injury has healed.)

Still, watch out for a dark red Honda Civic with the license plate B-CL-1844.