



Our readers continually ask us, "How do you do it? How do you scrape the undercarriage of a bike in a corner and get away with it? Isn't it too dangerous?" It's not if you know what you're doing. And it's really not all that hard. Besides that, it's fun. In this issue Road Test Editor Jeff Karr, past master of canyon carving technique and no slouch at roadracing, takes the street rider's point of view and tells you how to improve your riding ability to where you'll have to go to the racetrack if you want to go any faster.

Then, in an accompanying story, Keith Code, head of the California Superbike School and trainer of Kawasaki's club racing star Wayne Rainey (among others), takes the racer's perspective. Keith raced competitively in the AMA Superbike series before he began his school for racers. He knows what he's talking about, and he explains how the road affects the way you ride. He is concerned mainly with racetracks and how to get around

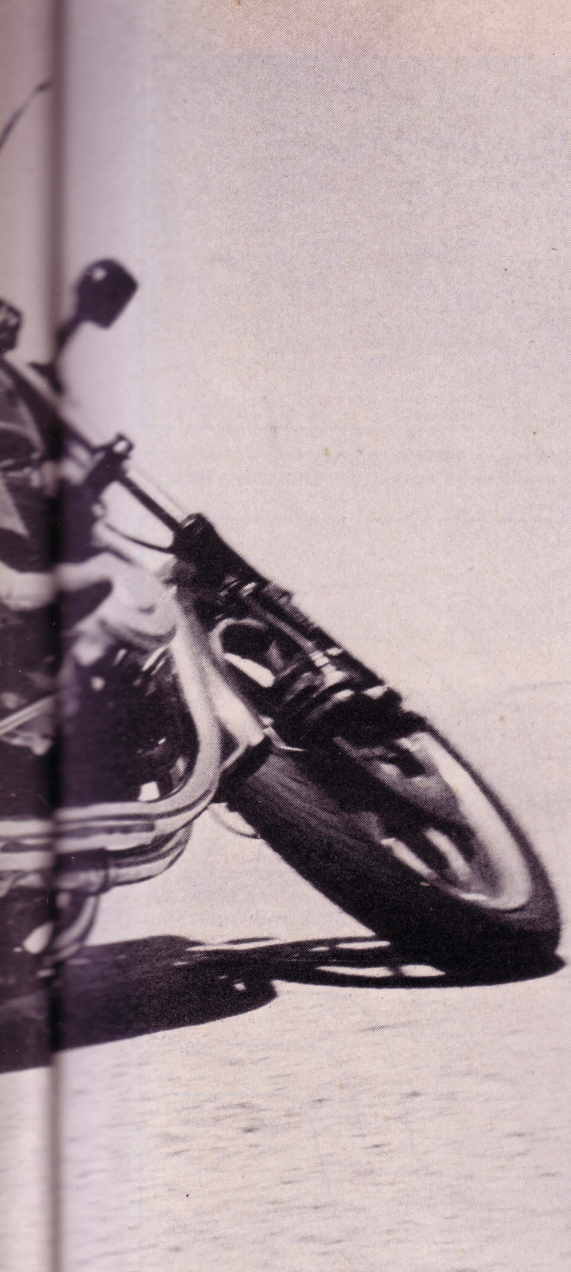
them as quickly as possible, but a stretch of pavement is a stretch of pavement, whether it is Daytona, or your favorite Sunday morning mountain road. Understanding what it does to you and your bike can only make you a faster—and safer—rider.

If you've been a street rider for a few years, at one time or another, you've probably gotten together with a few friends for a little Sunday ride; harmless fun. Pretty soon, the group makes a pass through the nearest section of twisty road. That's where the fast guys are separated from the slow guys. Unfortunately, you're one of the slow guys. While the Hot Shots seem to rip through the corners at horrific speeds, you find yourself floundering, terrified—and slow. What is the fast guys' secret? How do they do it?

This article attempts to answer these questions to some extent. Obviously, words alone can't teach you everything you need to know to go fast

safely. Theory and advice can't take the place of experience and basic coordination. But sound advice can get you going in the right direction, helping you to pick up the right habits and avoid the wrong ones. These words are intended for the competent street rider: the person who is fully in control during normal street riding, but who would like to improve his or her cornering skills to become safer and faster on curvy roads. Faster riders might also find some useful information here, but for the most part, they're probably aware of this information and practice it, or have developed their own techniques that work as well.

This brings us to the much-debated topic, "The Right Way To Corner." There are as many different cornering styles and techniques as there are riders—there is no one correct way for all riders. However, all riders are governed by the same laws of physics, and certain techniques seem to make the most sense when these laws are



er yourself lucky; primo pavement is in short supply. If the genuine article isn't available, you can still learn a lot even if you can only find a few curves in succession. The most important considerations are good pavement, the right posted speed and light traffic.

Once you've found a piece of road that is suitable, you need to make sure that your motorcycle is suitable too. You'll be demanding more of your bike than you normally do, so it must be up to the task. Probably most important are the tires. Fresh, low mileage tires in good condition are an absolute necessity for brisk cornering. Make sure that they're inflated to the manufacturer's suggested pressure. The wheels must be true and balanced. The swingarm pivot and steering-head bearings must be in good condition and adjusted properly. Suspension components must be fully functional and not excessively worn. The same goes for the brakes. The engine must be in good tune, and if your bike has a drive chain it must be properly adjusted. If all this sounds like your bike needs a thorough going-over, you're right. Fast cornering requires that every system and part on your bike perform properly; otherwise, it will be at best a hindrance and, at worst, a genuine hazard. You'll have the best luck if your bike is relatively unmodified. Heavy touring gear can make even the best bikes hard to manage at speed.

You need to be prepared also. A good helmet, eye protection and boots are all mandatory. A tough jacket and pants can save you grief and skin.

Mental preparation is also necessary. Clear your mind of extraneous thoughts, and concentrate on controlling your motorcycle, sensing the in-

formation it is giving you and the commands you are giving it.

That's one of your major objectives: to fully control your motorcycle and to be aware of what it is telling you about its condition in the corner. Most every rider has a clear understanding of how to control most aspects of a bike's operation; there's little mystery to the throttle, brakes and transmission. That stuff is simple. The one thing that isn't so easily figured out is how to steer the motorcycle into and through a turn.

There are several different theories on the best technique. The least popular is the steer-it-like-a-car approach, where you just point it where you want to go. Then there's the knee-pressure-on-the-gas-tank crowd. These guys say that you're supposed to press on the tank with your right knee to go left, and vice versa. Along similar lines is the footpeg-pressure clique. Just push down on the inside footpeg to turn, they say. And of course, there are the body leaners, who simply lean into the turns. Probably the biggest crowd is the riders who really don't know exactly how they turn, they just do it. These guys are using a number of techniques unconsciously, including the best one of all, countersteering.

If you have been able to survive in traffic for any length of time, you are already using countersteering, whether you realize it or not. It is far more effective and efficient than all the other methods combined. We won't delve into the theoretical reasons of why countersteering works; we'll concentrate on the practical applications. It's the simplest of techniques. With the motorcycle traveling along in a straight line at any speed over about 15 mph, a turn can be initiated by light

considered. The techniques and concepts outlined here, therefore, aren't the final word on cornering by any means, but they are a starting point.

While cornering technique can be learned and practiced during the course of normal street riding, the learning process can be sped up considerably if you go out and work at it on a section of lightly traveled, curvy road. This way, you can familiarize yourself with various techniques while avoiding adverse pavement conditions that can complicate the learning process. Trying to hone your cornering ability on oil slicks and chuckholes is considerably more difficult than practicing on clean, smooth pavement. Blind corners and shadows can hide dirt or water on the road, so ride cautiously in these situations. Ideally, a twisting back road with corners, posted for about 25 to 40 mph is best. Spacious run-off areas on the outside of the turns are nice too. If you have a road like this close to home, consid-

# AS THE WORLD TILTS

A Slant for Beginners On Leaning It Over

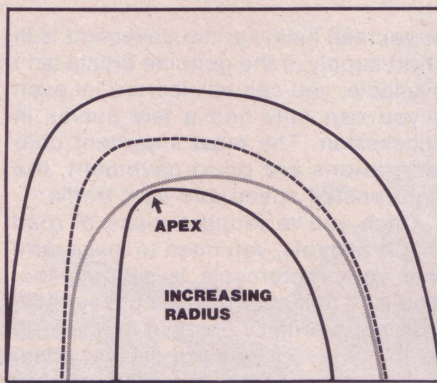
By Jeff Karr

pressure on either side of the handlebar. As a starting point, try pushing the left grip forward for about a second with roughly a half pound of pressure. The bike will bank over to the left and begin a left-hand turn. The handlebar pressure necessary to begin a turn increases proportionally with the speed of the bike. Once leaned over, many bikes will maintain the lean angle and continue to turn with no further input from the rider. Other machines will gradually straighten themselves back up, unless a small amount of pressure on the left handgrip is maintained. A few bikes will actually try to lean over farther and farther once the turn is initiated; this falling-in tendency can be counteracted by applying slight forward pressure on the right handgrip. When the rider desires, the motorcycle can be brought back to a vertical position again by applying forward pressure on the right grip until the bike straightens out. For right-hand turns, the process is just the opposite: pressure on the right grip initiates the turn, and pressure on the left grip brings the bike vertical. An experienced rider using countersteering can snap a bike over to its maximum lean angle with surprising suddenness. Countersteering provides maximum control with minimum effort.

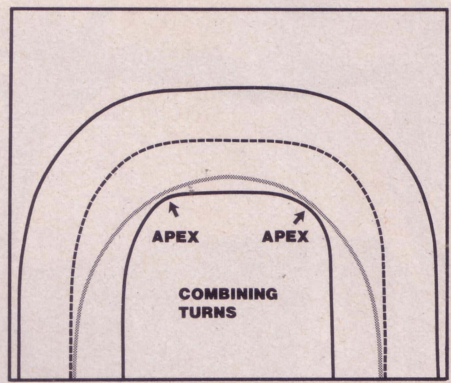
So countersteering is great. What's wrong with the other techniques? Either they don't work at all, or they don't work well. Steering the bike's handlebar as you would the wheel of a car makes the bike turn the opposite of the direction intended by the rider. Since the principles of countersteering still apply, turning the handlebar to the left will make the bike lean and turn to the right, and vice versa. Unfortunately that's just the opposite of what the rider wants.

Knee pressure on the gas tank is utterly useless. You can push on the tank hard enough to dislocate your hip, with no effect on the bike other than a dent in the gas tank. The reason knee pressure *seems* to do something is that in the process of pushing on the tank with your knee, you use the handlebars to keep your body from rotating on the seat. So when you push against the left side of the tank to initiate a right turn, you're unconsciously pushing against the right handgrip to keep your body straight on the bike. Pressure on the right grip? Aha! Countersteering. That is what begins the right turn.

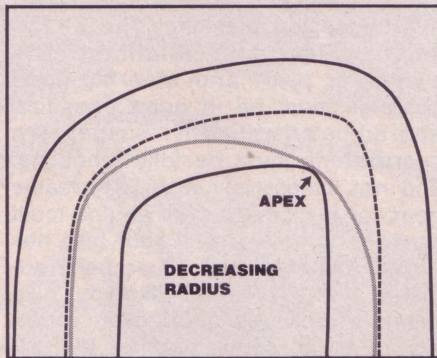
The pressure-on-the-inside-footpeg philosophy has much the same flaw. When pressure is applied to the inside footpeg, the hands are used to hold the body in position on the bike. Left foot pressure results in the rider unconsciously pushing forward on the left grip. Surprise, surprise, the bike banks to the left and turns. Coun-



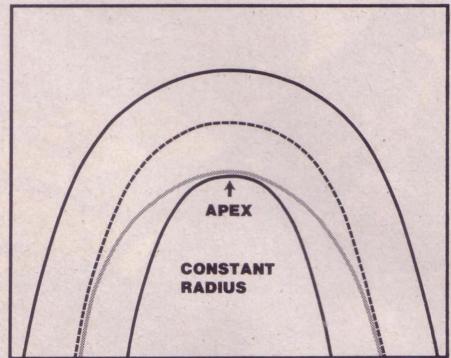
You can make good time through IR turns by apexing early then drifting outside.



Cutting a smooth, consistent arc through turns keeps speed up and saves time.



A wide entrance and a late apex in DR turns is quick, though not the only good line.

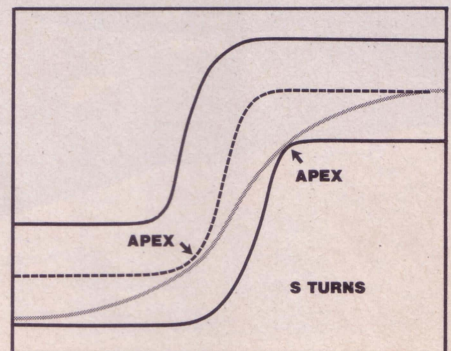


This classic line for CR turns is a cross between the shortest distance and widest arc.

tersteering comes into play again. The only time footpeg weighting works on its own is when the rider's weight is actually shifted to one side or the other, as is possible when standing, or hanging off the side of the saddle.

Body lean toward the intended direction of a turn has a few redeeming features, but is only a fraction as effective as countersteering. The bike responds sluggishly to your leaning inputs and is difficult to control using only lean. Like the rest of the techniques listed here, if body lean has worked for you in the past, it's undoubtedly because you were also countersteering without realizing it.

Practicing countersteering is relatively easy. Make a few passes on your practice road to familiarize yourself with the corners. Now make runs through at a slow, comfortable speed and try to use countersteering to initiate each turn. Push forward on the right handgrip to go to the right and forward on the left grip to go left. Use your normal cornering technique as much as you feel is necessary until you are comfortable with the way the machine responds to your countersteering inputs. Gradually, you should be able to use less and less of your old technique, and more conscious countersteering. You'll find that you have much more control over the machine: it takes far less effort to make it turn, and it responds more quickly and precisely to your inputs. With enough practice, countersteering will eventu-



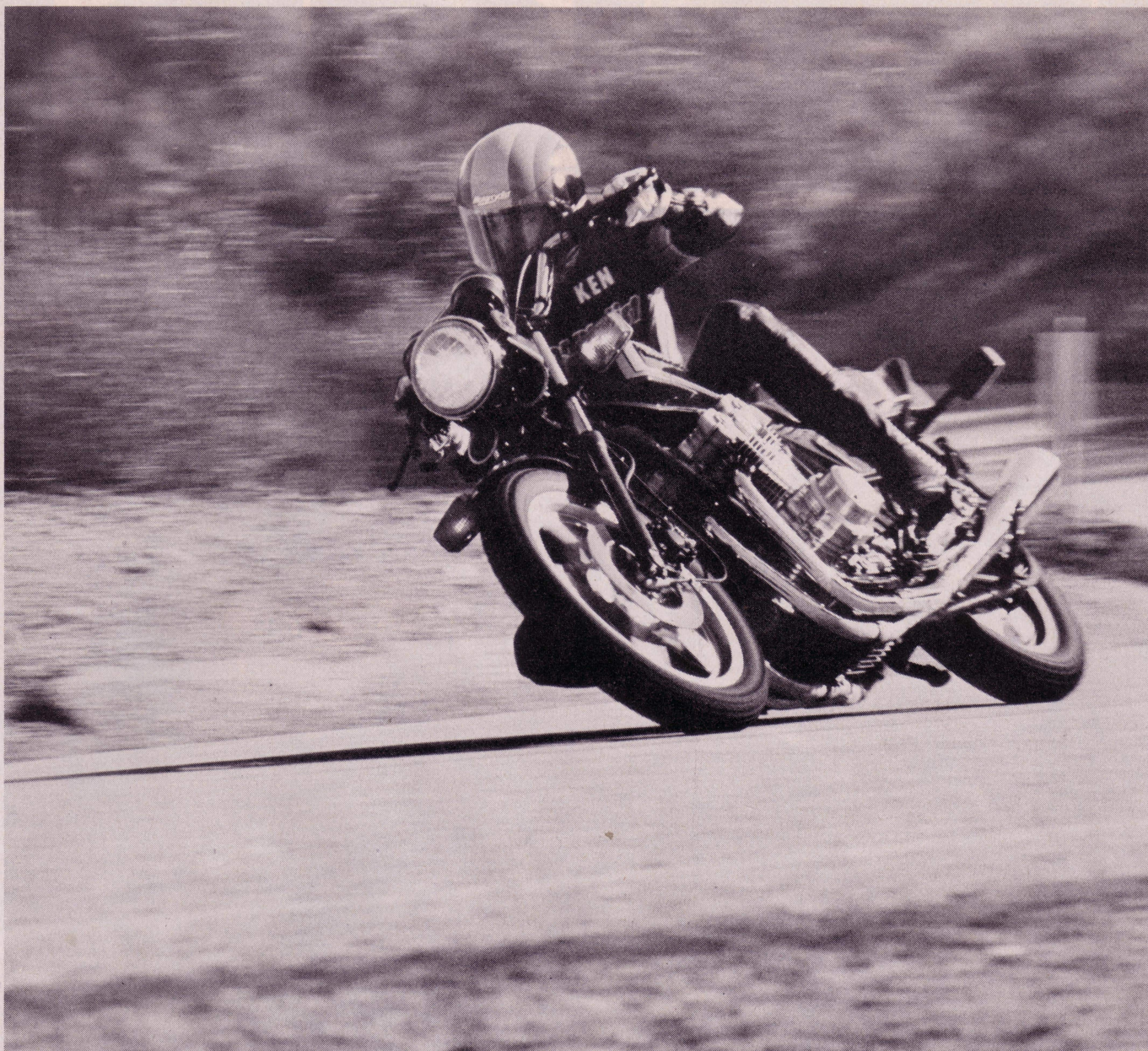
In esses, try to carve as straight a line through as possible, to keep speed high.

ally become your "style."

Now you know how your bike steers and are skilled enough to put it into practice. When you're competent at countersteering, you should be able to follow a 6-inch-wide path through a corner without difficulty.

If you now know how to make your bike stay on your chosen path through corners at moderate speed, you must now figure out exactly what path to take. Learning to choose the right path (or line) through a corner is one of the more important steps in becoming a faster, safer rider.

Selecting the right line is simpler when you consider one of the biggest limiting factors in cornering: tire adhesion. Your bike's tires can only be subjected to a certain amount of force in any of one or several directions before they will run out of adhesion and skid. The amount of adhesion they have can



**It's a good idea to keep your eyes level with the horizon when cornering to prevent dizziness or disorientation. Keep eyes focused well down the road and on your line.**

be as high as one "G" or more under ideal conditions. Sporting-type tires deliver more adhesion than high-mileage touring tires. This means that if the total weight of you and your bike is 500 pounds, it will take 500 pounds of force to make the tires slide. Provided they aren't pushed beyond their load rating, the same tires will just begin sliding with 700 pounds of side load, when used on a bike/rider combination totaling 700 pounds. This force can come in any direction, and is generated during cornering, braking, acceleration, or almost any combination of the three. The tires will slide with 700 pounds of cornering force, or with 300 pounds of braking force combined with 400 pounds of cornering force. Any time the load totals more than 700 pounds (the weight of the bike/rider combination), they cut loose.

Ideally, if you could use every bit of adhesion your tires offer at all times while negotiating corners, you'd be one fast guy. But using all of the traction all of the time is a tall order; it takes years of fast riding to develop a feel for telling just how close the tires are to sliding. For the most part, the only way for an expert to be certain that he is using all the tires have to offer is to push them beyond their limits—until they begin to slide—then ease off just enough to get them hooked up again. This sort of ragged-edge experimentation is for experts only, and should only be attempted on a race-track. Mistakes and miscalculations made under these conditions can have excruciating results.

The problem most inexperienced corner-carvers have is failure to consistently use all the adhesion their tires offer them. They brake for turns too

soon, then don't use the brakes as hard as traction will allow. They ease off the brakes, then gradually lean over. When they catch a glimpse of the exit of the turn, they whack the throttle open, maybe hard enough to drift the rear tire out. Since they were able to slide the back end, they figure they were really ripping through the curve. Actually, they were using only a fraction of what the tires had to offer, except for the one moment when they got on the gas hard. By using a consistently greater average percentage of the traction available, the same rider could have gone through the corner more quickly and safely. It is much better to use 80 percent of the traction consistently than it is to use only 60 percent through most of the corner, with occasional excursions beyond the tires' limits.

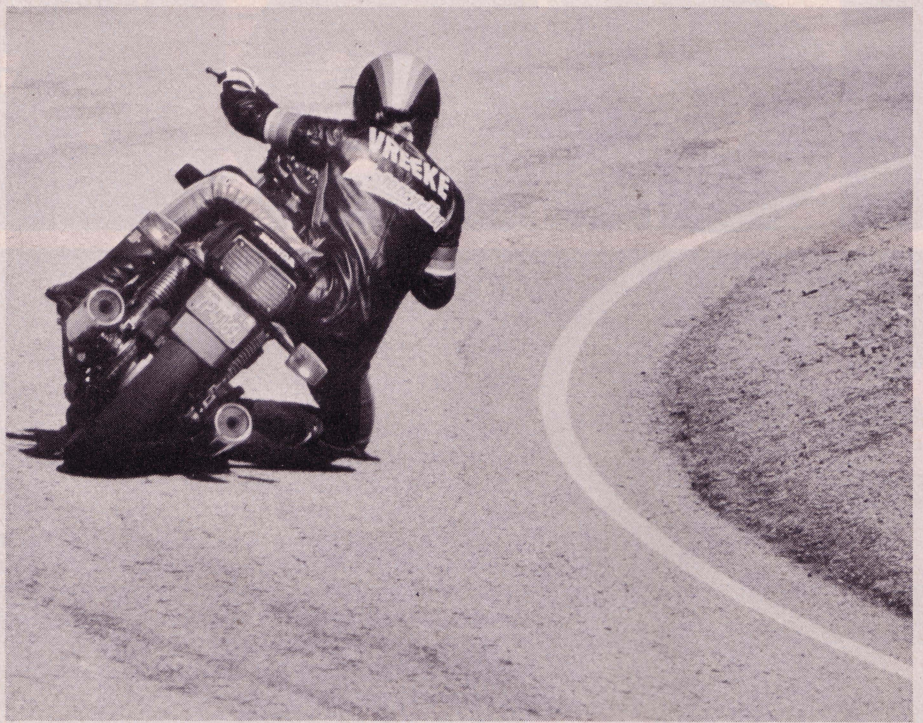
Whether you're a hardened back-road veteran trying to use 100 percent all the time, or an uneasy learner who only feels confident using half of the

traction available, your goal should be the same: to use as much of the adhesion as you're comfortable with through as much of the turn as possible. If you can do this, you can get through the corner smoothly and rapidly. As you progress and begin to use more and more of the available traction, you'll be able to negotiate the same curve at a greater speed.

To put more of your tires' grip to work, overlapping the basic cornering functions is a wise approach. Instead of completely separating braking, cornering and acceleration, they can be partially combined. When approaching the turn, do your hardest braking while the bike is still vertical, then ease off the brakes gently while initiating the turn with countersteering. As the bike leans into the turn, ease off the brakes gradually, finally releasing them completely just before the bike reaches its maximum cornering load. You'll find that with practice, this technique lets you brake later upon entering turns, but still gets the machine down to a comfortable speed by the time it's at its maximum cornering load. Then as you exit the turn, begin rolling on the throttle while the bike is still leaned over, just after you begin to straighten up again. Unless you're on a high-horsepower machine, you can probably be at full throttle before the bike is completely vertical again. Getting on the gas early gives you a headstart on the next straight.

Since your objective is not just to get through one turn, but to go through a whole section of curves as quickly as possible, several factors must be considered when formulating your line through a given corner. The shortest way around a corner is on the extreme inside of your lane. The line along the extreme inside of a turn is also the tightest arc. Tighter turns must be ridden at lower speeds while wider turning arcs can be negotiated at higher speeds. One of the widest turning arcs is at the extreme outside edge of your lane in a given turn. This wide line also happens to be the longest path around the turn. So you can have your choice: the shortest distance at a lower speed in mph, or higher speed with greater distance. Which line works best?

Most of the time, both. Or at least a combination of both. Approach the turn at the extreme outside edge of your lane, then—after most of the braking has been completed—sweep across to almost nick the inside at roughly the middle of the bend; apply power as the bike straightens up gradually and tags the outside edge of the pavement at the exit. You can make a good compromise between the short distance of a tight arc and the higher speed of a wide arc. This technique will get you around constant-radius



**Hanging off only becomes a necessity if you're going fast enough to use up all your ground clearance while riding in the normal position. The object is to get your weight inside.**

turns in good time.

Naturally, there are situations where a different line will be superior. If the turn is followed by a straight of any length, your line should probably be modified to give your bike a higher speed at the exit, even if it forces you to use a bit more time in the turn itself. A couple more mph of speed as you enter the straight will stay with you the whole way. Usually the gain on the straight is worth the loss in the turn.

If the turn is followed by another bend immediately, your line will have to be a compromise of what is best for each turn. If you are negotiating a series of turns followed by a long straight, the final turn before the straight is most important. Take a line that gives you a high exit speed so that you carry more speed out onto the straight.

Up until now, we've only considered the textbook constant-radius corner. In the real world, very few of these creatures exist. Most turns are either increasing- or decreasing-radius bends. Each type of corner deserves a different line.

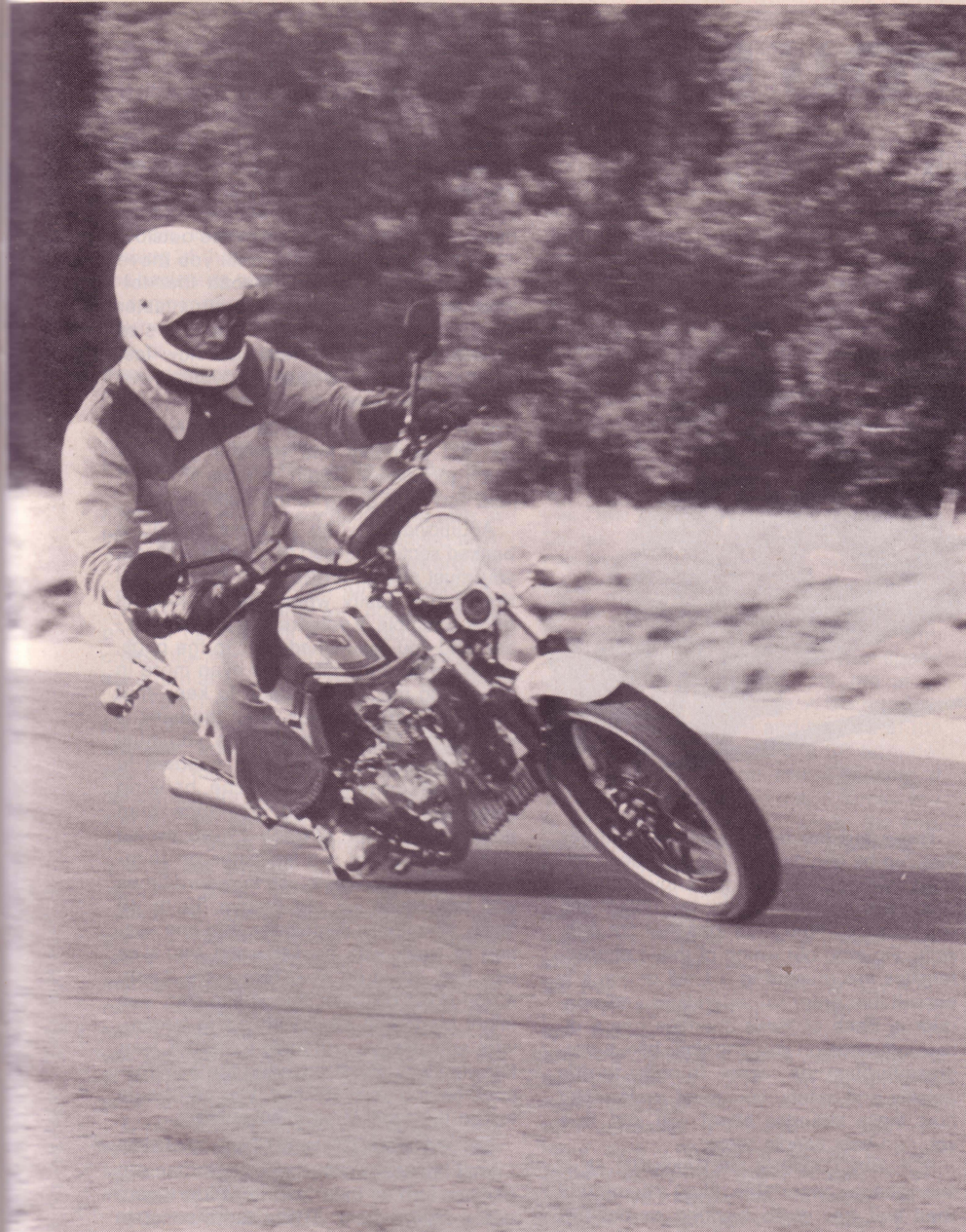
Increasing-radius turns are the sharpest at or near the entrance, the arc becoming more gradual the farther you go. You still enter the turn on the extreme outside of your lane, but you make your sweep to the inside sooner, taking an earlier apex (the point in the turn where you come the closest to the inside). Since this type of turn widens near its exit, you can usually get on the gas earlier than you would exiting a constant-radius turn.

Decreasing-radius turns are just what they sound like: turns that are

gradual at the entrance, then get progressively tighter at the exit. For this type of bend, it's probably safest and reasonably quick to still use the same basic approach, but stay to the outside edge of the lane longer, then sweep to the inside to take a late apex near the sharpest part of the turn. Decreasing-radius turns can be deceiving unless you are concentrating. If you get into one going too fast, you'll find yourself at your maximum lean angle—and suddenly you're out of road. If you happen to be using all of your tire adhesion on cornering alone, you'll have nothing left to use for braking. You'll be forced to straighten up and brake hard, so you'll be going as slow as possible when you end up in the dirt. If you find yourself making a habit of running off the road, you should probably do your practicing at a racetrack, or in a padded room.

For blind corners that you can't fully identify until you're in, the decreasing-radius type line is the safest. If the curve turns out to be a constant- or increasing-radius turn, you can always get on the throttle extra hard at the exit. And if it is a decreasing-radius bend, you'll be ready for it. A side benefit of this line is that it keeps you to the outside longer, where you can see a bit farther around the turn. For safety's sake, always slow down when you don't have a clear view of the road ahead. *Never* leave your lane and cross the center line. Always allow plenty of space for unexpected oncoming traffic.

About the only turns where it's best to totally abandon the customary lines are high-speed gentle bends. These



**This rider is over far enough to be dragging the footpeg. Even though the tires have some grip left, a bump could grind things hard enough to slide the tires. He should hang off.**

turns are too gradual to use up much of your cornering adhesion, so just take the shortest line around—the extreme inside of your lane the whole way. Few turns are identical, so you must discover the line in each one that works best for you. With practice, you'll slice through unfamiliar corners with good speed and few surprises.

So now you've got your head full of all sorts of theories and mental pictures that are somehow supposed to make you a better rider. Now what? Go out and try all that stuff on your own personal piece of road. First, however, get yourself in the right frame of mind. Total concentration is essential. Try to be as smooth as possible. Smoothness makes for control and consistency, two things that are vital when you're experimenting with new riding techniques. Erratic, out-of-control riding

won't get you anywhere, except into the bushes. Don't try to go too fast too soon. Normally, as your competence increases so will your speed.

There are many subtleties of motorcycle control that fast riders must master. Keep your body positioned near the front edge of the seat, with your torso canted forward slightly. If your bike has high pullback bars, this position won't work well. If you're going to make a habit of fast riding, toss the buckhorn bars in the garbage and replace them with a set of the lower, superbike-type bars. Use the brakes and throttle smoothly. Sudden, jerky inputs by the rider make for wobbly lines and frightening moments.

If you're not already doing it, keep your eyes and head as level with the horizon as possible. For most riders, letting their heads tilt with their body

and bike can be disorienting when cornering fast. Make sure your eyes are focused on a point on the road where you want to go. As you enter a turn, focus on the apex you have chosen. A second before you reach that point, pick a new point at the exit. Always try to keep your eyes focused about a half or one full second ahead of where you are. It's always too late to do much about where you are, but you *can* do something about where you'll be in one second. Picture your chosen line in your head, then follow it with your eyes. You will tend to go where you are looking. Avoid being distracted from the road ahead, except by things that might affect you, such as parked cars, animals or avalanches.

As you are negotiating a turn, the way you operate the throttle has a marked effect on how your bike handles, particularly when you are at or near the limits of tire adhesion. If you coast through the apex of the corner with the gas completely off and the bike is heeled over far enough, most bikes will slide the front tire first. This front-end washout is difficult to deal with, even for an expert. Even if you're using enough throttle to maintain a constant speed as you reach maximum lean at the apex of the corner, many bikes will still lose the front end first. If you're quick, you can straighten up the bike a little and get the front end to hook back up, but it's a very iffy situation. The consequences of not catching it in time can be quite painful. Almost all bikes are the most predictable when under mild to moderate acceleration. In these situations, it's the rear wheel that starts to slide first at high cornering speeds. If you're taking smooth lines and riding in a controlled way, the rear wheel will usually slide out in a somewhat predictable manner. The amount of predictability varies, depending on the bike and tires. Easing off the throttle will *usually* bring it back into line. Chopping the throttle suddenly will sometimes result in the dreaded high-side crash. Dirt riding experience can prove quite valuable on the pavement when tires are slipping and sliding. The ability to control a street bike with one or both ends sliding requires abundant experience and should only be dabbled in by experts on racetracks.

On the vast majority of street bikes, you'll run out of ground clearance before you use up all the traction the tires have to offer. Folding footpegs can flip up out of the way at extreme lean angles, but when solid things like centerstands or mufflers begin to drag, problems begin. If a solid part is planted in the ground hard enough, it will in effect lever the wheels partially off the ground. This causes the tires to lose their grip, and the bike to slide toward the outside of the corner. Gener-

ally, the sliding won't stop until the bike is straightened up enough to plant the tires firmly back on the ground and get the dragging pieces off the pavement. The amount of warning the rider gets before something drags hard enough to slide the tires varies from bike to bike. Some machines will scrape their pegs with an audible grinding noise long before anything substantial hits; others give less notice.

By turning up the rear shock spring preload you can pick up a bit more ground clearance. Bikes with air-assisted front forks will gain a little clearance with the addition of more pressure. Both of these adjustments will help, but neither will completely cure the problem.

That's why many fast (and just fast-looking) riders hang off to the inside of turns. By moving his body's center of gravity toward the inside of the turn, the rider can use more of the tires' traction to generate more cornering force and allow greater speed. It has the same effect as sitting normally and leaning the bike over farther—something that can't be done if the pipes are dragging on the ground.

The object of hanging off is to get as much of your weight to the inside of the turn as possible. It won't accom-

plish anything if you hang your hips way off to the inside but have your head and upper body hung off equally far to the outside. A really spirited hanger-off will occasionally (sometimes constantly) drag his knee during flat-out cornering. This practice is amusing, but not necessary. You can go as fast with your knee tucked in just enough to keep it from dragging.

Learning to hang off is obviously not necessary for all riders. It takes a good deal of practice to feel comfortable riding like an outrigger in the corners. The sensations are different, and the bike often handles and responds differently to your commands. The movement of your weight affects the machine, so you should slide to the inside smoothly. Some experienced riders use the movement of their weight in combination with countersteering to help initiate the turn.

Whether your style is to tear around corners sitting upright in the saddle, or to hang sidesaddle off the inside with your hide sliding along the macadam, make sure to leave yourself some margin for error. It's OK to drag bits and pieces of undercarriage now and then, but you shouldn't keep those pipes planted constantly. Bumps and dips in the pavement will make your bike's suspension compress, reducing the

available ground clearance somewhat. So if you've already got it buried when you hit a dip, the undercarriage will dig in hard enough to make one or both wheels slide out suddenly. On the other hand, if you leave yourself a small margin of clearance, the same bump probably won't bash your pipes hard enough to slide the tires.

If you're a normal person with a good instinct for self-preservation, this talk of skidding tires, dragging body parts and "unpleasant consequences" doesn't sound like your idea of fun. Maybe all you want to do is learn how to feel more confident and in control on the twisties. All the techniques that can make you faster can also be employed to make you safer. If you're more daring, and want to give your buddies a bit of a challenge on that Sunday morning ride, take your time. Practice the techniques described here and tailor them to suit the way you ride. Above all, don't rush yourself. Let your skill advance at its own pace, regardless of your own impatience or the comments and suggestions of others. Maybe someday you'll stomp those guys and make them eat their words. Even if that never comes to pass, through your efforts you will have developed the skills to be a faster, safer rider. **M**



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