PORSCHE HIGH-PERFORMANCE DRIVING HANDBOOK

2nd Edition

- Accelerating, Braking, Cornering and Shifting
- High-Performance Road and Track Driving
- Achieving Smoothness and Balance in Front-, Mid- and Rear-Engine Cars

Vic Elford

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On the cover: The author driving a Cayman S at speed in the mountains of Sicily during the 100th anniversary celebration of the Targa Florio. *Johnny Tipler*

On the frontispiece: Gérard Larrousse at the wheel of the Porsche 908/3 in the Targa Florio in 1971. *Porsche*

On the back cover: Shown here on the grounds of the Collier Museum in Naples, Florida, is the author with two of his favorite Porsches–the 911R he drove in the 1968 Corsica and Cevennes rallies (when it had an experimental twin-cam 6-cylinder engine that was eventually developed into the 917's unbeatable 12-cylinder powerplant) and a new Cayman. Forty years may separate them, but you can still see the "family" resemblance. *Anita Elford*

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"I've known Vic since 1968, when I almost signed to drive in the Cooper Formula 1 team with him. Prior to that, Vic was world-renowned for his prowess as a rally driver. He then got the opportunity to show his versatility by driving in Formula 1 and followed up by becoming one of the world's top sports car drivers in the legendary Porsche 917, where I got to know him better.

"Since his retirement from professional racing, I've had the pleasure of working with him at the Porsche Owners Driving School, where he did an excellent job administrating the program. We worked at diverse venues throughout the United States, from Candlestick Park to Sebring.

"To drive a car well has to be learned from someone with a special talent of being able to impart that knowledge gained over the years. Vic Elford has that talent."

Derek Bell
Five-time winner of the 24 Hours of Le Mans
Two-time winner at Daytona and twice World Sportscar Champion

"There is no driver better qualified than Vic to write a book on how to drive a Porsche–or anything else for that matter. The only driver to successfully switch from driving 911 rally cars on snow and ice to racing 240-mile-per-hour Porsche 917s at Le Mans–in the rain, fog, and night. This book will tell you all that you need to know."

Brian Redman
Porsche and Ferrari factory driver
U.S. Formula 5000 champion

"I always knew how to go fast, but Vic taught me how best to stop—a very essential part of safe driving. Thank you, Vic."

Martina Navratilova
Arguably the greatest women's international tennis champion of all time
Porsche Owners Driving School graduate

ABOUT THE AUTHOR

Vic Elford was 13 years old when his father took him to see the first British Grand Prix after the World War II at Silverstone. That day he decided he wanted to be a racing driver; it was a ridiculous notion at the time, since only wealthy young gentlemen could afford to drive racing cars. But throughout school and college the dream stayed alive, and he eventually got his foot on the bottom rung of the ladder and started the long climb to the top.

My first 1-horsepower experience on holiday in England when I was four years old. . .
Vic Elford collection

Porsche 917 at Spa, 1972
. . . many years later I had graduated to the 650 horsepower of the Porsche 917, seen here on the awe-inspiring descent toward Stavelot . . .
Vic Elford collection

Certainly other drivers have been more successful than Vic in terms of races and championships won. There have been great Formula 1 champions, Indy drivers, stock car drivers, rally drivers. But no other driver in the history of the sport has had success in so many varied disciplines.

Vic was the first British driver to really learn to drive on ice and snow, which he put to good use by being the first person to win the Monte Carlo rally for Porsche. He followed that up a week later by winning Porsche's first-ever 24 hour race at Daytona. Those two events marked the start of a long love affair and almost lifetime devotion to the German marque.

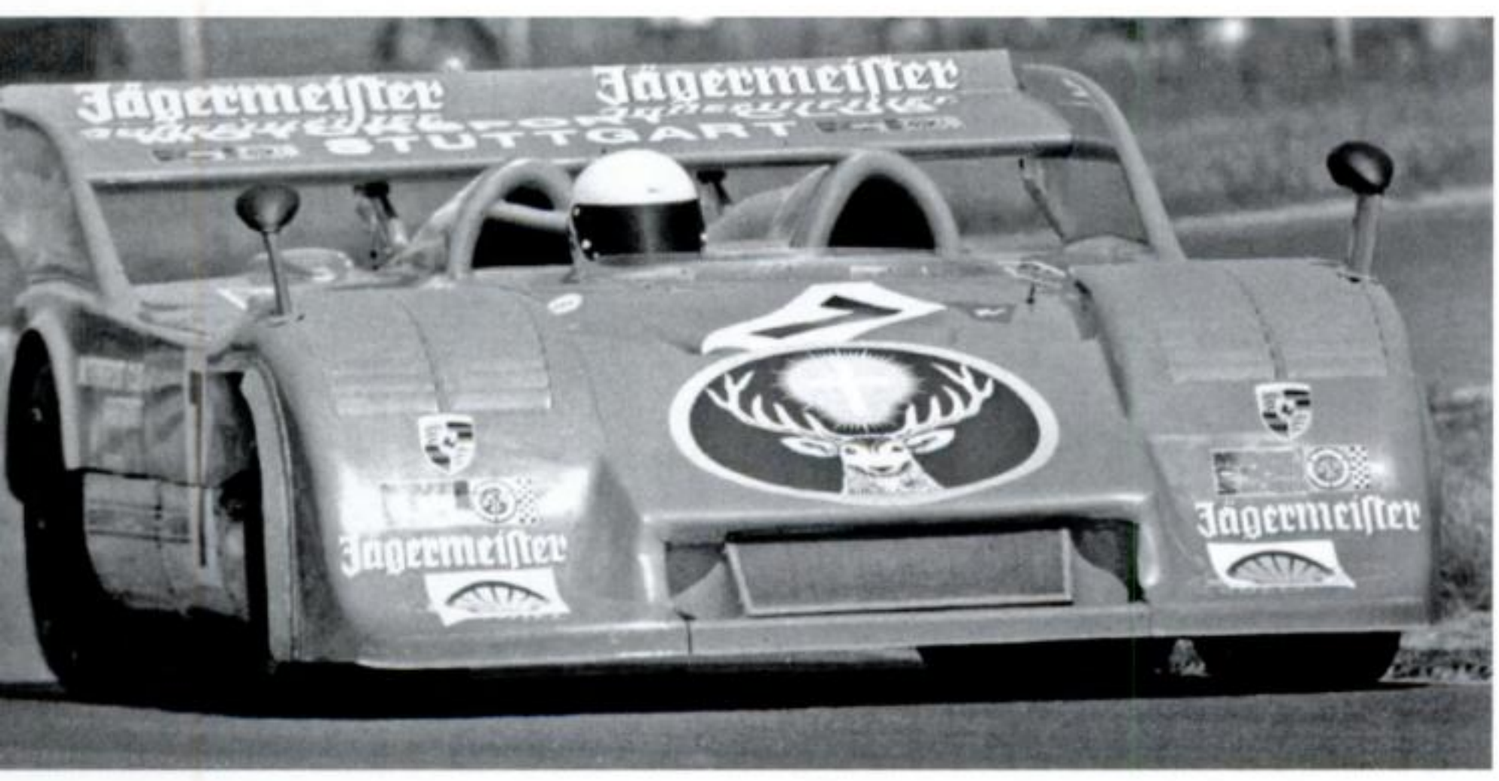
As a result of that experience he asked Bill France, the founder of NASCAR, if he could try a stock car and promptly came back the following year to finish 11th in the Daytona 500! Two years later he might have done even better. Seventh in his 125-mile qualifying race, he was running seventh in the 500 when the crew let him run out of gas, although he still recovered to finish 10th.

In his first Grand Prix he finished fourth, even though he was driving the slowest car in the field and started last, thanks to his ability to drive in the rain.

Vic also finished seventh in an outdated Cooper-Maserati in the Monaco Grand Prix only months after winning the Monte Carlo rally, becoming only the second driver ever to have started both events, let alone finish both and win one.

He had countless victories in international rallies, world championship sports car races, and other branches of the sport and until just a few years ago was still winning in historic and vintage racing, driving McLaren, Ferrari, Pontiac TransAm. and other cars.

No matter what you drive, probably no other driver in the history of motorsports is more qualified to offer advice on how to drive it.



Porsche 917/30, Hockenheim Interserie, 1973
. . . and ultimately the 1250 horsepower of the fabulous Porsche 917/30. Eberhard Strähle

ACKNOWLEDGMENTS

I know it sounds a little stereotyped and trite in today's world, but I really do have to start by thanking my parents. My mother was orphaned when she was 12, and my father was already alone and earning his own living when he was 11. For them, the idea that one could even imagine driving racing cars for a living, unless one had been born a millionaire and didn't actually have to make a living, was simply inconceivable. They had worked hard and sacrificed much in order for me to graduate from engineering college.

And then I announced that I was going to be a racing driver!

My early years in the seat beside the wheel and then in the seat behind the wheel they accepted with grim resignation, because at least I still had a "real" job as an engineer.

Then suddenly one night they were listening to a live radio report—cable did not exist in those days, and in England the only TV was the BBC—from the Mont Ventoux hillclimb in France, one of the special stages of what for me was the ill-fated 1967 Monte Carlo rally.

In the voice of the probably bored, at least to start with, BBC commentator, who would no doubt have preferred being home in front of a nice log fire. . .

". . . and I see the lights of the next car approaching . . . and now another set of lights coming up behind at tremendous speed . . . they are catching the car in front . . . they are going to overtake . . . it's not possible . . . there is no room to get by on this snow-covered road . . . but they've done it, they've gone by the other car . . . and . . . and . . . it's Britain's Vic Elford . . . in the beautiful new Porsche 911 flying toward the summit. . . ."

We didn't win that year–but suddenly I had my two most ardent supporters for the rest of my career.

Many other people deserve recognition, and I have tried to list them here. Their names are in no particular order and if I have forgotten anyone, I apologize.

The original version of this book happened almost by accident. Having just written the foreword for another Motorbooks publication, *Porsche Legends* by Randy Leffingwell, they suggested that with all my Porsche background, I should write a *How to Drive a Porsche* book. So I did.

The following people also helped make this book possible and deserve thanks.

Alec Rhodes, my school friend with whom I did my first rallies as a co-driver, stuffed into the passenger seat of an MG TF.

Baron Fritz Huschke von Hanstein

A gentleman driver in his own right when young, Huschke was the right-hand man and confidant of Dr. Ferry Porsche. He listened when I told him of the problems that I had been having with Ford and allowed himself to be persuaded into lending me a Porsche 911 to drive in the Tour of Corsica in 1966. A decision that, thankfully, neither he nor I would ever regret, as it started both of us, and Porsche too, on a new road to success. Multilingual and always impeccably dressed, Huschke was the perfect gentleman. Porsche

David Seigle-Morris, who was looking for a co-driver for international rallies when Alec decided to sell his MG and got married.

Ken Piper, who drove a DKW, and David Blackburn, the managing director of DKW in Britain, who gave me my first real chance to show what I could do. And the mechanics at the DKW importer who worked after-hours with no pay to keep my car running.

My friend John Sprinzel, whom you will meet later.

Graham Robson, journalist and manager of Triumph

Motorsports, who having been passed in the night by a flying DKW, gave me a chance in the Triumph "works" team.

Walter Hayes, for his confidence in incorporating me into the Ford of Britain rally team.

Bill Barnett of Ford, for all his support during what were often difficult times for both of us.

John Aldington and his father, Bill, the British Porsche importers, who gave me the opportunity to contest the British Touring Car racing championship in a Porsche 911. I won the championship for them, for me, and for Porsche.

Richard Petty, who is perhaps partly responsible for me still being alive today.

"Old" Bill France, with whom I always had a great relationship from the moment we met on my first visit to Daytona.

Jim Hall, who out of the blue asked me to drive the fabulous Chaparral 2J "vacuum cleaner" in the Can-Am and, later, his Chaparral Camaro in Trans-Am.

Most especially, thanks to all those people at Porsche, whom I counted as my friends for so many years.

The lovely Evi Butz, whom many of you now know as Mrs. Dan Gurney, but for years, along with Thora Hornung, was "Miss Fixit" in the racing/public relations/customer relations departments at Porsche in Stuttgart.

The engineers, many of whom you will meet in these pages; Hermann Briem; Norbert Singer; Peter Falk; Helmut Flegle; Helmut Bott. And perhaps the greatest automobile engineers of all time, Dr. Ferdinand Porsche and Dr. Ferdinand Piëch, along with all the mechanics who looked after the cars so lovingly, and everyone else at Porsche A.G.

David Stone, who for so long was my rally co-driver and contributed so much to my success in that field.

And to the one man who was almost single-handedly responsible for the fact that I was able to write this book: Baron Fritz Huschke von Hanstein and his lovely wife, Ursula.

Retired president of Porsche Cars North America, Fred Schwab and current director of public relations, Bob Carlson, as well as Mike van Sicklen and Rod Stotsenburg of Firestone/Bridgestone tires also contributed in no small way to making this book possible.

Last, but not least, my marvelous wife, Anita, who was subjected to countless proofreadings. They were made even more valuable by the fact that she also used to drive in rallies and hillclimbs in both France and her native Belgium years ago, so at least she had a vague idea of what I was trying to say.

Thanks to all of you.

Vic Elford
Chevalier de l'Ordre National du Mérite

This Porsche poster celebrating my victory in the 1968 Targa Florio was the only one that was ever devoted to the driver, rather than the car. In Porsche's words, it was the only race that was won by the driver, not the car. Porsche

FOREWORD by David Hobbs

Although I have known Vic for over 30 years and have known *of him* for 40 years or so, it was not until I read his original manuscript and the memories came flooding back that I again realized just how incredibly successful and comprehensive his rally and racing career had been. It also reminded me of some less than charitable thoughts I had held for "Quick Vic" many years ago as he made the switch from rally to race driver and purloined some drives that I was hoping for! How positively churlish.

Back in those "good old days" only ability counted to get drives. Mind you, a bit of astute politicking on the side never did any harm. But apart from the rich drivers Vic mentions, who usually drove their own cars, the "buy-a-ride" era had yet to dawn. Drivers were contacted regarding a certain drive or even a season and were offered money for their services. Now when contacted, drivers are expected to have some ability and *lots* of money.

The point of this digression is that Vic got where he was by sheer raw talent. In his case it was exceptional talent and hard work. To win the Monte Carlo rally in the depths of winter over the dark and incredibly dangerous mountain passes of the Alpes-Maritimes and then proceed to come in seventh just a few months later in the principality's Formula 1 Grand Prix is without a doubt an outstanding achievement in racing that no one else has ever come close to emulating.

Vic also won the Monte Carlo rally and the Daytona 24 hours within a couple weeks of each other! He won most of the great sports car classics that every driver dreams of winning; Nürburgring (where he is one of only three drivers ever to have won six major events); the Targa Florio; Sebring . . . all the races that I myself had wanted to win so desperately. To make matters worse, he was a multi-winner in many cases. When you add in Trans-Am, Can-Am, and Formula 1, it is just about as diverse a career as possible.

This book, however, is not about "Vic Elford, racing driver," but about "Vic Elford, instructor." It disseminates some of that vast store of rare qualities that made him what he was, to you, thereby increasing your knowledge and interest in all facets of driving. He discusses many issues in this book that are normally either ignored or taken for granted, such as chapters on smoothness, comfort behind the wheel, and braking and acceleration techniques—the whole gamut of driving. Every chapter is illustrated by a wonderfully delicious anecdote of a race or rally where the particular point in question is highlighted.

A few years ago Vic and I worked together on a ride and drive program for BMW North America directed at its dealer network personnel. The program was run by the Skip Barber organization, where Vic and I were the two senior instructors. We crisscrossed the country visiting most of the better-known race venues in the United States. The program was simple but effective—and I might add that it sadly illuminated the abilities of the average road driver. As dealers and salespeople for "the Ultimate Driving Machine," one might have expected them to be a bit more above average. As I said, illuminating.

The racetracks themselves were marked by cones for braking, entry, apex, and exit points for the corners in order to make life easier for the drivers. However, before getting onto the track we had a session with track diagrams and a few words from the instructors. I was struck then by Vic's conscientious approach to the task and his obvious teaching abilities. He made his points clearly and concisely and carried this theme throughout the program. Vic was a real stickler for detail, making sure his drivers were seated just right in the car and that they all took absolute note of everything he was saying to them.

Since that time Vic went on to create the Porsche Owners Driving School for Porsche Cars North America. This was a full-time occupation for him, so he further honed his educational skills.

Driving education in general is poor the world over and is almost nonexistent in the United States, where driving is regarded as almost a divine right. Road safety therefore is usually not achieved by education but by legislation—

some of it very flawed legislation. It would be comforting if the 240 million drivers on our roads had at least some idea of how to *drive* rather than just how to get from point A to point B.

This book will certainly go a long way toward alleviating that problem. For those who really do intend to improve their driving habits and skills, this book is a must. It is full of tricks of the trade, essential information on how to handle certain situations, great tips on car control in all conditions, and just plain common sense. It is also a damn good read, full of some of the most fascinating experiences of one of the world's most diverse and successful drivers.

In 1970, the BOAC 1000 km race at Brands Hatch in England was wet. And I mean *wet*. For some reason I was not taking part but watching Vic Elford in the Porsche Austria 917 and Pedro Rodriguez in the Gulf-Wyer 917 duke it out. It was a breathtaking display of car control . . . that went on for six hours. My memories of that titanic struggle in the rain are still vivid, and Vic's performance conjures up the paraphrasing of a line from Crocodile Dundee: "Now that's a driver."

Now read on.

David Hobbs
Former World Class Formula 1, Sportscar, and Trans-Am driver, and SPEED TV motor racing commentator

PREFACE

This is not the first book written on the subject of high-performance driving. It will probably not be the last.

So why bother?

Forty years ago I remember being driven by an elderly German driver in a Mercedes 180 taxi from the Nürburgring, through the Eiffel mountains, to Bonn airport. The driver had absolutely *no idea* how to drive and on corner after corner we were saved from catastrophe by the inherent capabilities of the car.

Today's cars have made such strides in road-holding, acceleration, and braking that it almost seems superfluous to be able to drive well. The car can do it all. Right?

Wrong!

With certain high-tech racing exceptions, the car can only respond to the input of the driver; it cannot do anything on its own. The better and more refined the demands of the driver, the higher the speed at which he or she can drive, the more pronounced the comfort, and above all, the greater the margin of safety.

This book is dedicated to Porsche drivers and all the other drivers who put quality and performance first—although you do not have to drive a Porsche to benefit from the knowledge and experience that I will try to share with you.

No driving handbook has ever dealt with every type of driving before. Many authors have offered books oriented toward racing, but none have covered the complete spectrum of driving as this book does. From driving on the high-speed autobahn to the delicate handling of a Porsche 911 on ice and snow; from off-road driving to accident avoidance and safety in a school zone—whatever you drive, wherever you drive it, young or old, experienced or debutant, there is something in this book for you.

CHAPTER 1
COMFORT

The place: Sicily
The time: 1968
The occasion: The 52nd running of the Targa Florio

Ever since cars were built, men and, still only occasionally, women, have raced them.

The Targa Florio was the last surviving true road race, dating from the beginning of the twentieth century. It consisted of 10 laps of a 45-mile circuit traced on narrow twisty roads of the Madonie Mountains of the Italian island of Sicily.

A year earlier, having competed in my first rallies in a Porsche 911 (the Tour de Corse and Monte Carlo) and finishing third in both of them, Porsche racing director Huschke von Hanstein had asked me, "Have you ever thought about circuit racing?" What a question. When I replied that I had thought of little else since I was 13 years old, he said, "OK, I think you had better start with the Targa Florio; it is like rallying in a racing car."

So after many laps in a 911 learning the circuit, I found myself behind the wheel of my first-ever real race car at 6 a.m. one morning. The car was a Porsche 906, and I remember wondering how in the world anyone could drive such a monster on a racetrack, let alone around the mountains of Sicily. Huge front fenders reduced the frontal visibility to the point where it was like looking through a funnel to just a narrow angle of road in front of the hood. But by the end of my first lap I felt at home and very comfortable.

In the race that year I drove a Porsche 910 with Jochen Neerpasch as co-driver. With smaller wheels and fenders than the 906, it had better visibility and was more maneuverable; we finished third behind two other factory 910s, one of them a 2.2-liter version.

Now, a year later in 1968, I roared away from the start line in a Porsche 907. The village of Cerda was soon behind me as I braked hard and changed down to second gear for the tight left corner that would lead me up into the mountains. My foot came off the brake pedal and onto the throttle, the engine revved—and the car just coasted slowly to a halt!

Assuming the clutch or transmission had broken, I unbuckled and climbed out, only to find that the right rear wheel had almost come off. (It was later discovered that a badly machined center-lock wheel nut from an outside supplier did not match the wheel and had simply unscrewed itself.) Spectators clambered down from the bank beside the road to help. I didn't even need to get the jack out—they lifted the car bodily while I tightened the wheel.

I strapped myself back in and set off again with a vengeance. High in the mountains all the serious teams had established an unofficial pit area, and I stopped briefly to have the wheel changed, but not the wheel nut, as they did not have any.

Ten minutes later the same wheel nut undid itself again, but this time it was on a fast downhill section, and as I lost power I also lost control of the car and slid off the road against a curb, puncturing a front tire. Again the spectators came to my rescue, lifting the car so that I could put the space-saver spare on the front and retighten the rear.

After a further stop at the main pits to change all four wheels and wheel nuts, I started the second lap 18 minutes behind the leader. Throwing caution to the wind, I drove like I had never driven before and probably never have since. Victory, I was sure, had eluded us, but I was determined to at least set a new lap record. I did—no less than four times—with each lap faster than the last.

I began making up time in great chunks, and then my co-driver, Umberto Maglioli, kept the ball rolling during his three laps in the middle and I took over again for the last three. As I passed the halfway pit area on the last lap, one of the German mechanics from the Porsche team was bounding up and down beside the road, brandishing a huge sign telling me that I had taken the lead the last time I passed the start/finish line.

Through the villages of Collesano and Campofelice, where only a little over half an hour earlier the populace had been savoring the prospect of an Italian victory by Alfa Romeo, I stayed at full speed. I was putting every ounce of concentration into keeping the car on the slippery, tortuous road and was unaware of the glasses of wine being raised to this crazy Englishman who had brought Porsche back from the jaws of defeat. I was hot (the Sirocco wind was blowing across the Mediterranean from

Targa Florio

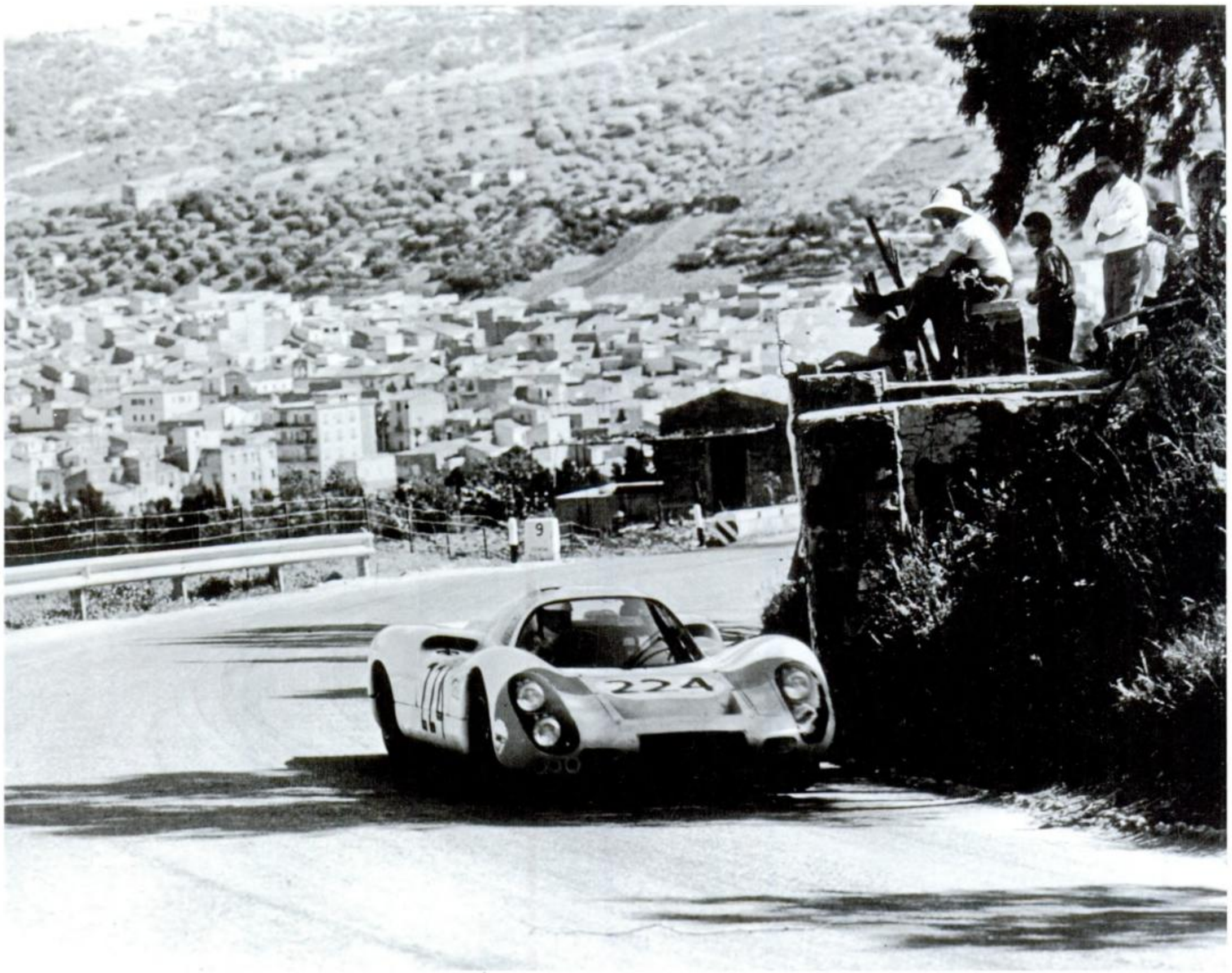
Umberto Maglioli and myself moments after our historic Targa Florio victory in 1968. After a first lap delay due to an ill-fitting wheel lug nut, an unscheduled pit stop in the mountains, an off-road excursion caused by the wheel problems, and a further pit stop to rectify those problems, I started the second lap of the 10-lap, 450-mile race 18 minutes behind the leader. In a never-say-die effort, I fought back to win by more than two minutes. Rainer Schlegelmilch

North Africa), tired (I had been at the wheel for more than four of the last six hours), thirsty, and almost exhausted from the physical and nervous effort.

Still taking each corner at the limit as I swooped down out of the mountains for the last time, I reached the narrow road that ran straight along the seafront, where for five miles the pounding wind buffeted the car left and right at 175 miles per hour. Through the last series of corners to the finish where everyone, even the Italians, was going wild, I felt so comfortable, so much at one with the car that I almost wished the race would go on forever.

THE IMPORTANCE OF COMFORT

When you see a driver exit a car hot and tired after an arduous race, you might think that comfort is of little importance, but nothing could be further from the truth! European or world championship rallies often used to call for virtually nonstop, almost flat-out driving for 24 hours or more at a time. Long-distance sports car or 500-mile races may see drivers called upon to stay at the wheel for up to four hours. Some of today's off-road races, like the Baja or Dakar, have placed drivers back in the iron-man (or woman) category, spending huge amounts of time

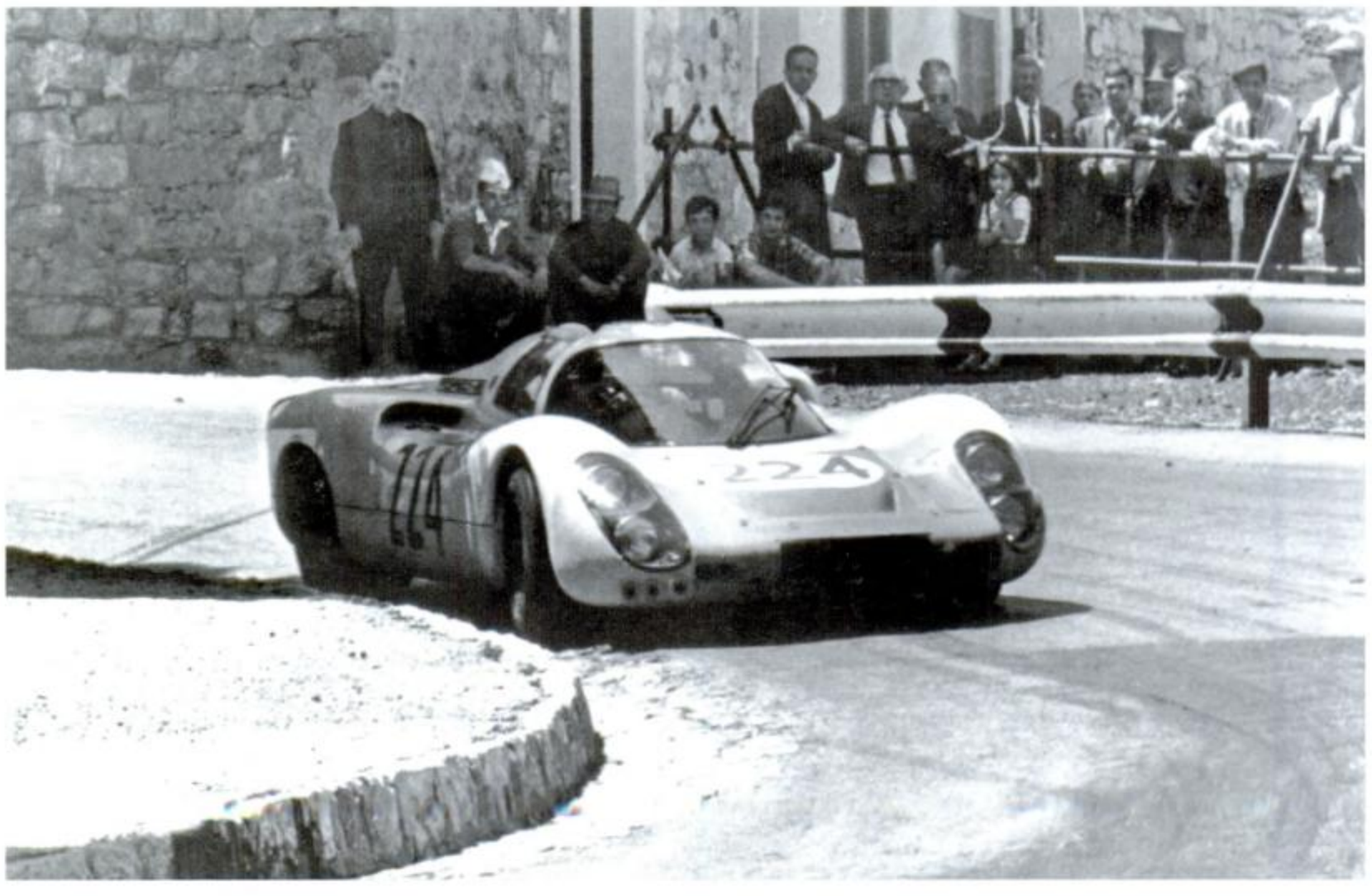


Above:

Porsche 907, Targa Florio, 1968

Background scenery on the Targa Florio . . . the sleepy little town of Cerda in the background as I head up into the mountains en route to one of my most pleasing victories.

Porsche



Right:

Porsche 907, Targa Florio, 1968

All dressed up to watch Sunday's race! Despite the month of disruption that it brought to their otherwise quiet lives, the Targa Florio was the social event of the year for many Sicilians.

Porsche

Porsche 908/3, Targa Florio, 1971
Despite the proximity of spectators to the race cars, the Targa Florio had an enviable safety record, although only God knows why. Here I am almost running over people's toes as I sweep through a corner in the Martini Racing 908/3 that I shared with Gérard Larrousse.
Porsche

behind the wheel over some of the most inhospitable terrain on the planet.

When you drive a Porsche, every moment spent behind the wheel should be a pleasure. If you are not comfortable, driving becomes a chore, attention can wander, and in the extreme you might find yourself in an accident.

I hate the cold, and for me anything under 75 degrees Fahrenheit is cold, so you can imagine how uncomfortable I was when Ford once sent me to practice for the Swedish rally, where the temperature was 25 degrees below zero, in a car *with no heater!*

SEATING POSITION

Have you ever bought a good-looking, expensive pair of shoes and found the first time you went out in them they were so uncomfortable that it took all the pleasure out of wearing them?

The same can be true of a car. If you are not comfortable driving that beautiful Porsche, even a short journey will take on the aspect of a nightmare. Conversely, a little time spent preparing will make each moment behind the wheel such a joy that you will spend as much time there as possible.

During the early 1990s while I was running the Porsche Owners Driving School that I created for Porsche Cars North America, I noticed that many drivers started by sitting much too high in the car. They were not happy unless they could see the extremity of both front fenders, as well as the ground about 3 feet in front of the car. In fact you should learn, even without being able to see them, exactly where the front fenders are. Within reason, the lower you can sit in the car, the better. As long as you can still see over the steering wheel—not through it—the more comfortable you will be. The lower you sit, the better you can feel the *balance* of the car.

So if you have a car in which the seat height is adjustable, start by putting it as low as it will go. You can still see over the wheel? Good.

Now adjust the fore and aft positioning of the seat until with brake and clutch pedals fully depressed you still have a comfortable bend in the knees. Nothing is more uncomfortable—or frightening—than pushing to the limit of your fully extended leg and finding that you are still not quite at the limit of brake or clutch movement! If your car has power-assisted brakes, make sure you do this with the engine running, otherwise you may not get the full extension of the brake pedal.

The next step is to adjust the rake of the seat back so that with a comfortable angle, with your head in a relaxed position (not straining your neck muscles to hold it up straight) and with your hands at approximately the 3 o'clock and 9 o'clock positions on the steering wheel, your

Porsche 908/3, Targa Florio, 1971

Here, Gérard enjoys an almost spectator-free stretch of road in the same car. Unfortunately, our race came to a premature end when, after a series of tire problems, Gérard literally crashed a wedding party and spent the rest of the day as an uninvited but welcome guest at the nuptials. Porsche

elbows are slightly bent. (The three o'clock and nine o'clock positions may not be exact and will depend on the position of the spokes of the steering wheel.)

Modern Porsches have very form-fitting seats that hold the driver firmly and comfortably in place. Older models or non-Porsches may have seats with less control, in which case you might want to purchase an aftermarket seat, which, although probably more difficult to get in and out of, will certainly hold you more firmly in place once you're in. Many such suppliers can be found in the Porsche Club magazine *Panorama* or other specialist magazines.

STEERING WHEEL POSITION

If the steering wheel is adjustable, position it as high as possible, but still make sure you can see over the top of it. At the same time, if you have a tilt wheel, adjust the angle

of it so that it is roughly perpendicular to an imaginary line drawn from your shoulders to the wheel center.

Modern Porsches, of course, have progressed more than most, and it is probable that yours is fully adjustable in terms of tilt, up and down movement, and even telescopic in and out adjustment.

There are two schools of thought about the placing of the thumbs relative to the spokes of the steering wheel. If you are driving a modern ground-effects racing car, then you will almost certainly need the additional leverage provided by hooking your thumbs over the spokes. However, for normal road driving and especially for driving on poor surfaces such as snow and ice, gravel, off-road, or other conditions that make rapid, violent, and large steering inputs necessary, it may be better not to use this approach, but to lay the thumbs along the rim of the wheel. In the event of a violent steering wheel kickback, this position will help prevent an excruciatingly painful (and I speak from experience) dislocated thumb!

With the body and arms now correctly positioned, you should be able to make a complete half turn of the steering wheel without pulling your shoulders away from the

Targa Florio, 1971

In 1968 I had driven the race of my life to come back from a first lap deficit, finally beating my friends Ignacio Giunti and Nanni Galli to the checkered flag. In the first race of the 1971 season in Argentina, Giunti was tragically killed in a violent accident and his mother presented the once-only Giunti Memorial Trophy for the fastest lap in his favorite race, the Targa Florio. I was determined to win it and did so before Gérard had problems with the car. Here I am receiving the trophy from Giunti's mother at the prize-giving ceremony. Porsche

Hands should be at, or very near, the three o'clock and nine o'clock positions. For open road driving you should rarely, if ever, need to change the position of the hands on the wheel. Here they are shown with the thumbs laying along the rim of the wheel. Vic Elford collection

backrest. Indeed, the upper hand should be able to make almost three-quarters of a turn without the shoulder moving forward.

If you drive a late-model Porsche, your steering wheel is already leather covered, which in my opinion gives the best and most comfortable grip. If you own an older Porsche or another car with a plastic steering wheel, you might want to have it covered in leather to make it more comfortable. Plastic steering wheels are often too thin to give a really comfortable grip, so while you are at it, add some padding as well.

The ultimate modification, of course, is to replace the original steering wheel with an aftermarket one. A number of companies make excellent products that you can buy online or, better still, find in your local accessory store.

If because of your physical build there is a conflict between the seat position for legs and arms and it is impossible to get the exact positions referred to above, *the arms should have priority*.

GEARSHIFT LEVER POSITION

In a Porsche, once you get the body, hand, and arm positions adjusted as above, you will find that the gear lever falls perfectly to hand. Or to be even more graphic, just letting go of the steering wheel will allow the hand to fall naturally onto the gear lever.

If you drive something other than a Porsche and you find yourself having to reach for the gear lever, you might need to modify the lever itself or even have a new one made, but the ergonomics of virtually all modern cars are so good that there is little likelihood of that being necessary.

LEG AND PEDAL POSITION

If having done all the adjustments you still cannot comfortably reach the pedals, then you may have to visit your Porsche dealer or local service station for a little minor surgery to the car. If you are a competent mechanic, you can even do it yourself at home. By "it" I mean adding

blocks to the surface of the pedals so that you can fully depress them as above.

In theory, the block for each pedal—clutch, brake, and throttle—should be the same thickness, so that the pedals keep their same positions relative to each other as the original. However, not all cars have the pedals properly positioned to start with, so wait until you have read Chapter 8 before going to work on them.

In addition to the throttle, brake, and clutch, most Porsches have an additional pedal to the left of the clutch.

Europeans simply call it a footrest. Americans refer to it by the quaint name of "dead pedal," which does not appeal to me very much, so in this book I will call it a footrest. Whenever the car is moving, your left foot should be planted firmly on the footrest. The knee should be slightly bent so you can force yourself lightly but firmly back in the seat, but the left foot should be able to slide easily to the right when it is needed on the clutch pedal.

If your car does not have a footrest, and many do not, it is well worth the effort and minimal investment to fabricate and fit one. It is all part of the comfort package that will help you be a better driver.

In a racing car, everything is designed to be almost infinitely variable. First the seat is molded around the driver and then the position of the steering wheel, pedals, and even the gearshift lever are adjusted and tailored just for him or her. Obviously this is not possible in a production car, but again, aftermarket sources can probably help if you really have problems.

MIRRORS

Last, but by no means least, make sure your mirrors are properly adjusted. You may have to move them three or four times to get them just right, but you should be able to see clearly what is behind you with just a flick of the eyes, not an exaggerated movement of the head.

In this photo, the thumbs are shown hooked over the spokes, where they give greater leverage in extreme conditions, but are more at risk in the event of sudden wheel kickback. Vic Elford collection

Sit as low as you can in the car while still being able to see over the steering wheel. The overall driving position should be totally comfortable and relaxed. The body should have complete contact with the seat, right up to the level of the shoulders. Vic Elford collection

SEATBELTS AND DRIVING HARNESSES

Most states (all except New Hampshire) and indeed most countries worldwide now require the use of seatbelts by at least the driver and front seat passengers, although neither their use nor the enforcement thereof is as high as it should be.

Seatbelts save lives by keeping you inside the relatively rigid central capsule of a car in the event of accident. Yet almost daily I read in my local newspaper of people being killed having been ejected from their vehicle in an accident. Frequently they are single-vehicle accidents. All too often they are caused by a moment's lack of attention, a lack of appreciation of what the car can or cannot do, or not knowing how to get out of a difficult situation. Many would have been survivable accidents if only the victims had been wearing seatbelts.

Many years ago, before cars were fitted with seatbelts as standard, a friend of mine was driving along Knightsbridge, a well known fashionable London street, at about 30 miles per hour. Seeing another car approach down a side street at high speed, he slammed on the brakes to avoid an accident. In fact, there was no accident, as the

Make sure you can turn the steering wheel a good half or even three-quarters of a turn without dragging your shoulders away from the seat back, as I am doing here. Vic Elford collection

other driver stopped before reaching the intersection, but my friend's wife was taken by surprise and died from injuries received when her head hit the windshield, a tragedy that would certainly have been avoided in a car with seatbelts.

Why is it considered so macho to show what a big man, or woman, you are by not wearing seatbelts? In fact, wearing them may not only save your life in the event of an accident, it will also help to hold you firmly in position in the driver's seat, giving you much more positive control of the car—no more wasted energy trying to avoid being thrown around when you are driving quickly; feet and hands free to concentrate 100 percent on getting the best out of the vehicle.

If you watch Formula 1, NASCAR, Champ Cars, or any other form of racing on television, you will see how carefully the crew make sure the driver is strapped in so tightly that he or she becomes one with the car. Have you ever watched in amazement as a driver walks away from a racing crash that reduced the car to a pile of junk that would almost fit in a suitcase? It's because he was strapped in so well when the accident happened.

Here, even at the limit of steering, I am still totally "connected" to the car and completely relaxed. Vic Elford collection

Most cars today also have airbags for additional protection. Porsche was the first manufacturer to introduce both driver and front seat passenger airbags as standard on its 1990 models, but even if you have that additional built-in safety, *you must still wear the belts* for the car's safety features to be totally effective.

Like most racing drivers, I have had my share of accidents. The fact that I am still here to write this book today is in part due to having had my life saved by safety belts on more than one occasion.

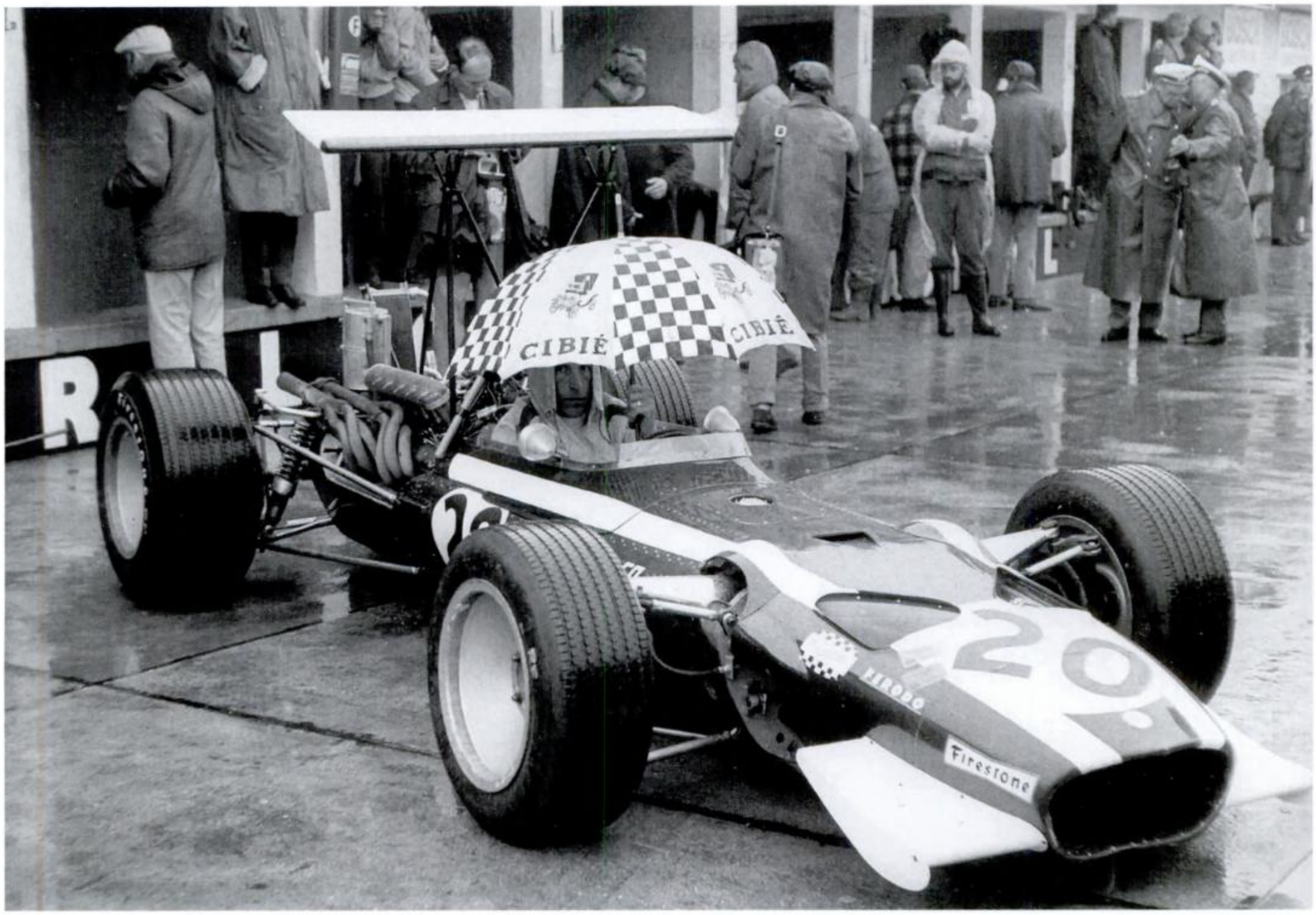
On both the Czechoslovakian rally with a Ford Cortina and the Monte Carlo rally with a Porsche 911, I crashed head-on into a tree (not the same one of course) at about 60 miles per hour. In both cases my co-driver and I were able to walk away with nothing more than sore necks and bruised shoulders from the effects of the seatbelts.

On another occasion, again in a Ford Cortina, I was practicing a hillclimb at night in Luxembourg. I slid off the road at about 70 miles per hour and glanced off a tree, which flipped the car onto its roof. The car spun along upside down until it finally somersaulted off the edge of the road and slid backward down a steep slope before coming to rest against (yes, you guessed it) another solid tree. My co-driver on that occasion was John Davenport, who wore glasses. Although he lost them during the accident, when we came back the next morning to survey the wreckage we even found his glasses underneath the car, and thanks to seatbelts, neither of us had a scratch.

Comfort can be defined as when the driver becomes an almost integral part of the car. The only body parts that can really move are the hands and forearms, feet and ankles. Maureen Magee

Sebring, 1968

Holding my own personal seat insert, molded to my body, I await my turn on the night shift at Sebring. Each driver had his own seat insert, which fit into the rigid seat shell inside the Porsche 907.
Dave Friedman



Cooper F1, Nürburgring, 1968

Comfort really is important . . . even in Formula 1 . . . even just waiting for the rain to stop at the Nürburgring. Jutta Fausel

Perhaps the most impressive of all was an accident in the German Grand Prix at the notorious and famous Nürburgring. Although I had a good position on the starting grid, I made a terrible start, and Mario Andretti in a Lotus and Jean-Pierre Beltoise in a Matra both overtook me on the way to the first corner. Mario's car was an experimental one with Ferguson four-wheel-drive, and it had been so problematic during practice that he had never done a lap with a full fuel load. Halfway around the first lap the inevitable happened; the car bottomed out and Mario lost control and slid off the road. Both his left-side wheels were ripped off, and one of them came rolling and bouncing across the road. Beltoise had just enough room to squeeze between the wheel and the edge of the road, but by the time I arrived a few tenths of a second later it had made one more bound and closed the gap. My left front wheel hit it at about 120 miles per hour, and I did a slow lazy roll over the top of the bushes before crashing to the ground in (of course) the trees. My right arm was almost torn off, my nose was broken, and my face received various cuts and bruises (this was in the days before full-face helmets), but six weeks later I was back in a race car.

Compare those results with my first-ever car accident before the days of seatbelts. Driving my father's Wolseley 6/80, the same as the cars used by the British police at that time, a tire burst at about 70 miles per hour. The car launched itself into a series of end-over-end somersaults before coming to rest on what was left of all four wheels. Having been bounced around like a Ping-Pong ball in a washing machine, I found myself spread-eagle over the transmission tunnel in the rear of the car with a severe concussion and three broken vertebrae. The main structure of the car was relatively undamaged, and had I been wearing a seatbelt I would probably have had little worse than a headache. As it was, I spent the next six months wearing a steel corset while my back healed.

If the macho look or showing your friends how good you are is important, then buckle up, you'll do a much better job of impressing them with your driving.

I can already hear the cries of "But what happens if I have an accident and land in a river, or an accident that results in the car catching fire?" The answer to those and other similar questions is simple. If you have such an accident and are wearing seatbelts, you are *far more likely to be conscious* when the car stops and therefore more capable of getting out than if you are *not* wearing belts.

Many of the world's great rally drivers have been, and still are, from Finland. During practice for the Monte Carlo rally in 1966, one of the famous flying Finns, Rauno Aaltonen, driving a Mini Cooper S, crashed at high speed at night in the French mountains. Being a practice car, it was not equipped with a four-point harness, just a typical lap and diagonal. The car rolled a number of times and caught fire as it came to rest on its wheels. Although Rauno was groggy he was still conscious and his co-driver Henry Liddon was completely unhurt. By the time Henry had freed himself, the buckle of Rauno's seatbelt had welded itself together from the heat, but with the aid of some judicious wriggling they still had the time to extricate him before he was burned.

Seatbelts are not a luxury. They should be treated as a necessity. Whether you use a three-point, four-point, or full competition five- or six-point harness, buckling up should be as fundamental as starting the engine. As long ago as the early 1960s, those of us who drove in competition had already accepted seatbelts as a way of life. But even after they became mandatory in many countries I still remember receiving rental cars in Italy with no seatbelts. Getting into an Italian rental car in those days, I used to feel as naked as if I had gone out without my pants on.

DRIVING CLOTHING

Many things may influence what you wear when you are driving. If your business involves calling on half a dozen clients during an average day, it is obviously not practical to drive in casual clothes, rush into the restroom to change for every appointment, and change back again before heading for the next one. But try to keep your wardrobe to soft comfortable clothes. Take off your jacket and loosen your tie while you are driving—it will only take a moment or two to smarten up when you arrive for your next meeting. Your jacket will look fresher too.

Ladies, if you wear high-heeled shoes out of the car, keep a pair of comfortable flat-heeled ones that you can easily slip on in the car for driving. Cotton, silk, and wool are comfortable materials that let the body breathe. Avoid nylon, polyester, or other synthetic textiles that tend to become uncomfortable when you sweat. They can also melt and stick to you with disastrous results if you are unlucky enough to catch fire. Actually, there is an old English saying that only horses sweat; gentlemen perspire and ladies get uncomfortable. But you get my meaning.

When setting off on a leisure drive with no dress restrictions, you should wear comfortable, loose-fitting clothes and a pair of soft, thin-soled shoes. Leather is probably best, and it is a good idea to keep a clean rag in the door pocket so you can dry off the soles when you get in the car on a rainy day. Avoid rubber-soled shoes if possible, especially in wet weather, as wet rubber soles on the rubber pedal covers will make for a very sticky yet slippery combination, and your feet are likely to slide off the pedals just when you don't want them to.

Although tennis shoes or sneakers are almost a uniform in terms of casual wear these days, they are usually not good to wear for driving because the soles are so thick that they allow very little "feel" for the pedals—and they are usually made of rubber.

I like to wear light, leather-soled moccasins or, as an apparent contradiction to what I have just said, soft thin boating shoes. They do indeed have rubber soles, but it is non-slip rubber, and anyway, I wipe them dry before driving. Always make sure there is nothing lying around on the floor that might slide forward and interfere with your footwork. Nothing is more embarrassing than finding that the brake pedal won't work because your camera is wedged underneath it.

Of course, these suggestions are for leisure driving on public roads. For competition driving, there is a wide variety of purpose-built driving shoes and boots.

SUNGLASSES

A word about sunglasses. If you need to wear them, you might want to experiment with different brands or types, but in any case, beware of sunglasses that are more of a fashion statement than eye protection. Make sure you can still really see when you are wearing them.

Years ago I was driving over a special stage on the Alpine rally in France just as the sun was coming up. The bright sun low in the pale sky made for a lot of glare, and although I was wearing sunglasses I found myself partly blinded going from sun to deep shade and back again. Three times in a few miles I misjudged distances and slid off the road. Nothing dramatic, just a few feet late in braking, but each time cost precious seconds as I had to reverse up before continuing. Finally, after the third off-road excursion, I took my sunglasses off and threw them out the window—and have never worn sunglasses for driving since. I wear Polaroids for sailing and when I used to fly because they give anti-glare protection without affecting my depth perception.

CHAPTER 2

The place: The French Alps
The time: January 1968
The occasion: The 37th running of the Monte Carlo rally

Just one year earlier I had led the Monte Carlo rally in my Porsche 911S virtually all the way until the last special stage over the Col du Turini. To win Monte Carlo is every rally driver's dream and ambition, but victory had been snatched away from me at literally the 11th hour by an unexpected blizzard that caught me on the wrong tires and allowed two other cars to overtake me, dropping me back to third place.

This year, after three days and nights spent driving from starting points all over Europe, in my case from Warsaw in Poland, followed by 36 hours of against-the-clock driving in the mountains, the leading 60 cars set out for what is essentially a 600 km night race through the Maritime Alps above Monte Carlo and Nice.

Remembering the disappointment of a year ago I was finding it difficult to settle into a balanced rhythm. I had already been beaten—not by much, but beaten nevertheless–on the first two special stages by my own teammate, Pauli Toivonen, as well as two of the French Renault Alpines.

Monte Carlo rally, 1968
Moments like this are worth all the hard work. Here, co-driver David Stone and I have just received all the silverware from Princess Grace and Prince Rainier after our hard-won victory. Porsche

Porsche 911,
Monte Carlo rally, 1968
The future winners speed over the snow in the French Alps while a local fan gets a great close-up photo opportunity.
Eric della Faille

Porsche 911, Monte Carlo rally, 1968

Flat out down the Col de la Couillole. Almost a minute faster than our nearest competitor on a 17-minute test. Could we have taken two corners faster . . . or three?

Vic Elford collection

Now on the long run to Saint Sauveur and the start of the third special stage, my co-driver David Stone was lecturing me like a kindly old uncle. "You're trying too hard," he told me. "I'm being thrown around uncomfortably because you are thinking of speed rather than balancing the car the way you usually do. Forget about last year. Forget about the ice and snow. [We had spent the previous night going over the route checking the amounts of ice and snow on our corner-by-corner "pace notes."]. There might be less than last night but not more. Forget it is Monte Carlo, just drive the way you normally do in the mountains where you know you are the fastest—uphill and down."

By the time we started the special stage over the Col de la Couillole, he had gotten my nerves under control. As we waited for the start signal I was relaxed, comfortable, and felt that I could walk on air.

Tight and twisty on the way up but with long fast stretches on the way down, the Couillole is a great test of man and machine. It was a beautiful night with the moon reflecting eerily off the white snow banks lining the 17-mile ribbon of asphalt. The road was mainly dry but still with large patches of snow and ice in places, particularly on the descent. But we knew where they were, and David would be able to give me plenty of warning as he read the

road to me from the pace notes. With this in mind we elected to go on racing tires and at the service point just before the start the mechanics had fitted a brand new set.

Ten minutes later we had crested the summit and were on the way down toward the village of Beuil. Reaching speeds of over 120 miles per hour with our racing tires often slipping and sliding over the packed snow and ice before regaining grip on the drier surface beyond, I used the pendulum effect of the 911's rear engine to help steer the car, which was balanced as though on a tightrope. The slightest mistake and we would have fallen off. Car, tires, and above all the crew were absolutely at 100 percent, even using the snow banks as buffers as we sometimes exited corners too fast. But we made no mistakes and our time of 17 minutes was 57 seconds quicker than the second car, more than enough to propel us to Porsche's first outright victory in the world's most famous and coveted rally.

Much later, when we had both recovered from the nervous exhaustion, David and I analyzed those 17 minutes. He thought there were three corners that I could have taken faster—I thought there were two.

THE IMPORTANCE OF BALANCE

Remember in the first chapter that the word *balance* was highlighted? This was for a very good reason: Balance is probably the *single most important* word in the art—and it is an art—of safe, controlled, high-performance driving that will be emphasized throughout this book.

Have you ever tried walking on stilts? Balancing is difficult because your center of gravity is so high relative to the ground.

Can you recall your first attempt at riding a bicycle? In my case it was in a narrow alley behind a friend's house, and every time the bike leaned one way I leaned the other.

Porsche 911, Monte Carlo rally, 1968

Same car, same "Monte," but this time at night over the Col du Turini, where we had been caught out with the wrong tires the previous year. Note the lighting set-up; we'll talk more about it later. Eric della Faille

Fortunately the alley was narrow with a high wooden fence on each side, so there was not room to fall off—but I did remove most of the skin from both elbows before finally getting the hang of it.

I have already talked about fitting yourself to the car, or even fitting the car to you if necessary. Apart from the movement of the feet to control the pedals (notice I said just *the feet*, not the legs, which you will see later should hardly move) and the hands and arms for the steering wheel and gearshift lever, the rest of the body should be tightly strapped in so it feels like part of the car. A little leaning of the head toward the inside of a corner is acceptable, the way you lean in when riding on two wheels, but it should not be exaggerated.

SHUFFLE STEERING AND BALANCE

Remember in Chapter 1 I discussed the position of the hands on the steering wheel? One of the reasons this is so important is the effect it has on balance. Just for a moment try holding the steering wheel with both hands together at the top. Now, still holding the wheel with both hands like that, steer the car right and left (it might be wise to try this exercise in a deserted parking lot on Sunday morning where there is nothing to hit). You will find it just doesn't feel right because by moving both arms together to the same side you create an asymmetrical situation.

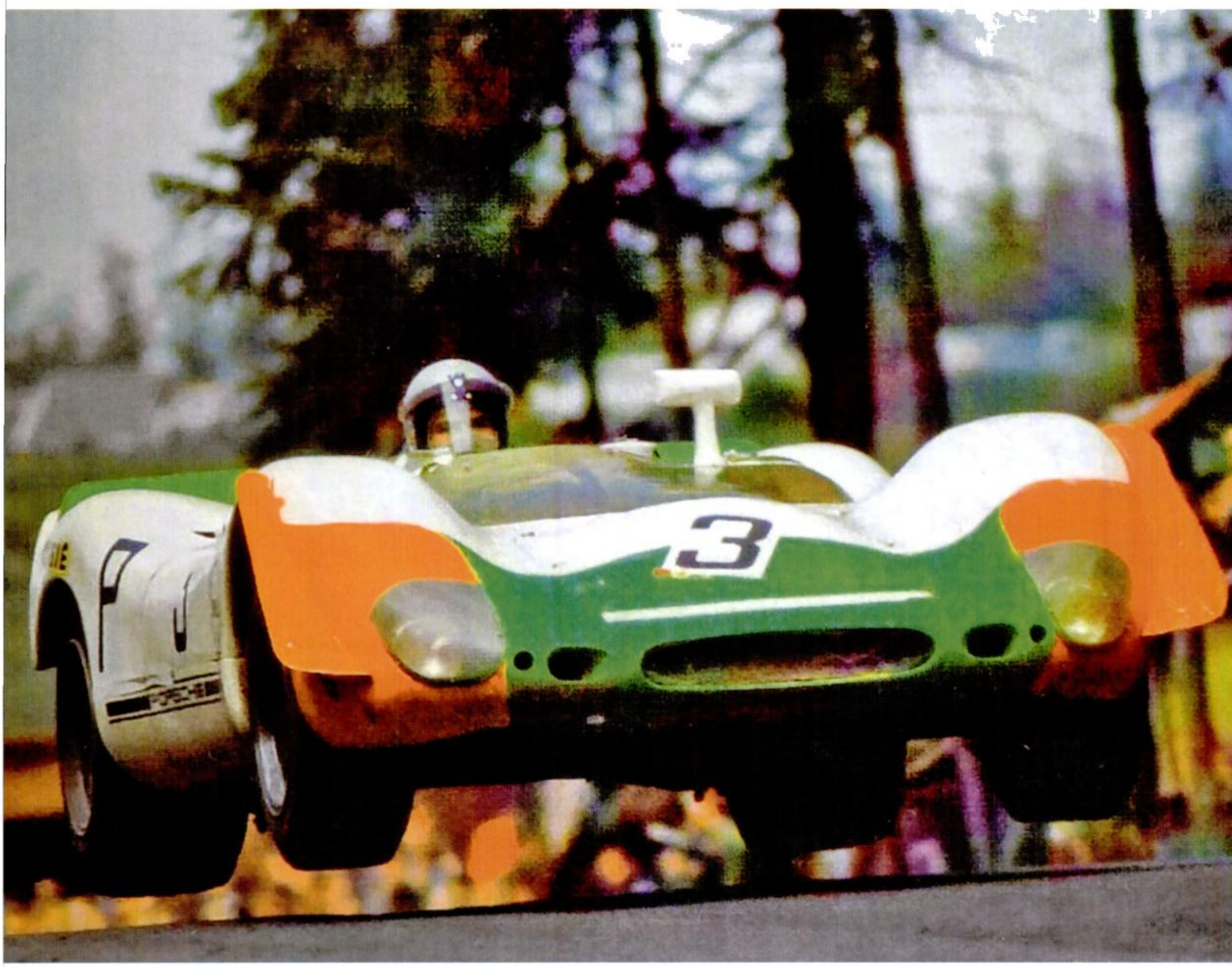
Now go back to the three o'clock and nine o'clock position and try it again. To start with, turn the wheel through 180 degrees; in other words, just a full half turn.

Porsche 911, Monte Carlo rally, 1968

Early stage on the way to winning. Even in the French Alps there are fans cheering on a Brit driving a German car. Vic Elford collection

Porsche 908, Brands Hatch, 1969

Above: *Even transferring from one lock to the other, the car is still obviously beautifully balanced in the transition.* Porsche **Below:** *No exaggerated head movement, hands symmetrical on the steering wheel, the perfect balance is evident here as I turn into the tight Druid's hairpin corner during the 1969 BOAC 1000 km race. I went on to finish second.* Kräling



Porsche 908, Nürburgring, 1969

Even airborne the car remains perfectly balanced as I "fly" the 908 toward third place in the Nürburgring 1000 kim. Porsche

Don't let go of the wheel, just adjust your grip as the turn increases. Feels a lot better doesn't it? That's because all the elements of your body remained in a symmetrical position.

Now let's go a stage further. Instead of just turning through 180 degrees (half a turn), keep going until you have turned the wheel through 270 degrees (three-quarters of a turn). "Wait a moment," I can hear you saying, "I would need arms like spaghetti to do that."

Well not exactly. The correct technique here is to keep the grip firm with the hand that is uppermost on the wheel (that is, the left hand for a right turn, the right hand for a left turn) while relinquishing the grip with the lower hand when it has reached the half-turn position. Relinquish the grip *but leave the hand there* ready to re-grip the wheel as it returns from its full-turn position after the turn.

All Porsches have very direct steering, as do most other sports or sporty cars, and you will find that with the exception of very tight turns in city traffic or the parking lot of your local supermarket, where *shuffle steering* is more logical, mastering this technique will give you total *balanced* control of most driving situations.

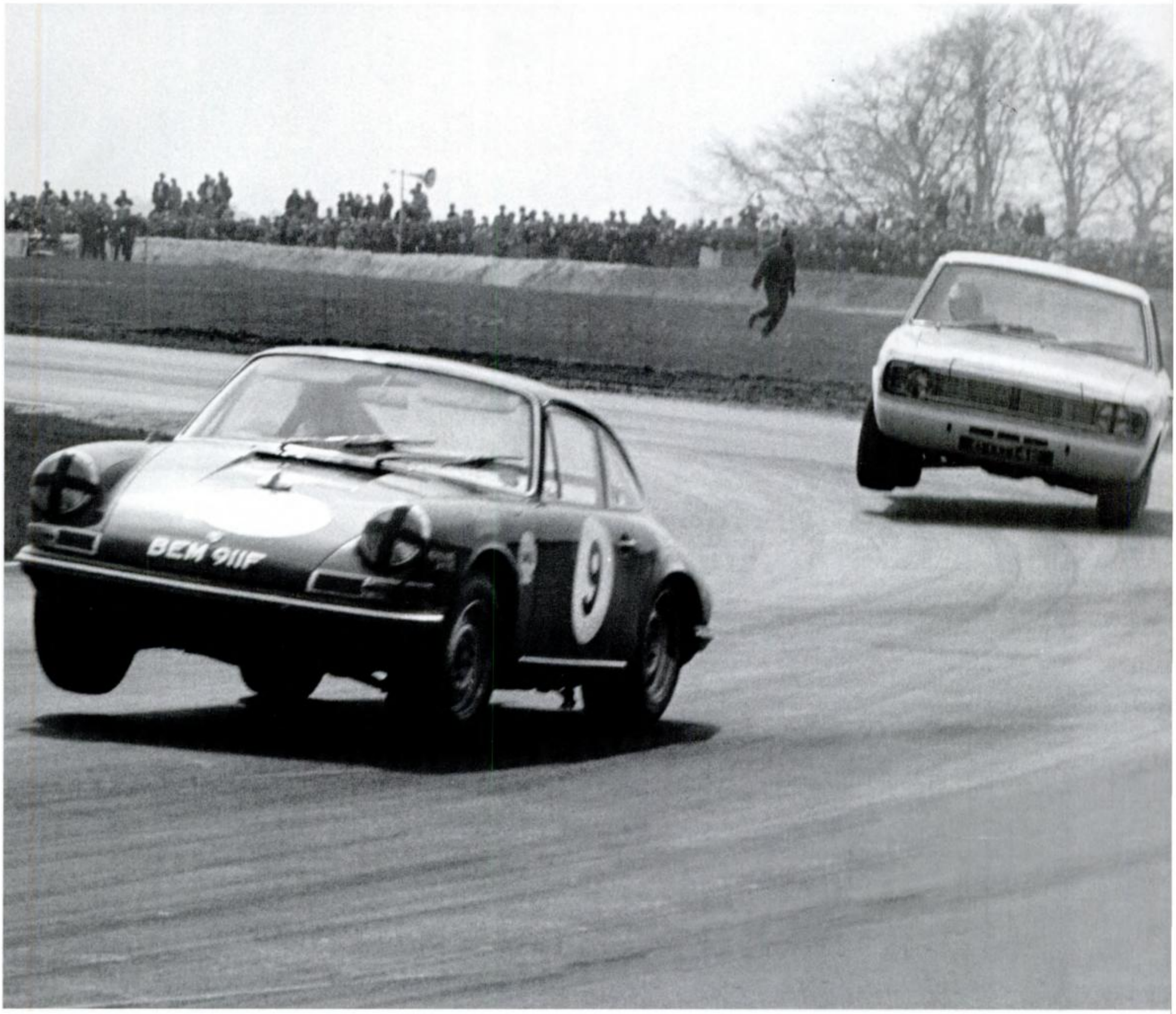
Shuffle steering means just that: Shuffling the wheel from hand to hand but always keeping your left hand somewhere between the seven and eleven position, and

the right hand between the one and five position. For a left turn, for example, the right hand will take the wheel from the three position to the one position, whereupon the left hand will take it from the eleven position to the seven position. If you still need more turn, the right hand will take over at the five position and continue up to the one position, and so on. You will use an even more evolved form of shuffle steering on snow, ice, gravel, or other loose surfaces, which I will discuss in a later chapter.

WEIGHT TRANSFER

Driving does not mean just balancing left and right. It also means balancing up and down. Did you ever dive off a 10-foot diving board and get your body balance wrong? Even if it does nothing more, it certainly leaves you with a sore back or, perhaps worse still, a sore front for a few days.

For the moment, just notice what happens to your car, yourself, and your passengers as you drive. Each time you accelerate you are pushed back in the seat. You can see and



Porsche 911, Silverstone, 1967

Balance! Here, with one wheel off the ground, I lead Paul Hawkins in his Lotus Cortina with two wheels in the air in a British Touring Car (Sedan) Championship race at Silverstone. I went on to win the 2-liter category of the championship. Maureen Magee

How NOT to hold the steering wheel, with the hands assymetrical, creating an instant out-of-balance situation for the entire body the moment you start to turn the wheel. Vic Elford collection

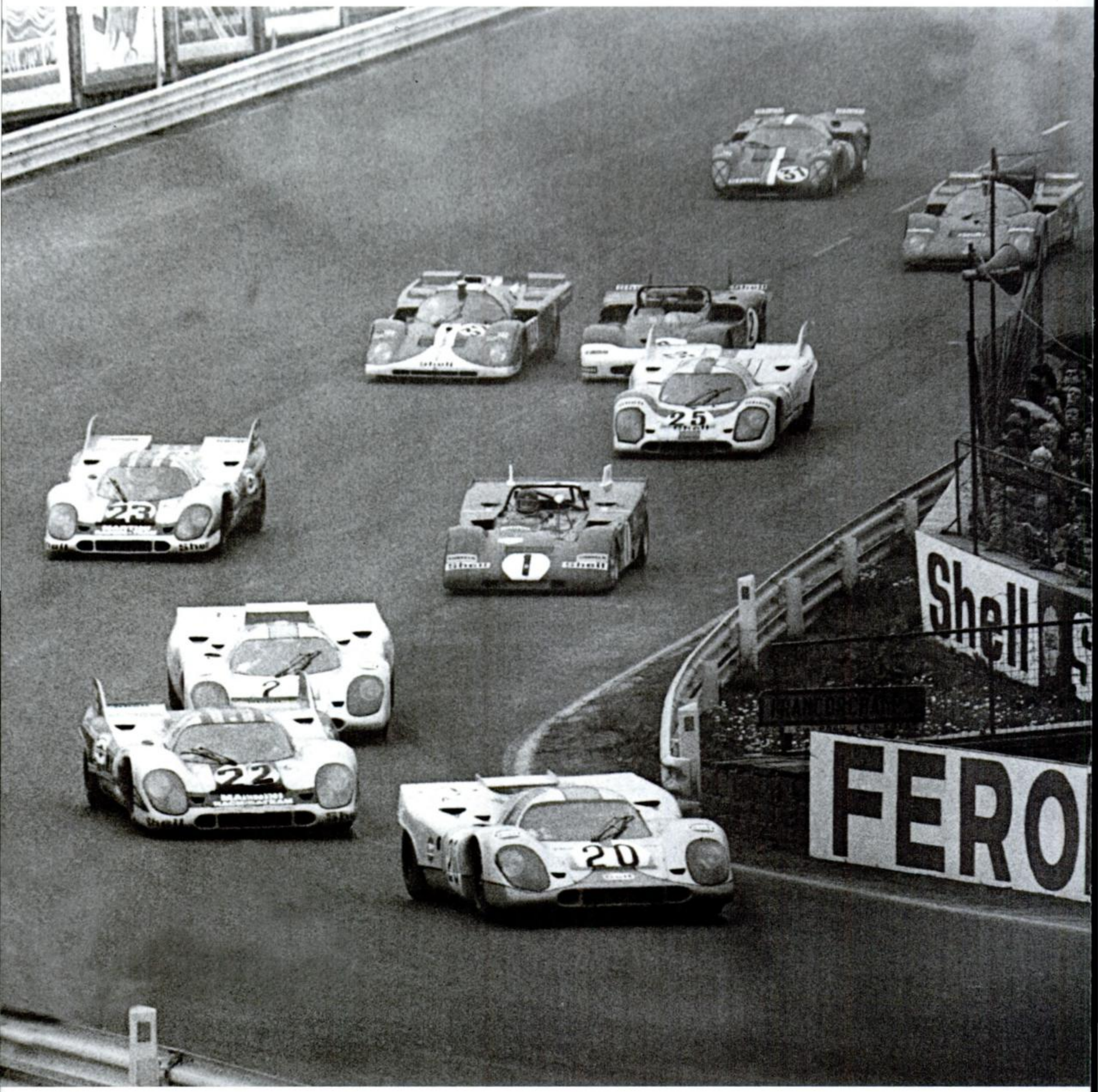
This is much better, allowing you to feel everything that is going on with the car. Vic Elford collection

feel that the car tends to lift up at the front and sit back on the rear wheels. Conversely, when you brake the nose dips and you are thrust forward against the seatbelts.

In fact, considerable weight transfer is taking place in both these circumstances. In acceleration, weight is taken off the front wheels and transferred to the rear, giving excellent traction for that acceleration (in a rear-wheel-drive car) but less grip at the front wheels for steering. Under heavy braking, weight is transferred in the other direction, from the rear to the front. The harder you brake the greater is the weight transfer. By the same token, the greater the weight transfer you can apply toward the front of the car, the harder you can brake without locking the front wheels.

Similarly, as you turn a corner to the left, weight transfers from the left side wheels to the right. Again you can feel this weight transfer as your body and head tend to be pushed toward the outside of the corner.

These reactions are governed by the laws of physics. In a later chapter I will go into greater detail of how you can adjust the balance of the car, both left to right as well as fore and aft, as well as both at the same time, to help steer it and even lift it over obstacles in its path.



Spa-Francorchamps, 1971

All aspects of balance together in the same photo. At Eau Rouge, one of the most daunting corners in all of racing, just after the start of the 1000 km race in 1971, you can clearly see the effects of weight transfer on the various cars. The number 1 Ferrari is heavily on the brakes in a straight line; number 22 Porsche 917 (with me driving) is still braking heavily but also getting sideways weight transfer as it turns into the corner; number 20 Porsche 917 has already released the brakes, and the nose has come up as it begins to accelerate out of the corner. Eberhard Strähle

CHAPTER 3
SMOOTHNESS

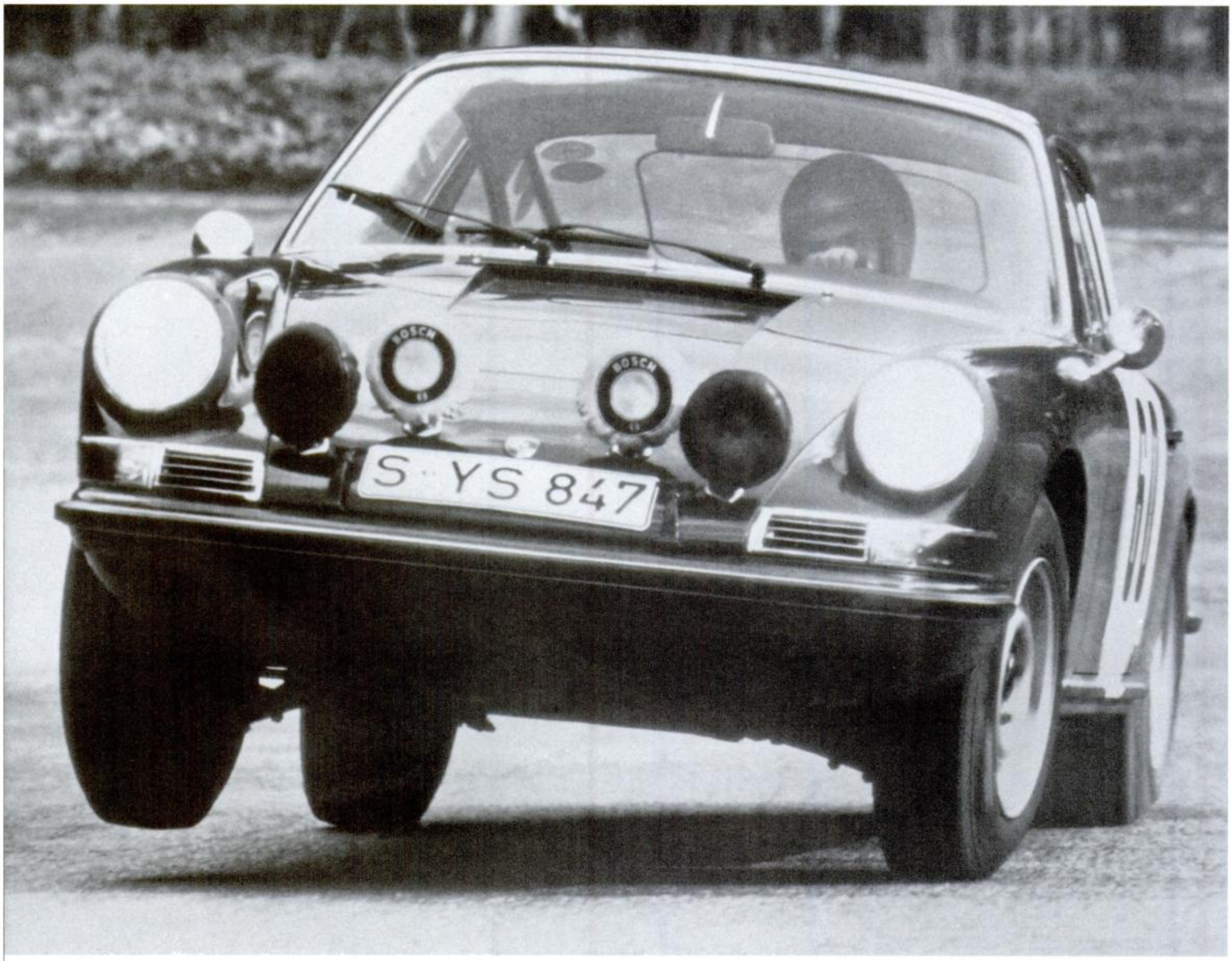
The place: The City of Lyon, France
The time: 1967
The occasion: The Stuttgart/Lyon-Charbonnières Rally

I had first driven a Porsche 911 on the Tour of Corsica rally in 1966. In 1967 the rally cars were still prepared in the Porsche customer service department in Zuffenhausen under the direction of my great friends Huschke von Hanstein and engineer Hermann Briem. Until now, all of Porsche's competition efforts had been directed toward circuit racing, but a third place in Corsica followed by another third after leading for so long on the Monte Carlo rally had opened their eyes to the benefits to be gained through rally success.

Huschke and Hermann paid me the ultimate compliment of absolute trust in everything concerned with the

Porsche 911, Stuttgart/Lyon-Charbonnières, 1967

David Stone and I celebrate a dominant victory. The car had to be pushed into position for the photos. Read on and you will find out why! Jean Sejnost



Porsche 911, Stuttgart/Lyon-Charbonnières, 1967

I had calculated that the race on the Solitude Ring, literally just down the road from the Porsche factory in Stuttgart, would account for 40 percent of the rally's overall test results, so performance on the track was vital to achieve success. Porsche

rally program, even to designing the specification of the car.

Porsche was one of the first manufacturers to use a five-speed gearbox in its production cars and at the same time offer a vast selection of alternative gearbox and final drive ratios. This gave us a tremendous advantage over other manufacturers who could usually change only the final drive ratios but not those in the gearbox. Later this year I would win the Tulip rally with a Porsche 911 whose top speed at 7200 rpm in fifth gear was only 100 miles per hour, but which, with five equally spaced gears, gave shatteringly fast acceleration.

For the Stuttgart/Lyon-Charbonnières rally we calculated that the first special stage, which was in fact a race on the Stuttgart Solitude Ring track, would account for about 40 percent of the total test time of the rally, so we had to balance the requirements of the racetrack and its more than 150-miles-per-hour-top speed with those of the hill climbs that would come later.

Normally on a Porsche 911 designed to go quickly in the mountains, first gear is used only for starting. Once under way the car is driven as if it has a four-speed transmission using second, third, fourth, and fifth gears. In this case we would have to reverse the process, using only first, second, third, and fourth for the mountains. Fifth would be so high that it could only be used on the racetrack. But that meant using a first gear at least as high as our normal

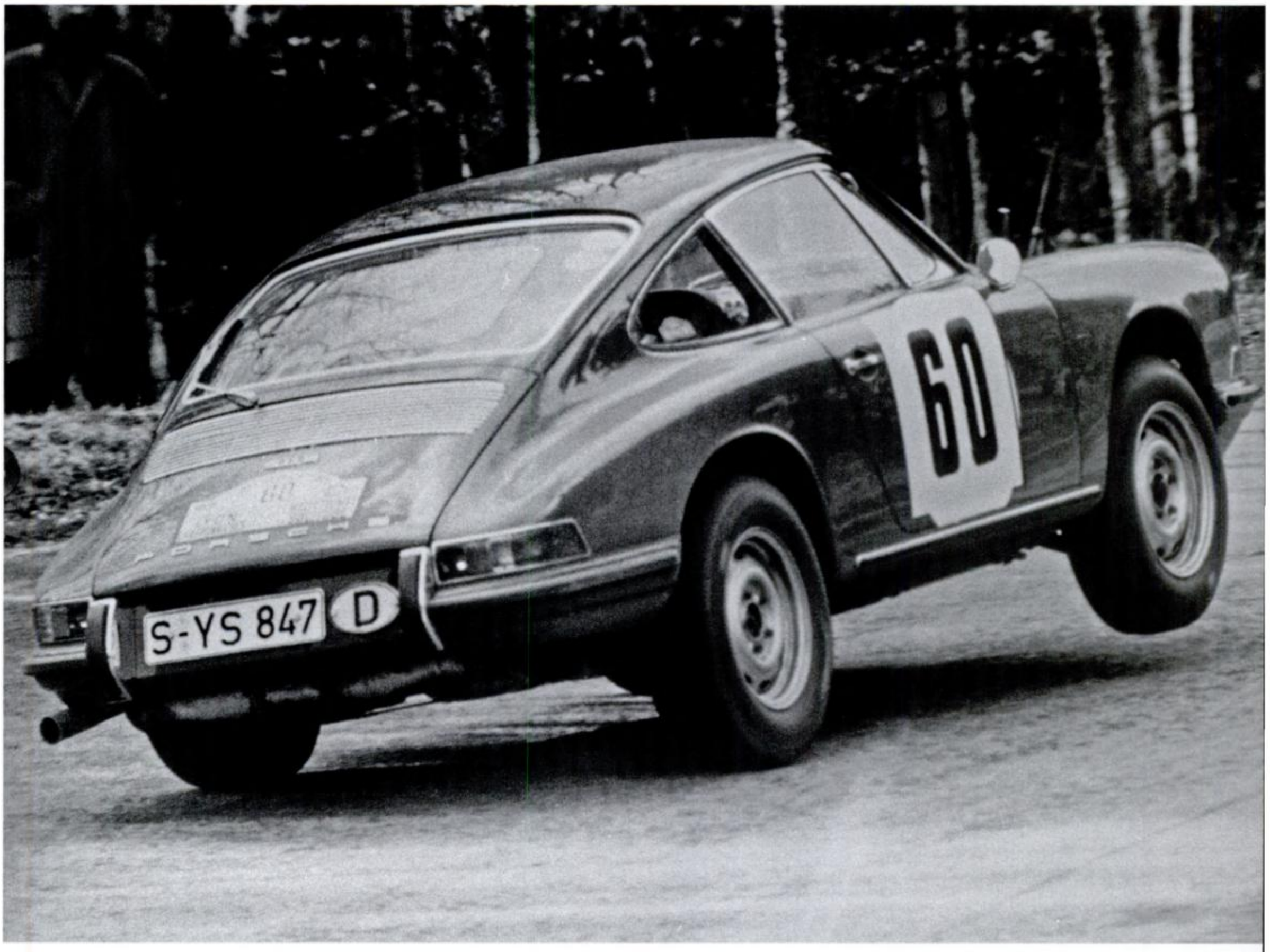
second, and I would have to be very, very careful getting it away from the start line on all the mountain climbs.

The rally had started three days earlier in Porsche's hometown of Stuttgart, with the first competitive test being the race on the high-speed Solitude track. With my back-to-front gearbox I had won the race at Solitude and then continued to build an unassailable lead.

Now it was midnight—cold, dark, and raining. All the competition driving was behind us, and we had only to traverse Lyon and reach the casino town of Charbonnières to record our first victory in a Porsche 911.

Suddenly the needle on the rev counter was mounting —but not the one on the speedometer! Despite all the babying of the car off the start lines of the hillclimbs, the clutch was worn out and starting to slip. I was faced with the longest 30 minutes of smooth driving of my life. Instead of being able to accelerate hard after each red light, I had to caress the throttle pedal as though there was a fresh egg between it and my foot. Fortunately, few natives of the city of Lyon are on the road at midnight. Not for nothing is Lyon known as the gastronomic capital of the world, and those who had partaken of its culinary delights were by now at home and savoring a last Cognac before bedtime—unless they were motor racing fans, in which case they were waiting with bated breath at the casino of Charbonnières for the winners of the rally to arrive.

In many European countries, especially France, roads are subject to "the priority of the right," which means that

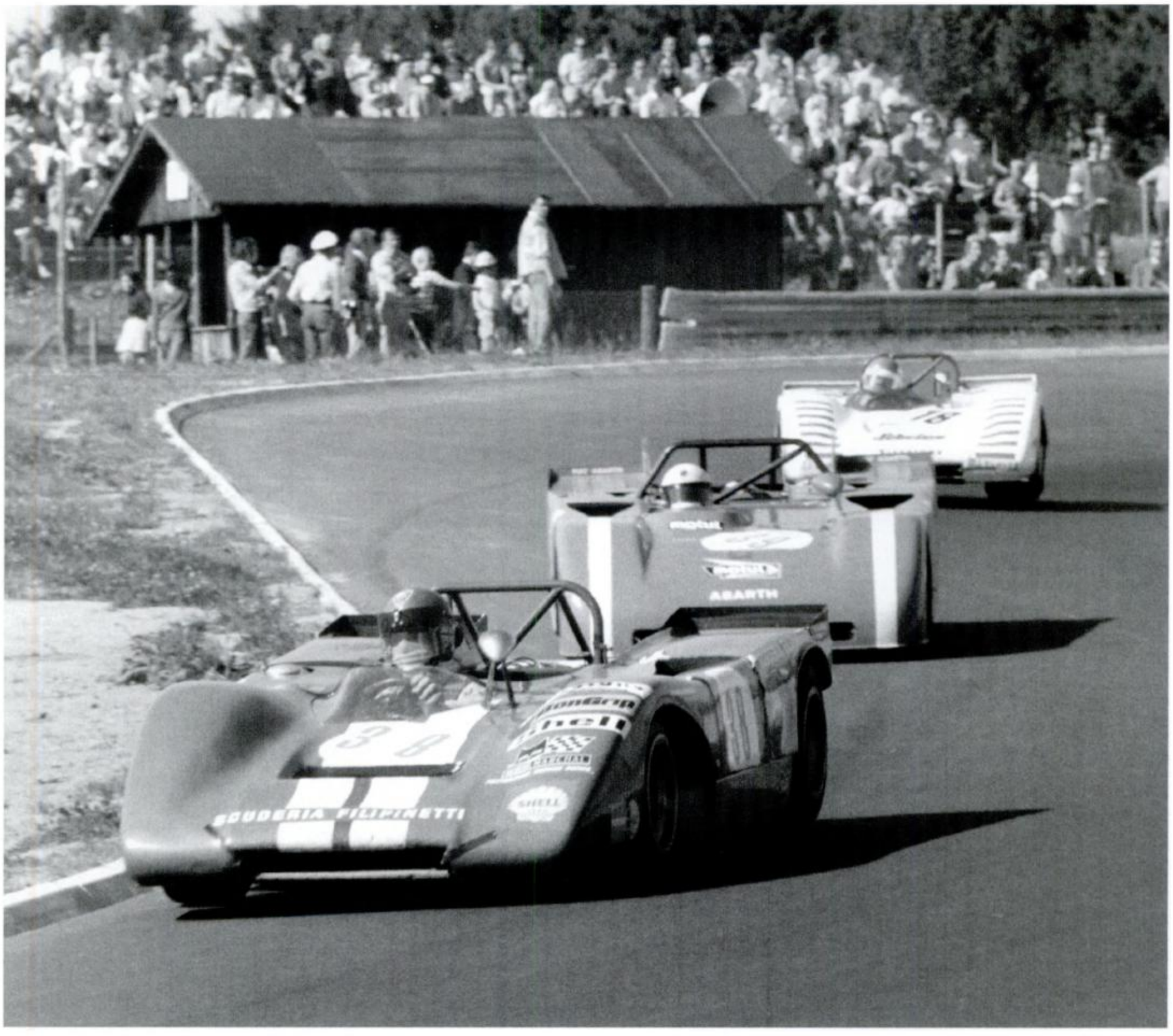


Porsche 911, Stuttgart/Lyon-Charbonnières, 1967

These were the early days of the Porsche 911, and the engineers had yet to solve the problem of keeping all four wheels on the ground while cornering on the limit. But despite that, the overall smoothness is evident. Porsche

Porsche 911, Stuttgart/Lyon-Charbonnières, 1967

Smoothness was the key to climbing the Freiberg Hill on the Lyon-Charbonnières. I was doing a great deal of steering with the throttle and the balance of the car, rather than with the steering wheel. Julius Weitmann



Lola 212, Nürburgring 500 km, 1971

Leading an Abarth and another Lola on the way to winning my second consecutive Nürburgring 500 km, my car looks more stable and balanced than the other two.

Vic Elford collection

where no right of way is established by a "Stop" or "Yield" sign, the vehicle approaching from the right has priority. Just one more obstacle in our path as I tiptoed my way across the third-largest city in France with a car that I knew if it stopped would never start again. With my co-driver David Stone peering left and right at all the intersections, trying to calculate, gauge, or just simply guess the traffic light sequences, we made it to the finish line at Charbonnières in victory. And being in France, the champagne tasted very good indeed.

When the mechanics went to move the car from the impound area the next morning, they had to push it. Despite having cooled down during the cold night, there was no clutch left at all. It was undriveable.

THE IMPORTANCE OF SMOOTHNESS

If *balance* is the single most important word in driving, *smoothness* is a close second. Next time you have the opportunity, watch how a good truck driver can wheel a monster 18-wheeler around without sudden braking or acceleration, without sudden changes of direction. If they can do it, surely you can, too, in a vehicle that is only a fraction of the size and weight and a lot better balanced.

ANTICIPATION

One more little ingredient to add to create that flowing smoothness is *anticipation*. Don't stare fixedly at the tailgate of the pickup a few car lengths in front of you. Be aware of what is happening all around you: to the sides using your peripheral vision; to the rear using your mirrors; and especially way in front of you. Try to look through the windows of the car in front to see what is happening down the road. If that is not possible, drop back a little so you can see past one side or the other; this is particularly efficient on a twisty road.

It may get you a few strange looks from other drivers, but a good way to exercise your anticipation and awareness of what is going on around you is to give a spoken running commentary as you drive. Talk to yourself about everything that you see: A ball running out into the road probably means that a child is going to be following it; a small pair of feet and legs seen beneath a parked car can warn of an unexpected dash into the road in front of you. On a rural road or freeway, take note of the road shoulders. If the road were suddenly blocked in front of you, could you safely drive off the road to avoid an accident?

You will be amazed to find that with a little practice you will become so aware of things you never noticed before that even at 30 miles per hour there is not time to say it all.

I'm sure that many of you reading this book fly or ride in private planes. At first, listening to air traffic control sounded like listening to a foreign language, but after a while you could understand what was being said, even above the crackle and static of the airwaves, because with experience *you had already anticipated and knew what the instructions or messages were likely to be* before you heard them.

SMOOTH TRANSITIONS

In a car, knowing what you are probably going to need to do helps you do it right when the time comes. Watching motor racing from the in-car camera on television gives a good insight to the way drivers anticipate. You will notice that they often act and react extremely quickly, but are rarely in a hurry, because whenever they have to do something they have usually anticipated doing it well in advance. All the movements flow together to form one continuous transition. Even though with practice you will be able to go from full throttle to maximum braking in only hundredths of a second, it must be done *smoothly*. Turning from a straight must be a *smooth* transition into and then out of the corner. Stamping on the gas or the brake pedal or jerking the steering wheel will upset that delicate balance that I discussed in the previous chapter.

My first-ever international rally as a driver was the RAC Rally of Great Britain in 1961. John Sprinzel was a well-known English driver who through his tuning company, Speedwell Conversions, had also established a solid reputation for making Austin A35s and Austin-Healey "Bug-eye" Sprites go indecently quickly. He had prepared his own Sprite for the rally when at the last minute he was offered a factory, or "works," drive. Since his car was ready it seemed a shame not to use it, so he offered it to two penniless, determined would-be future world champions: Paul Hawkins and me.

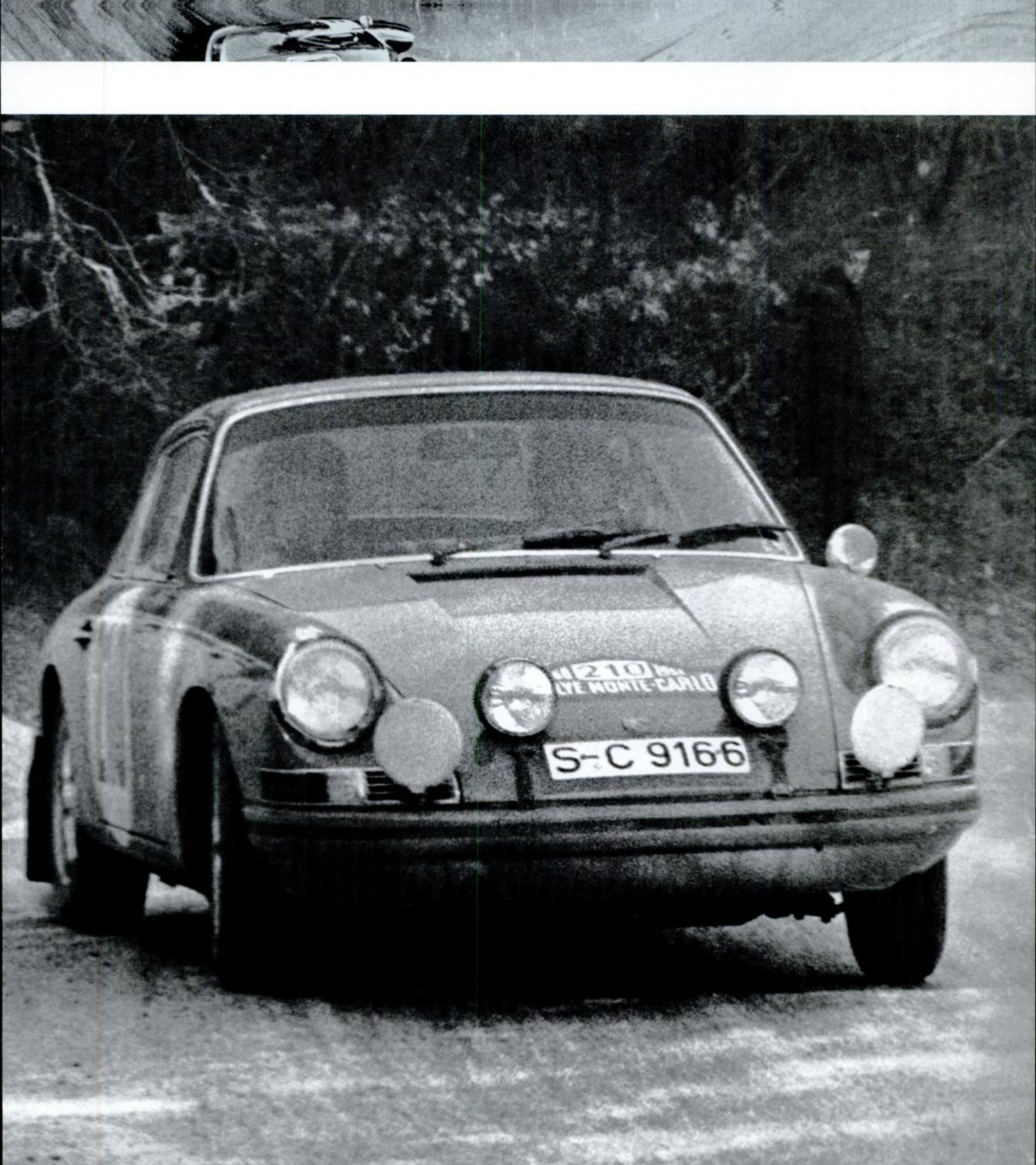
Paul was one of the most colorful characters ever to leave his native Australia to seek fame and fortune on the European racing scene. Son of a lay preacher, his face looked as though it had been carved out of a piece of granite—with a blunt chisel. At a Silverstone race, Paul drove what was then the new Lotus-Cortina, and I was in a Porsche 911. We were parked side by side in the paddock after the race, and Colin Chapman asked Paul's opinion of the car. Paul was able to spend two minutes telling him, without ever repeating the same swear word twice.

Paul had never done a rally in his life, and when we met at John's workshop he announced that he could not drive at night and did not know the top of a map from the bottom. So I would have to navigate during the day while he drove—and then I would have to navigate *and drive* at night while he slept.

I have always had plenty of endurance, so the first part of the ultimatum wasn't too bad. As far as the second part goes, for those of you who have ever experienced the inside of an Austin-Healey Sprite, I suppose I must have driven pretty smoothly because Paul really did sleep at night.

Sadly, Paul was one of many who lost their lives in racing crashes, before track owners and race organizers realized that race cars and trees a few feet from the track edge do not belong together.

Whether in normal road driving or on a racetrack, the car should always be driven as though it were on rails. It may look and feel spectacular when the car is sideways, but modern chassis, suspension, and tires give the best results when the car stays glued to the road. The exceptions to this rule are when driving on ice and snow or other loose surfaces, and I will discuss them later. But whatever the conditions, even on loose surfaces where you are steering the car with the throttle, you must still be *smooth*.



Porsche 911, Monte Carlo rally, 1968

Even when the car is sliding through a corner on the ice and snow, it remains perfectly balanced. Porsche

CHAPTER 4
THE CARS

The place: The Mulsanne Straight, Le Mans, France
The time: 4:02 p.m., one Saturday in June 1970
The occasion: 24 Hours of Le Mans, the First Lap

I was heading down the Mulsanne Straight at over 240 miles per hour in the fastest racing car ever built, and the only 5.0-liter long-tailed Porsche 917 entered in this year's race.

Although I had been on the pole position, which I won after setting a new lap record and being the first person ever to cover the 8.4-mile circuit at over a 150 miles per hour average two days earlier, Jo Siffert had just beaten me away at the start. I was sandwiched between Jo and Pedro Rodriguez in the two Gulf-Wyer short-tail 917Ks as we streamed under the Dunlop bridge, down through the "esses," and around the Tertre Rouge corner onto the straight.

As we approached maximum speed the smooth slippery shape of the long-tail had taken over and I had swept ahead of Jo and drawn away from the two short-tailed cars. Past the two Hunaudières restaurants huddled together on the left of the road, customers sipping their first cocktail of the evening, only three feet from the edge of the road, see little more than a white flash as the car goes by, covering the ground at more than 350 feet per second!

I go through the Mulsanne kink, which I take flat out in a long, smooth, balanced arc and on toward the notorious Mulsanne corner. About 500 yards from the corner I feel the front of the car get light as it crests the famous

Porsche 911S, Tour de Corse, 1966

My first experience in a 911. Compared with a Renault Alpine or Renault 8 Gordini, the 911 was a BIG car for the tiny mountain roads of Corsica. It was also the start of a three-month apprenticeship in learning to drive the reputedly difficult-to-handle rear-engine layout. Porsche

Left: DKW, Tulip rally, 1967
In total contrast, here is my first rally car, the little 750cc three-cylinder two-stroke front-wheel-drive DKW, climbing the Mont Ventoux at my first international rally as a driver. Vic Elford collection

Below: Ford Lotus-Cortina, Coupe des Alpes, 1966
One of the best "conventional" rally cars of the 1960s. Capable of great performance but often suffered from annoying little failures. Vic Elford collection

Porsche 911R Sportomatic, Marathon de la Route, Nürburgring, 1967

After leading this incredible event for 72 hours in a Ford Lotus-Cortina before it broke in 1966, Jochen Neerpasch and I were joined by Hans Herrmann in the 1967 event and won comfortably. The only time a Sportomatic transmission was ever used by a factory Porsche race car. Porsche

hump; the wheels do not quite leave the ground but there is so little weight on the front ones that the steering has little effect. As the weight settles again onto all four wheels I glance in the mirror and see that the colossal speed advantage the long-tail body gave me on the more than 3-mile straight, over half of which is covered at sustained maximum speed, has opened a big gap to the pursuing cars. Even just a quick glance shows Jo and Pedro being hounded by four Ferrari 512s.

No matter what the car, there is only one speed for the Mulsanne corner, about miles per hour. Past the 300 meter marker board and then smoothly, firmly, then harder and harder on the brakes. In less than 300 yards the speed comes down from over 240 miles per hour to about 40 miles per hour. Even in daylight, those standing at the edge of the track can see the brakes glowing white hot through the wheels.

Balancing the car delicately through the Mulsanne Corner—the long-tail doesn't take kindly to being jerked around, even in slow corners—I accelerate cleanly and smoothly for the next two miles. At 200 miles per hour just a lift from the gas pedal gets me through the right-hand kink. It leaves the car poorly positioned for the Indianapolis Corner but has the advantage of keeping the high speed going longer.

Through Indianapolis and the short straight to the very slow, narrow, right-hand Arnage Corner in first gear then back up through the gears to over 200 miles per hour

in fifth gear before, with a little touch on the brakes to steady the car, I change down to fourth while the car is airborne over the little humpback bridge. I instantly flick right toward the famous and notorious left-hand White House Corner, then accelerate hard again to the left and right of the Ford Chicane to swoop back onto the pit straight alone. There can be few experiences in the world as exhilarating as those first three and a half minutes at Le Mans in a car like the Longtail 917!

PORSCHE CARS

Dr. Ferdinand Porsche built the first car to bear his name for himself, because he simply could not find the sporty car that he wanted in the market at the time. His genius and dedication were inherited by his nephew, Dr. Ferdinand Piëch, who will probably be remembered in history as one of the greatest automobile engineers of all time.

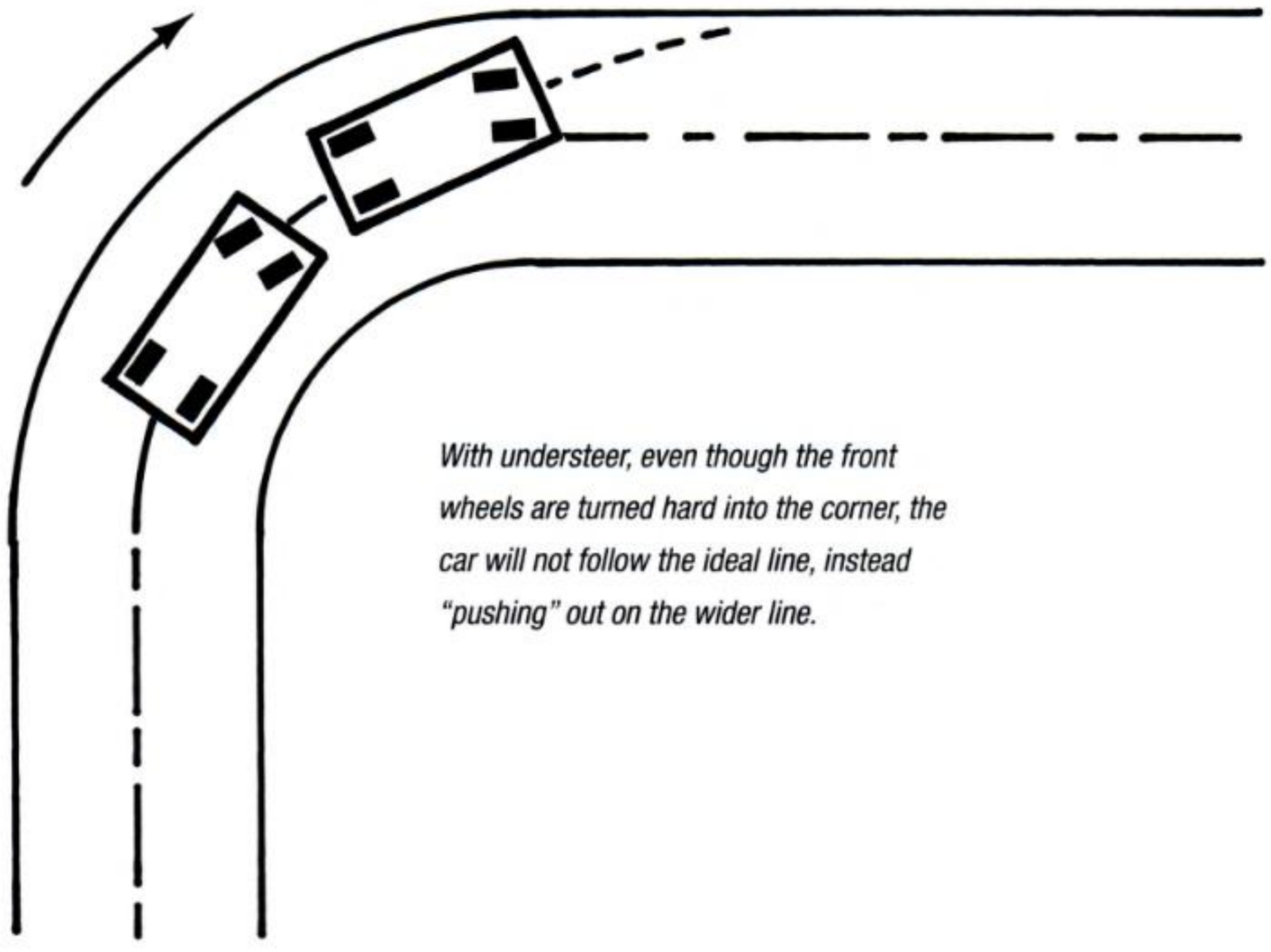
From involvement in the 911, which first saw the light of day in 1963 (and is still the standard by which other sports cars are measured today) through the unbelievably lightweight 908 and perhaps the greatest racing car of all time, the fabulous 917 in all its variations, the stamp of the fertile imagination of Ferdinand Piëch was everywhere. He left Porsche in 1972 and subsequently became chairman of Audi, where he was responsible for a range of passenger cars second to none, as well as the sensational World Rally Champion Quattro Coupe. From there he went to Volkswagen and again assumed the chairmanship of the German giant as he led it into the twenty-first century. Under his guidance Volkswagen cars moved upscale, far away from the little people's car that his grandfather, Dr. Ferdinand Porsche, had designed back in the 1930s, and he was a major force in the development of the new Diesel engine revolution that saw Audi win Le Mans with oil-burning power. At the same time the incredible, mind-blowing Bugatti Veyron also became reality.

PORSCHE HANDLING TRAITS

Before we start talking about the cars and their varying handling characteristics, there are some phenomena with which you need to be familiar. Don't worry, I am not going to blind you with science, I'll just give you some very simple definitions. I will go into a more technical analysis of why these things happen and what to do about them in a later chapter.

- ***Understeer:*** Also described as "pushing" or "plowing," understeer is what happens when you turn the car into a corner and it still has a tendency to go straight on. You find yourself winding on more and more steering to try and follow the desired arc through the corner.
- ***Oversteer:*** Also described as "loose," oversteering is the opposite of understeering. Having turned into a corner, the car turns more sharply than desired and the rear end tends to lose grip and slide outward.
- ***Neutral Balance:*** Providing you make no excessive acceleration or braking demands on the car, it will neither understeer nor oversteer, but will follow a "neutral" balanced line through and around a corner.

While all of these conditions are largely dependent on the design of the car (for example, its weight distribution, spring rates, and other built-in properties), they can also be affected by the input from the driver.



With understeer, even though the front wheels are turned hard into the corner, the car will not follow the ideal line, instead "pushing" out on the wider line.

FRONT-WHEEL DRIVE

In looking at the basic handling characteristics of different cars, let us start with the only one *not* made by Porsche.

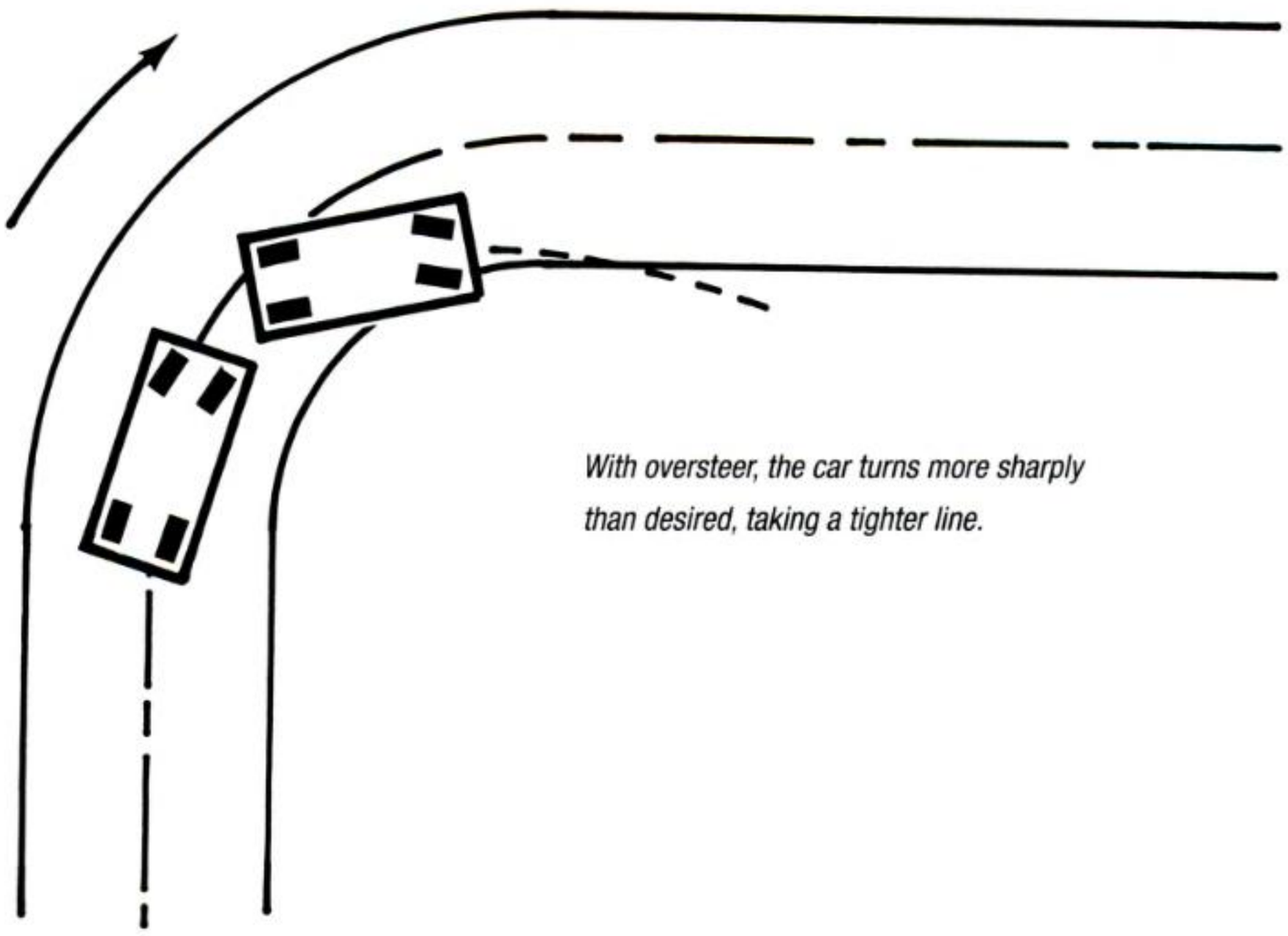
Front-wheel-drive cars exist for three fundamental reasons. First, because the entire power and drivetrain package are all together at the front in one unit, they are cheaper to build. Second, with no transmission tunnel or driven rear axle taking up room, they allow more usable space within the vehicle. Third, in the hands of many everyday users whose only notion of driving is that you push one pedal to go, the other one to stop, and you turn the steering wheel to point the car in roughly the right direction, they are inherently safe.

The front engine and drivetrain configuration means that front-wheel-drive cars have a weight bias toward the front. Indeed, depending on the make and model, the weight distribution may be as high as 60 percent over the front wheels with as little as 40 percent at the rear.

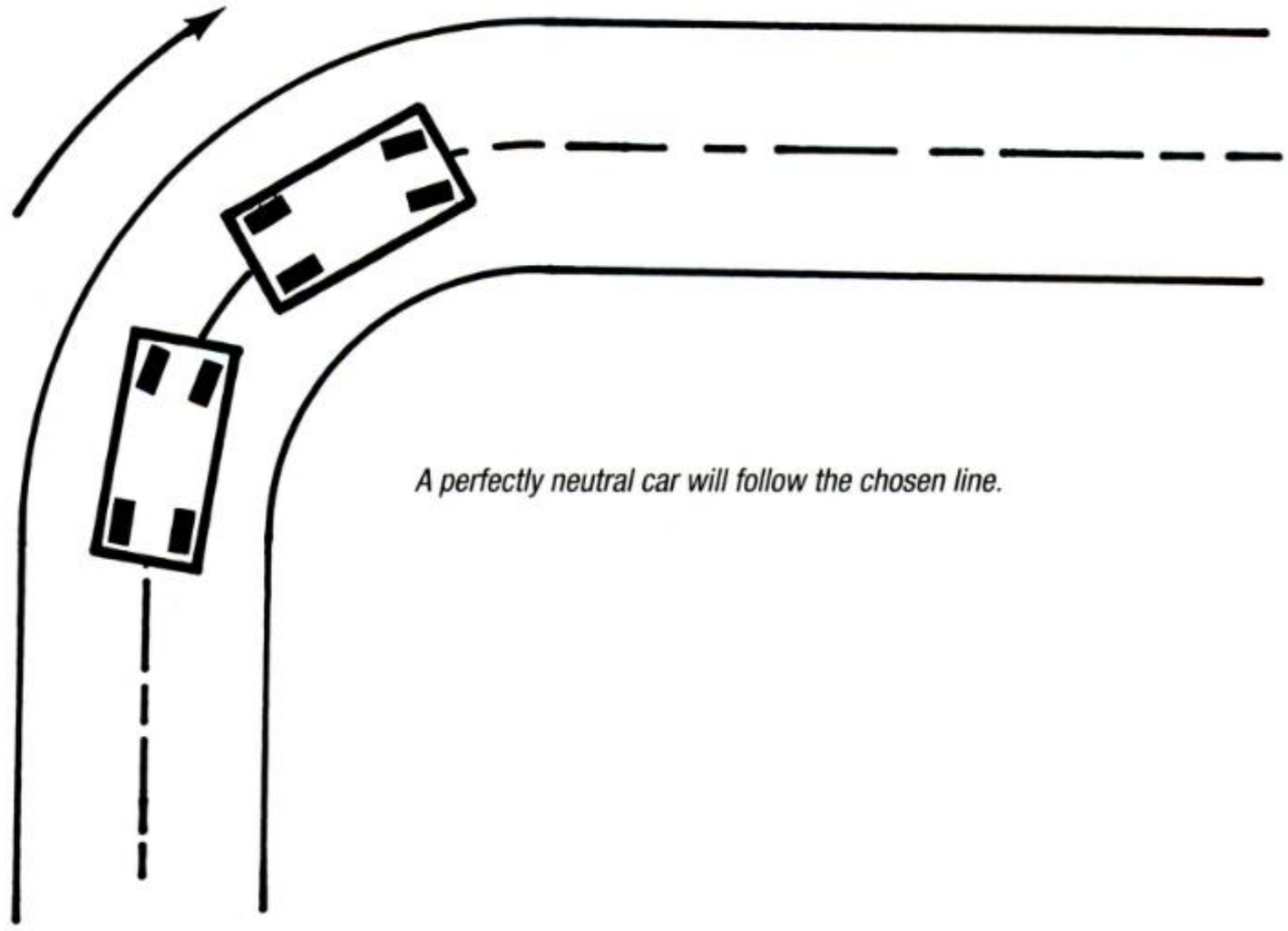
In production form, they all understeer. The inexperienced driver arriving too fast into a corner will usually have a natural, automatic reflex action—lift off the throttle pedal. With a front-wheel-drive car, that is absolutely the correct thing to do. It instantly cuts off the transmission of power to the road (which was using up some of the capability of the tires). At the same time it transfers weight to the front wheels, which in turn gives them added grip to steer the car.

In the heyday of the original Mini Cooper, which had so much weight over the front wheels that a really strong person could lift the back off the ground single-handed, we used to joke that the only reason it had rear wheels was to stop the body from dragging on the ground!

I like to use the term "negative safety" concerning front-wheel-drive cars, since with them, doing nothing, or at best having almost a panic reflex action in an unexpected situation, is in fact the safest thing to do. There are some "positive" things that can be done with front-wheel drive, but they are rather advanced in concept and comparatively difficult to master, and I will discuss them later.



With oversteer, the car turns more sharply than desired, taking a tighter line.



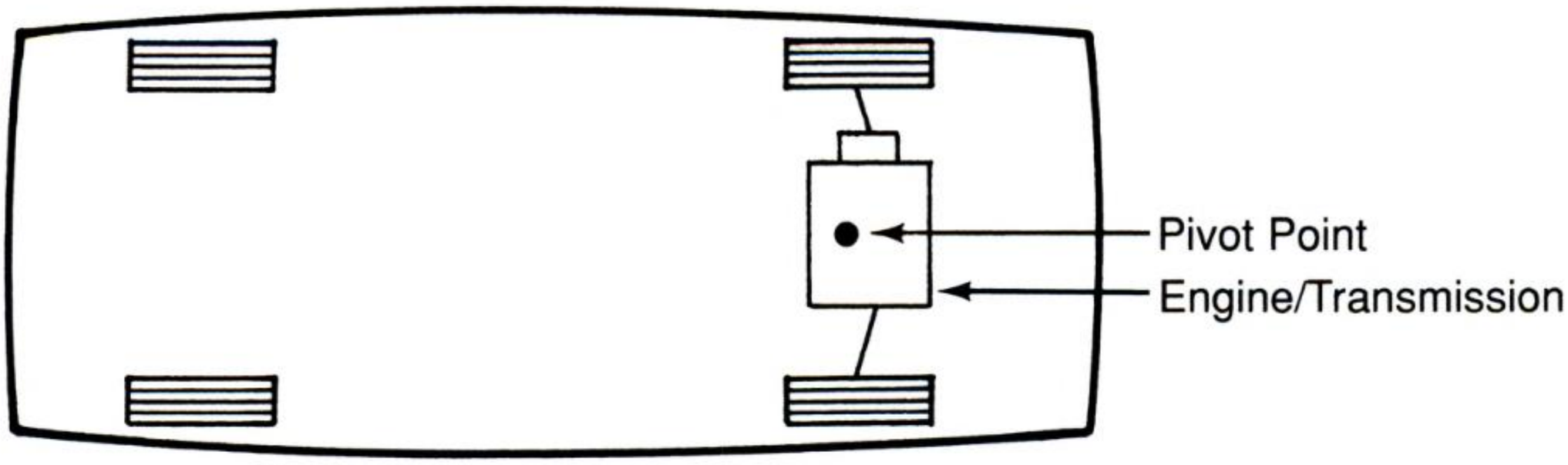
A perfectly neutral car will follow the chosen line.

REAR-WHEEL DRIVE: FRONT ENGINE, FRONT TRANSMISSION

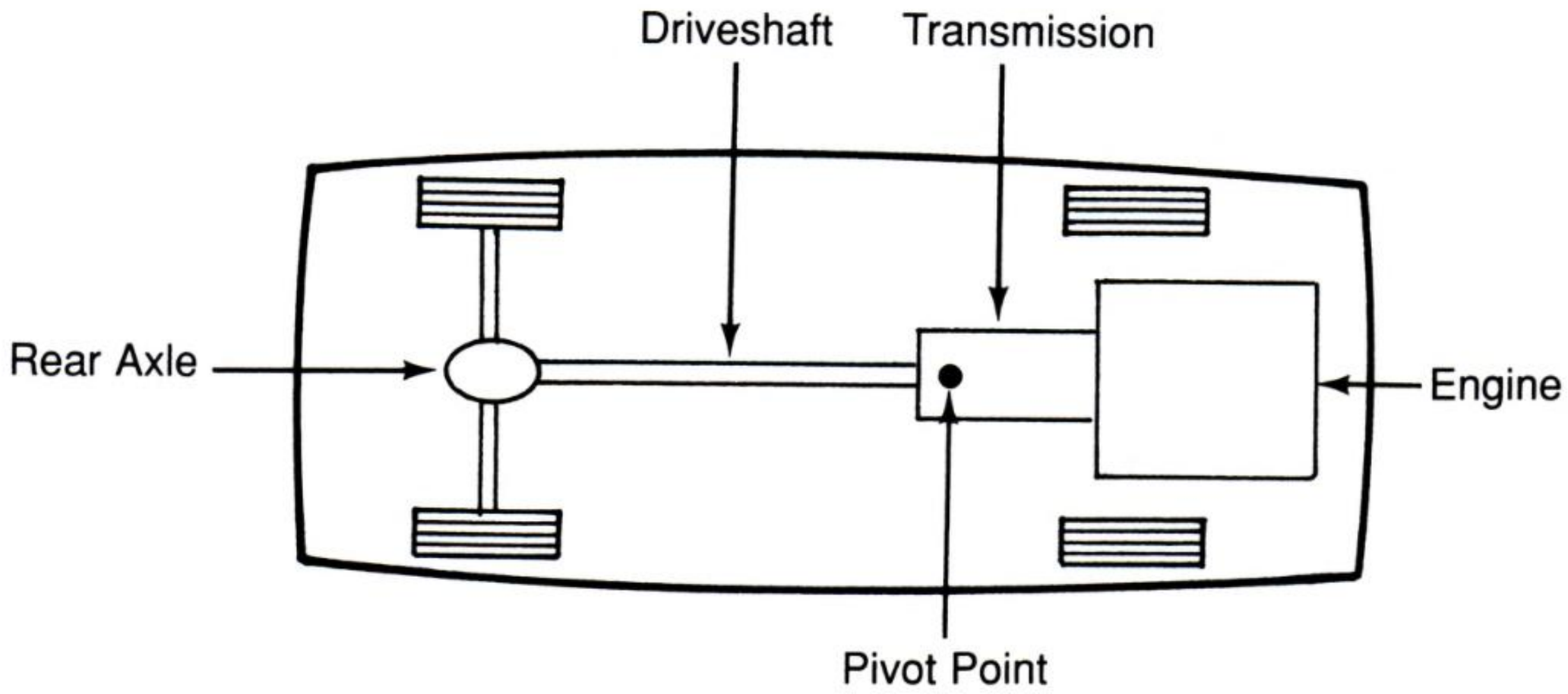
Engine and gearbox coupled together at the front and just the rear axle providing power transmission to the road was the traditional layout for decades. Still nose heavy, like the front-wheel-drive cars, it is basically an understeering configuration. However, because of the comparatively light loading on the rear wheels, it can be tricky to drive under extreme conditions.

REAR-WHEEL DRIVE: FRONT ENGINE, REAR TRANSMISSION

As long ago as the mid-1970s, Porsche pioneered the splitting of the transmission in sports cars in order to create almost equal weight distribution on both front and rear wheels. This is the layout of the Porsche 944, 968, and 928, and the result is an almost perfectly balanced vehicle. The engine is at the front and a combined gearbox and rear axle, called a transaxle, is at the rear. Not only does this provide almost 50-50 weight distribution, it also gives the car a very high polar moment of inertia,



With front-wheel drive, most of the weight is centered over the front wheels—including the pivot point.



The front-engine, rear-wheel-drive setup.

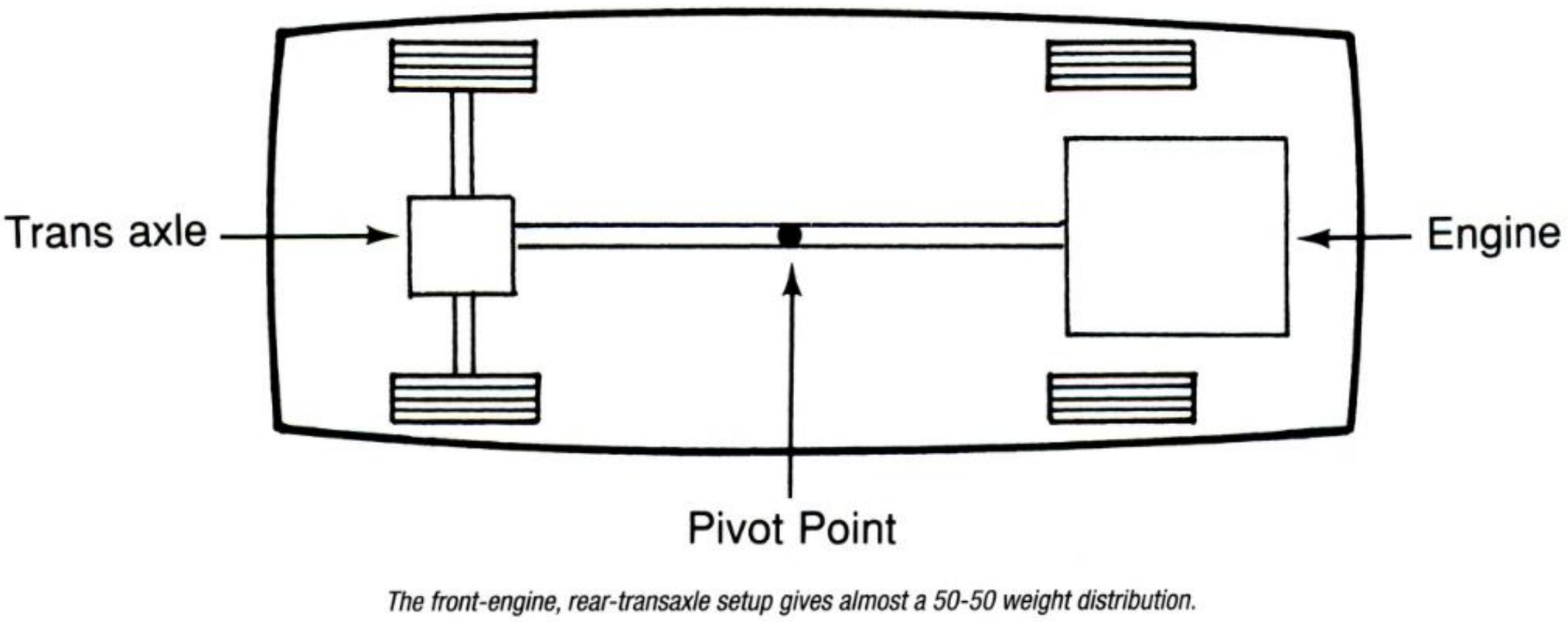
which endows it with great stability at high speed, especially in the event of crosswinds. (This is discussed in more detail under the heading **Handling and Pivot Points.**) It also means that the car is almost neutral in its handling and its ultimate comportment can be greatly influenced by the input of a skillful driver.

REAR-WHEEL DRIVE: MID-ENGINE

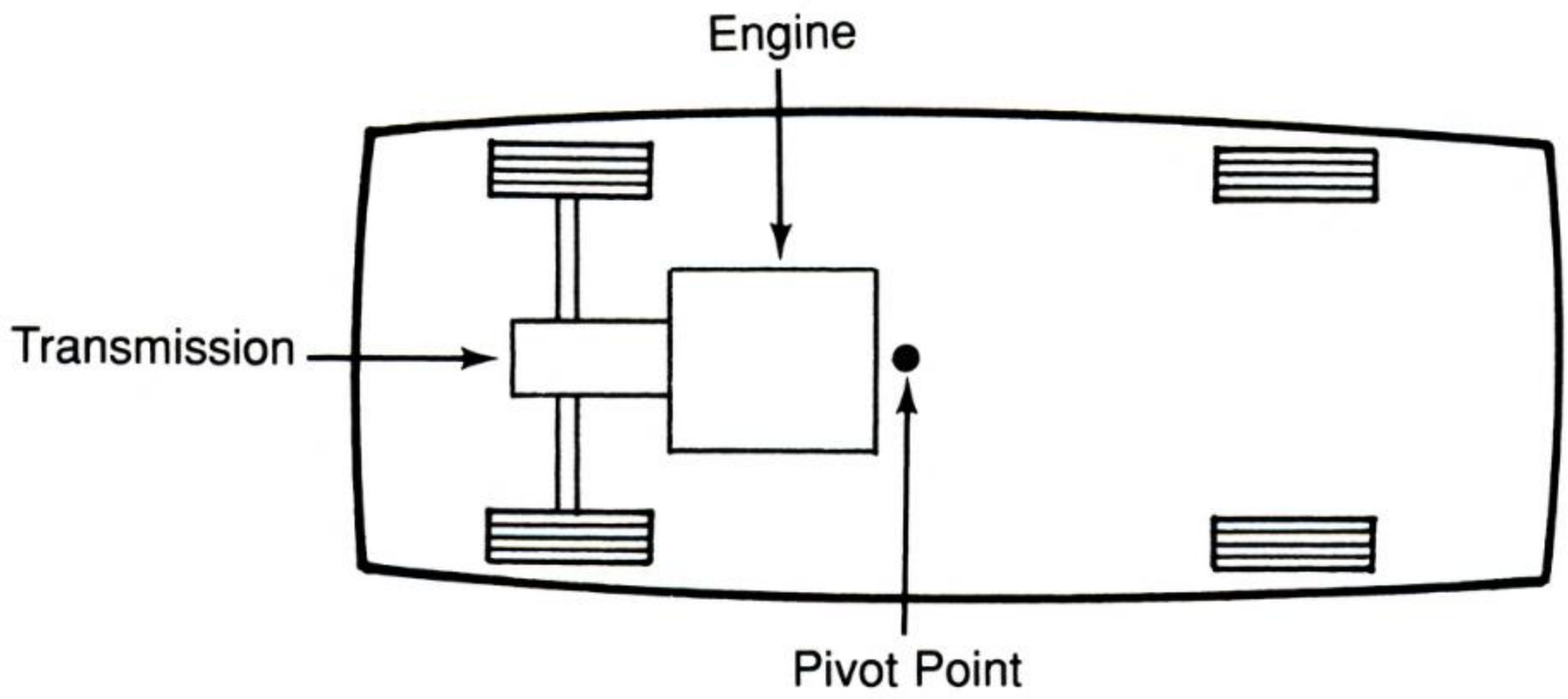
For the Porsche fan, mid-engine used to mean the 914. Once again, Porsche was a pioneer in mid-engined sports cars, but there are others. Ferrari's Testarossa and Toyota's MR2 immediately come to mind, and in the early 1970s there was the superb Lancia Stratos. The main difference between the Lancia Stratos and the others was that the Lancia was conceived and designed to be a rally winner first—then adapted to become a street-legal vehicle afterward; the Porsche 914, as well as the others, was originally designed as a road-going sports car and then modified for competition afterward.

Like the 944, 968, or 928, the 914 also has approximately 50-50 weight distribution, but instead of the weight being concentrated in two masses, one at each end, it is all concentrated in the middle. This makes for a well-balanced, neutral-handling car, but with a very low polar moment of inertia, which has two significant effects on its handling: It tends to be susceptible to crosswinds and on slippery surfaces will rotate very quickly.

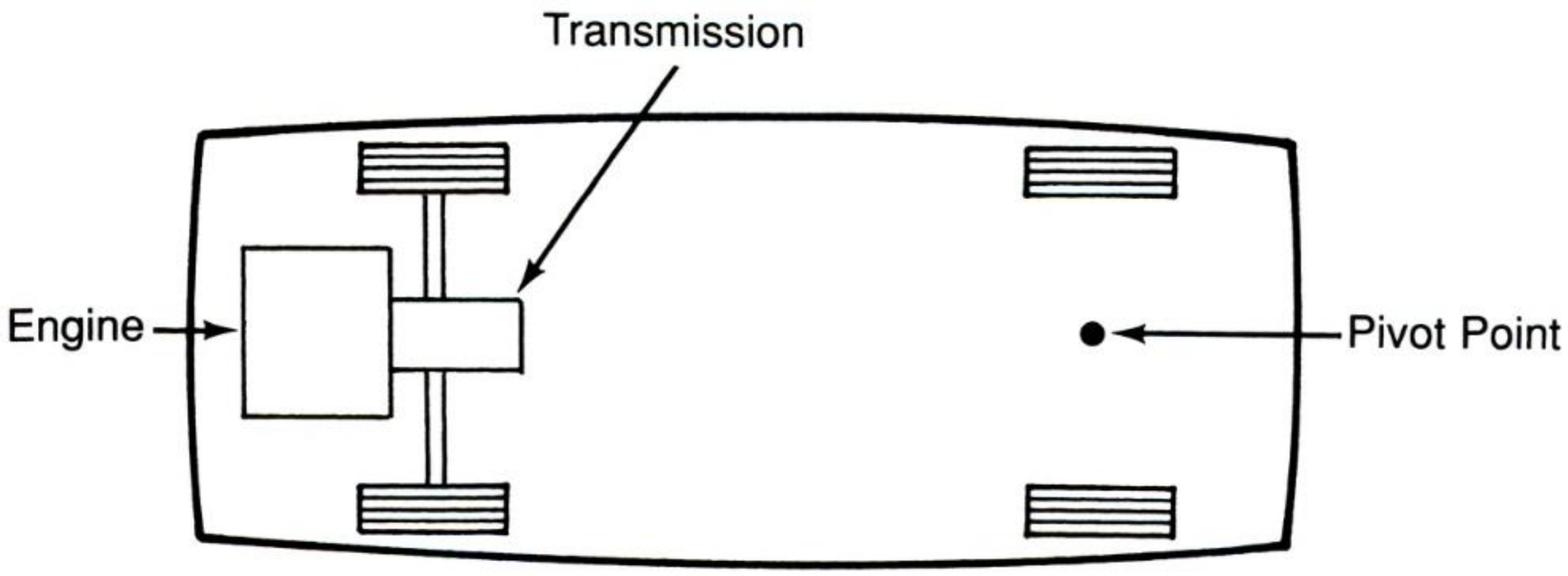
Since the first version of this book was written, Porsche has introduced new models that in many ways contradict what has been written here, cars that now have names in



The front-engine, rear-transaxle setup gives almost a 50-50 weight distribution.



A mid-engine layout gives almost a 50-50 weight distribution, but lack of weight at each end makes for "nervous" handling.



A rear-engine car, such as a 911, features a pivot point that is separated from the weight concentration.

place of numbers, the Boxster and the Cayman, both of which are mid-engined. Although the weight distribution remains similar to those mentioned above, Porsche engineers have brought their immense knowledge of and experience with suspension and chassis design to bear, and although they still react very quickly to steering and throttle inputs, they do so without the nervousness of their predecessors.

REAR-WHEEL DRIVE: REAR ENGINE

With those words the first thing that comes to mind is the Porsche 911. Also, in the minds of many, are stories of 911s spinning or leaving the road backwards, leaving nasty marks on the guardrails around freeway exit ramps. Most of these stories come from people who assume that because of their rear weight bias, 911s automatically spin the moment conditions are anything but ideal.

The truth of the matter is that although early 911s were indeed more difficult to drive than "conventional" cars, in part because of the weight distribution, but also because that was coupled with comparatively narrow wheels and tires, once the technique is mastered, one can do things with a 911 that, if not impossible, are certainly much more difficult with other cars. However, it is vital to cultivate the sense of balance and develop the smoothness discussed earlier in order to get the best out of this car.

The weight bias of today's Carrera is still approximately 40 percent on the front wheels and 60 percent on the rear, but advances in suspension design and wheel/tire sizes that match the requirements made of them have helped to

Porsche 911R Sportomatic, 1967

Our winning car proudly sports its victory garland outside the factory after returning to Stuttgart. Porsche

create a superbly balanced car, free of vices, which can comfortably be driven very close to its limits.

ALL-WHEEL DRIVE

There is one more type of car that we have not yet looked at, and that is four-wheel drive, or all-wheel drive, as it is often called. Depending on the weight distribution, it will handle basically as shown above for its two-wheel-drive counterpart.

In other words, the fundamental handling and balance of a Porsche Carrera 4 will resemble that of a 911 or a two-wheel-drive Carrera. Similarly, an Audi Quattro will be like a front engine/front transmission, rear-wheel drive. But there are many subtle differences in the way they must be driven to get the best out of them, and I will examine some of those subtleties in a later chapter.

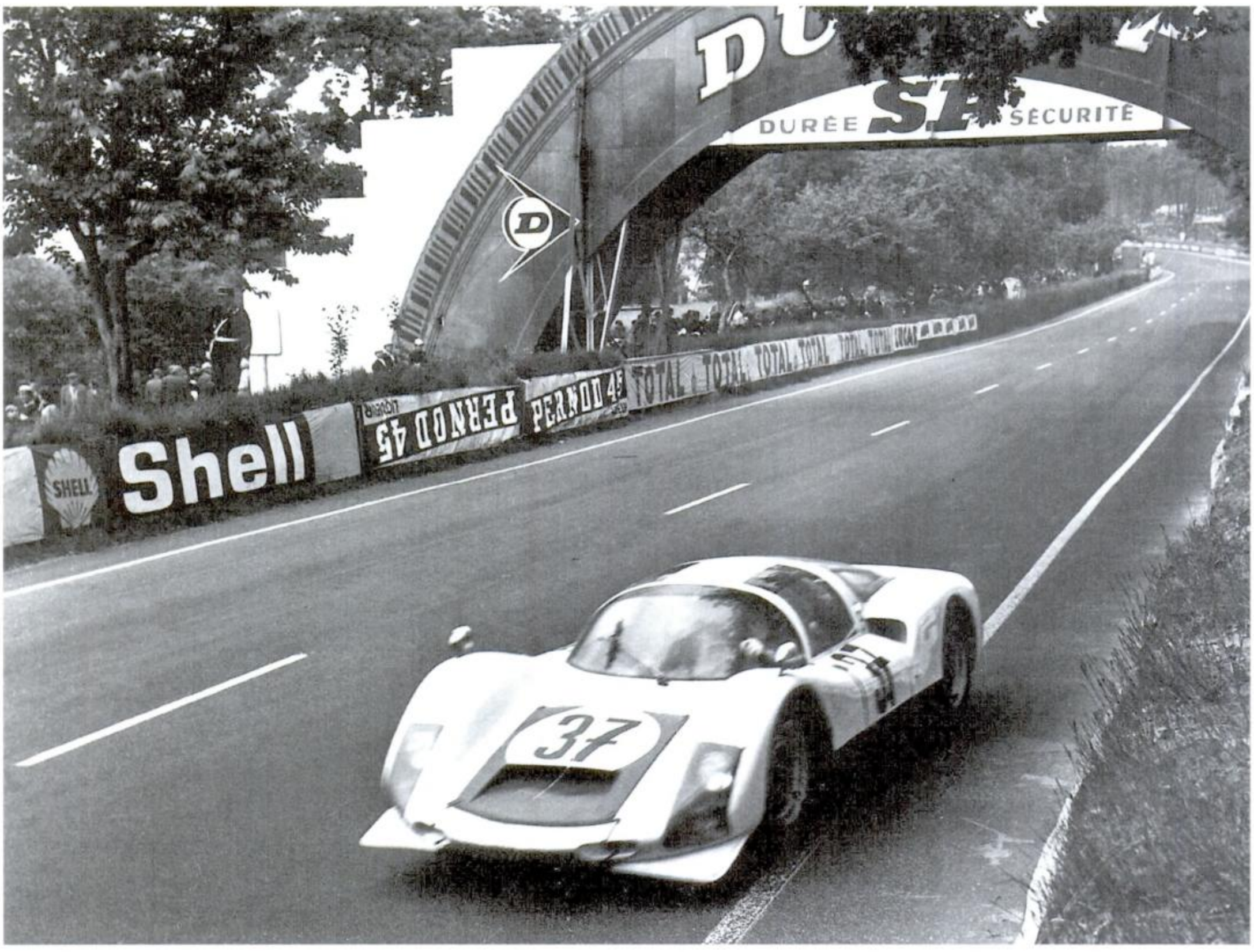
HANDLING AND PIVOT POINTS

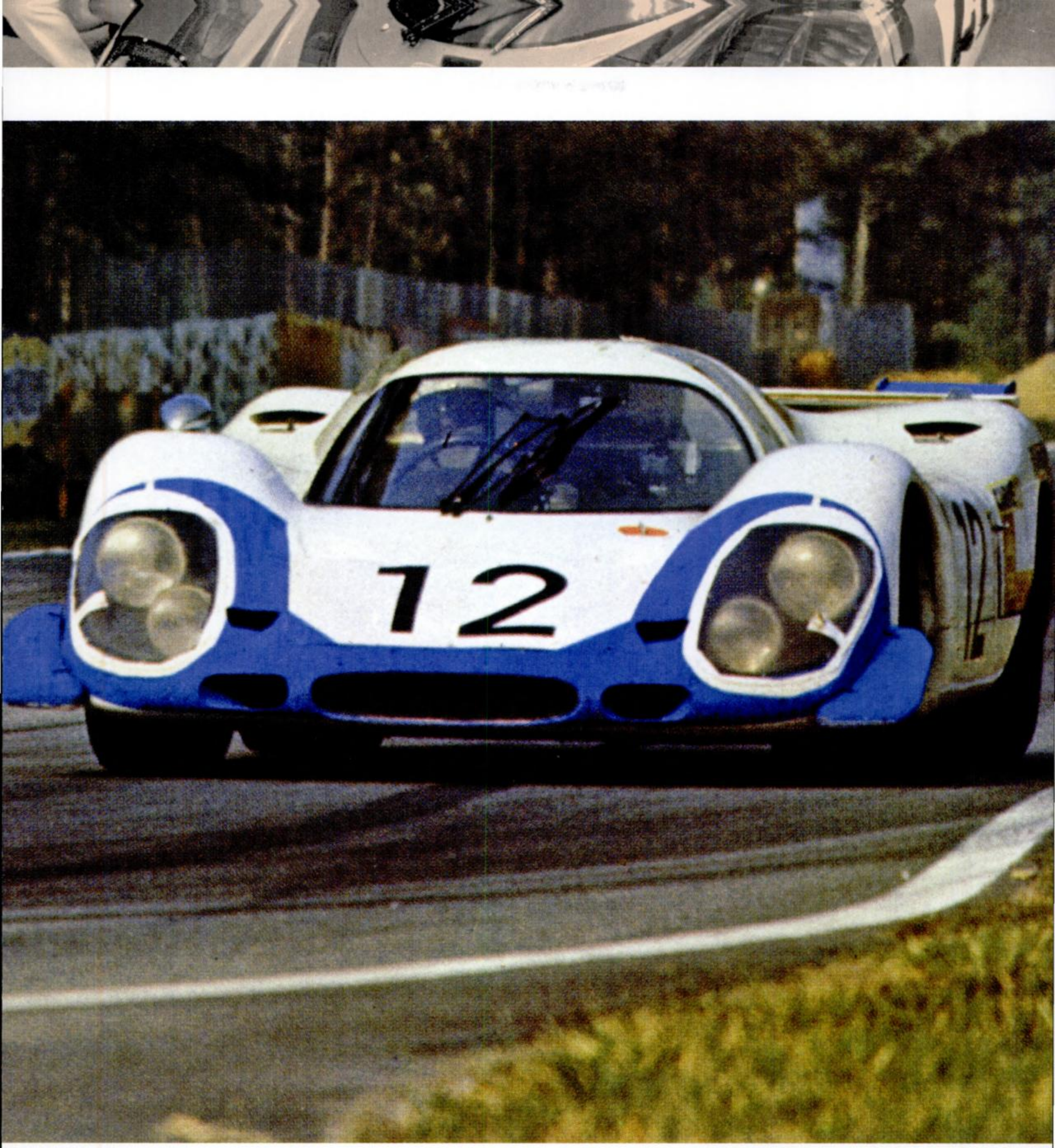
In order to better understand the behavior of each type of car, let's look at where the various "pivot" points are with the aid of the previous diagrams. By pivot point, I mean the imaginary point around which the car will rotate when cornering or sliding. In the case of front-wheel drive, you will see that there really is not a pivot point. Everything is more or less centered over the front wheels; they lead and the rest follows.

For a conventional front engine, rear-wheel-drive car, the pivot point is perhaps a third of the way back from the front wheels. Having a good proportion of the engine/transmission mass very close to the pivot point means that this type of car is very stable, but at high speeds or on slippery surfaces, the light loading over the rear wheels allows them to rotate very quickly.

Porsche 906, Carrera 6, Le Mans, 1967

As Huschke von Hanstein weaned me from rallying and into the sports car racing team, I made my first visit to Le Mans, teamed with Dutch driver Ben Pon. We finished seventh overall and first in the Group 5 category. Porsche





Porsche 917, Le Mans, 1969

I lobbied hard to drive the first 917 at Le Mans. Although engineers Piëch and Bott insisted the car was still very experimental and would only last six hours, Richard Attwood and I drove it with kid gloves and were leading by more than 50 miles when it broke after 21 hours. Porsche

Porsche 917 Longtail, Le Mans, 1970

In just one year, the Porsche engineers, led by Ferdinand Piëch, had transformed the 917 into the potential world-beater it was intended to be. I drove the only 5-liter Longtail and qualified on pole after the first-ever lap of Le Mans at an average speed of over 150 miles per hour. Michael Keyser

In a front engine/rear transaxle car, the pivot point is right in the middle, but the mass at each end makes the rotation very predictable and controllable.

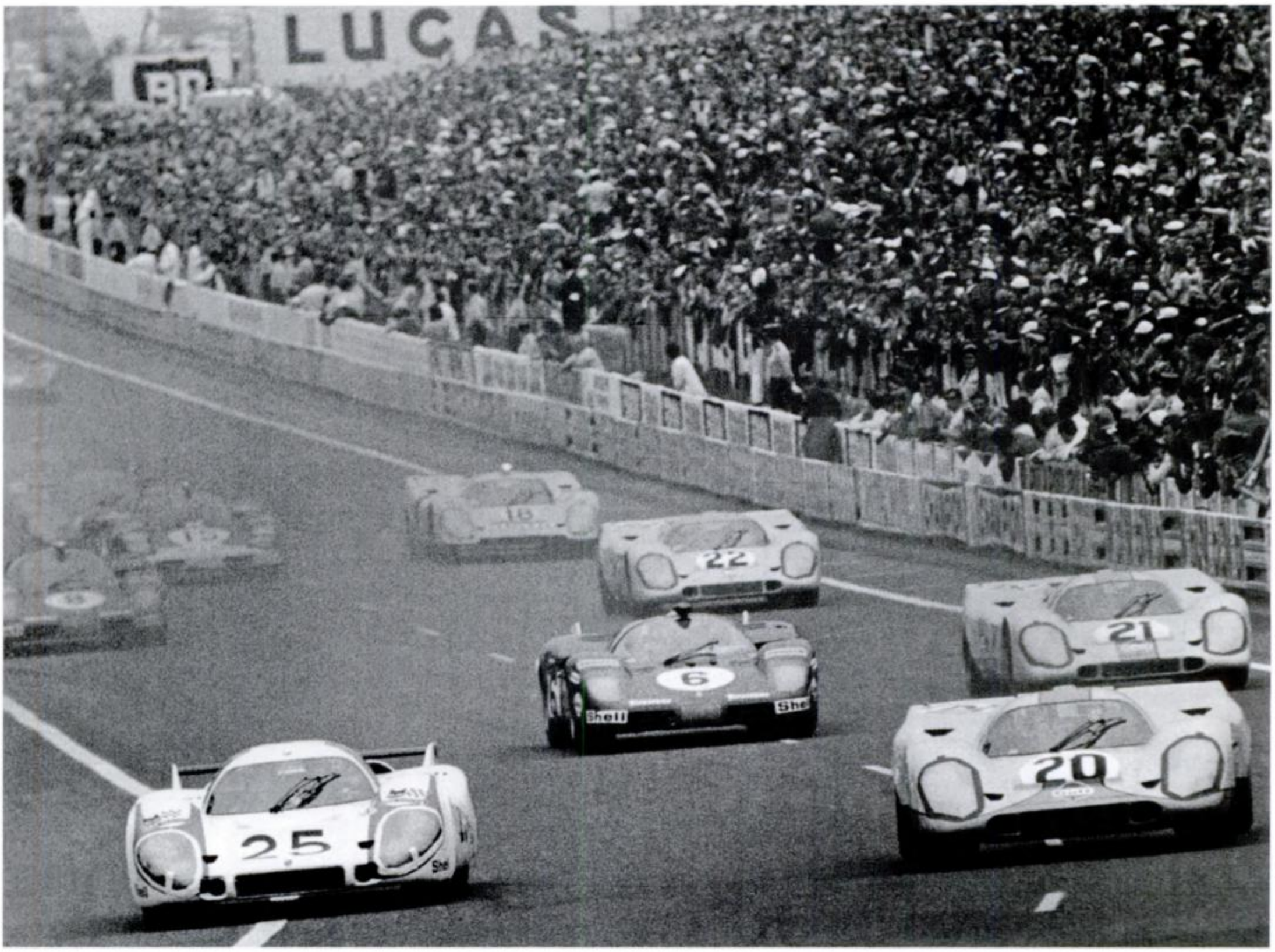
With a mid-engine car, the pivot point is again right in the middle, but the lack of weight at each end means that it can rotate very quickly.

Finally, there is the rear engine car, which today means quite simply the Porsche 911. Known now in its latest form as the Carrera, it has its pivot point more or less on the center line between the front wheels. So much weight at the rear causes a pendulum effect as the car rotates and can create problems for inexperienced drivers. As there is so much mass to get moving, it starts off almost imperceptibly and slowly builds momentum as the slide progresses. Drivers who get into trouble with a 911 usually do so because they have not developed a sufficient sense of *balance* and *feel* for what is happening. That first moment when the pendulum starts to swing goes unnoticed, and by the time the driver realizes it is under way, it has accelerated to such a point that it is too late to regain control.

Now you can see the need for balance and smoothness. The instant the rear of a 911 starts to move it must be controlled. During over 30 years of teaching high-performance driving, I have learned that virtually every single person I have ever taught—even those who have had some competition experience—start with one basic fault: They do not move quickly enough. In many cases they are simply unaware that the car will accept rapid steering or other inputs. Often it is because they are not sufficiently "at one" with the car to feel its balance and are therefore afraid that a rapid movement will upset the equilibrium.

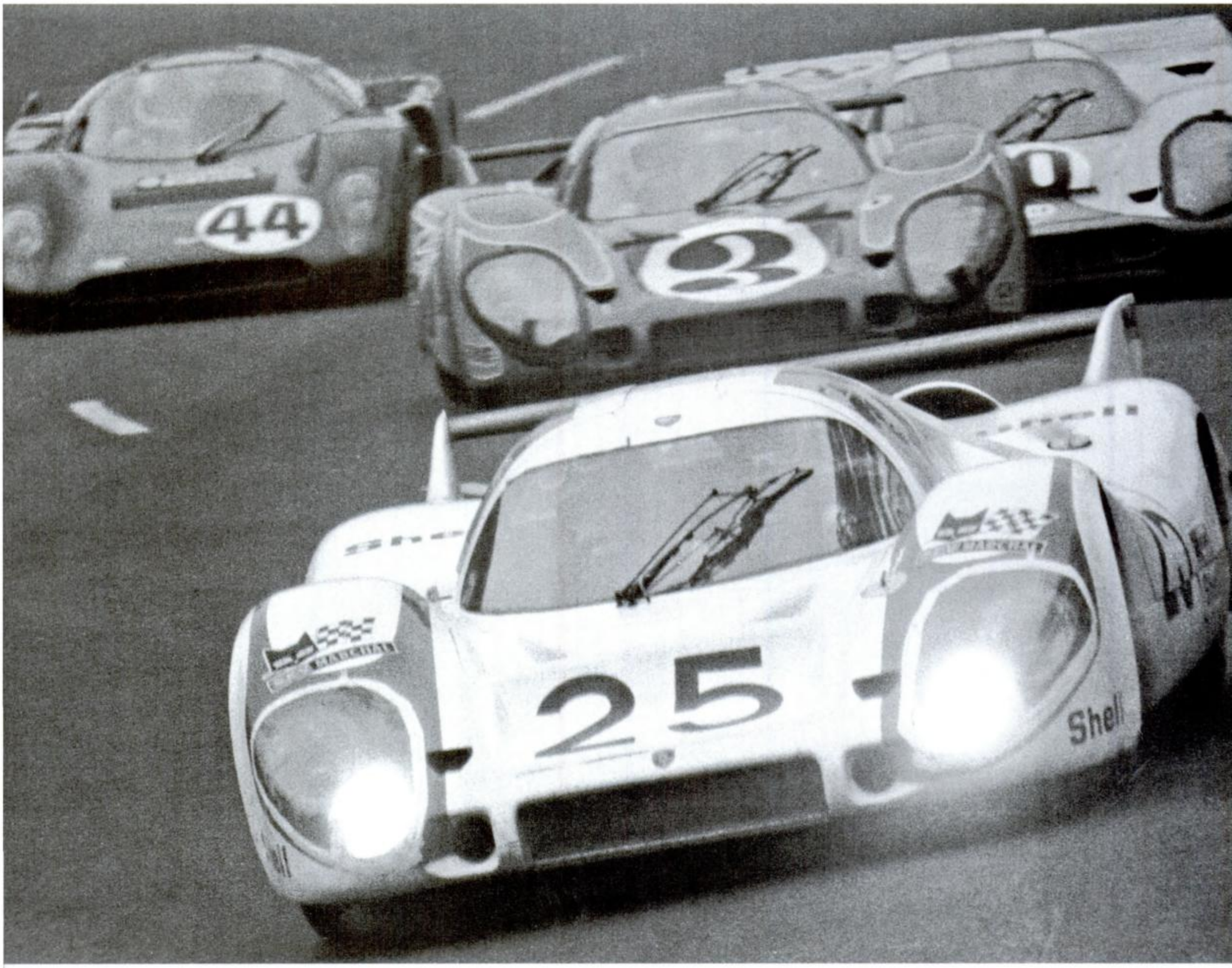
Wrong.

Remember how you thrilled to the high-wire walkers at the circus when you were a child? As they walked across the



Above: Porsche 917 Longtail, Le Mans, 1970
Seconds after the start, Jo Siffert, having made a slightly better get-away, is already alongside me as we head for the Dunlop curve.
Michael Keyser

Left: Porsche 917 Longtail, Le Mans, 1970
But having made use of my tremendous top-speed advantage on the 3½-mile Hunaudières straight, I already had a huge lead as we crossed the start/finish line for the first time. Michael Keyser

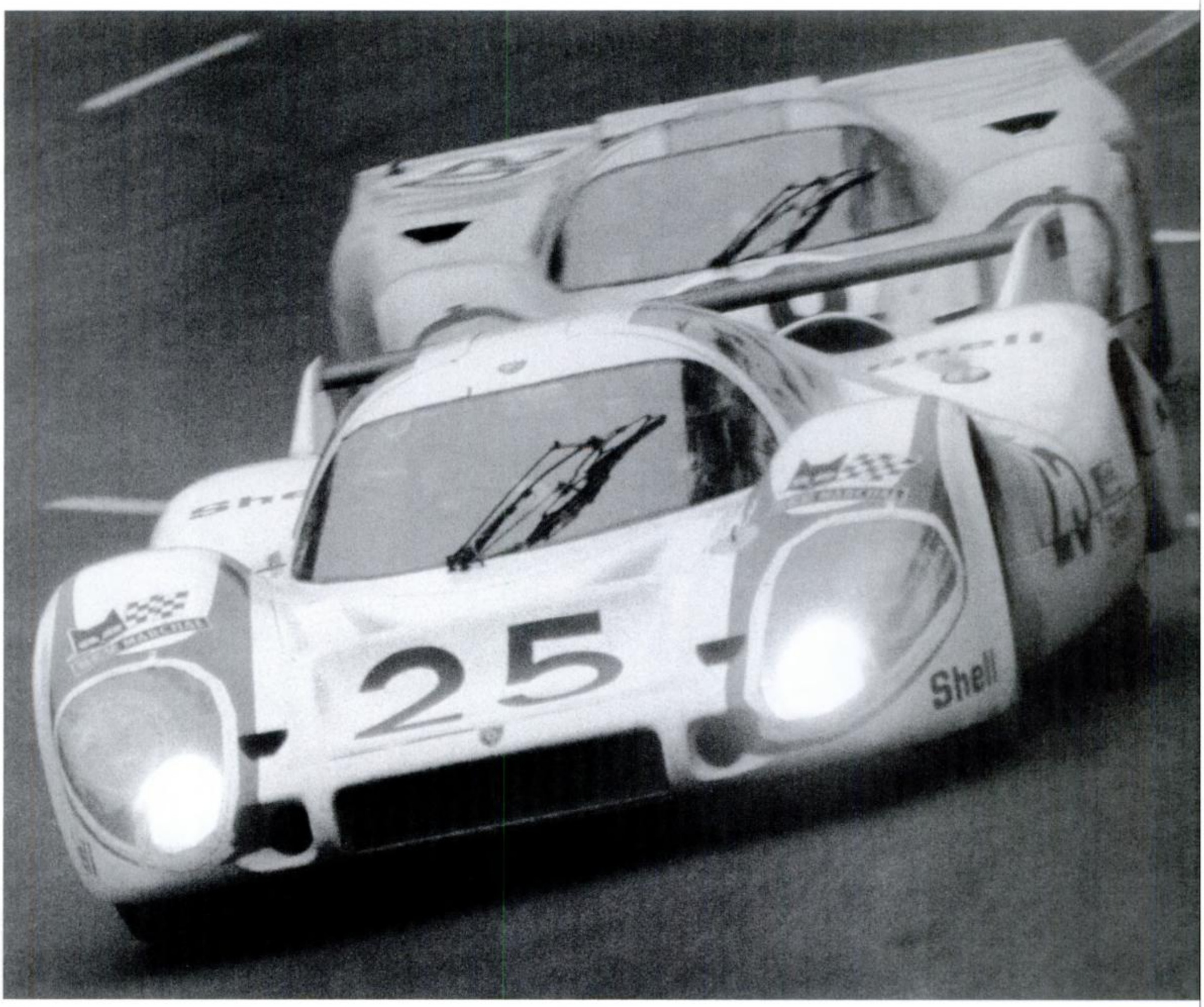


Porsche 917 Longtail, Le Mans, 1970

Porsche number 3 was also a 917 Longtail, but with only the original 4.5-liter engine. Gérard Larrousse and Willi Kauhsen drove it to second place overall, behind the even slower, but faultlessy reliable, 917 of Richard Attwood and Hans Herrmann. Porsche

wire they did not wait until they were leaning over at a 30-degree angle before attempting to come back upright. They were in constant *rapid* movement, staying in an almost vertical position the whole time. I said earlier you must never be in a hurry when driving a car, but there are times when you *must move quickly*. The car must *always* be in a constant state of balance, not a succession of out of balance sequences joined together by desperate recovery measures.

In 2006 I was invited to Sicily to celebrate the 100th anniversary of the Targa Florio, where along with my old friend and fierce competitor Nino Vaccarella, I was given the Freedom of the City of Termini Imerese. Another nice surprise was offered by the Porsche importer in Palermo, who loaned me a Cayman S for the week of my visit. With its six-speed manual transmission and Porsche Stability Management (PSM) system, the Cayman S is perhaps the ultimate production car for driving the magnificent 45-mile Little Madonie circuit of the Targa Florio. Superbly comfortable and with astonishing luggage room, the Cayman will amble along quite happily at little more than walking pace in fifth or even sixth gear, but has performance to spare when it is really opened up in the mountains.



Porsche 917 Longtail, Le Mans, 1970

The Gulf-Wyer 917 of Jo Siffert and Brian Redman had to work very hard on braking and cornering speeds to stay close to my superfast Longtail. Porsche

A little later in 2006 it was a cold, grey morning in Alabama when I arrived at the Barber Motorsports Park just outside the city of Birmingham.

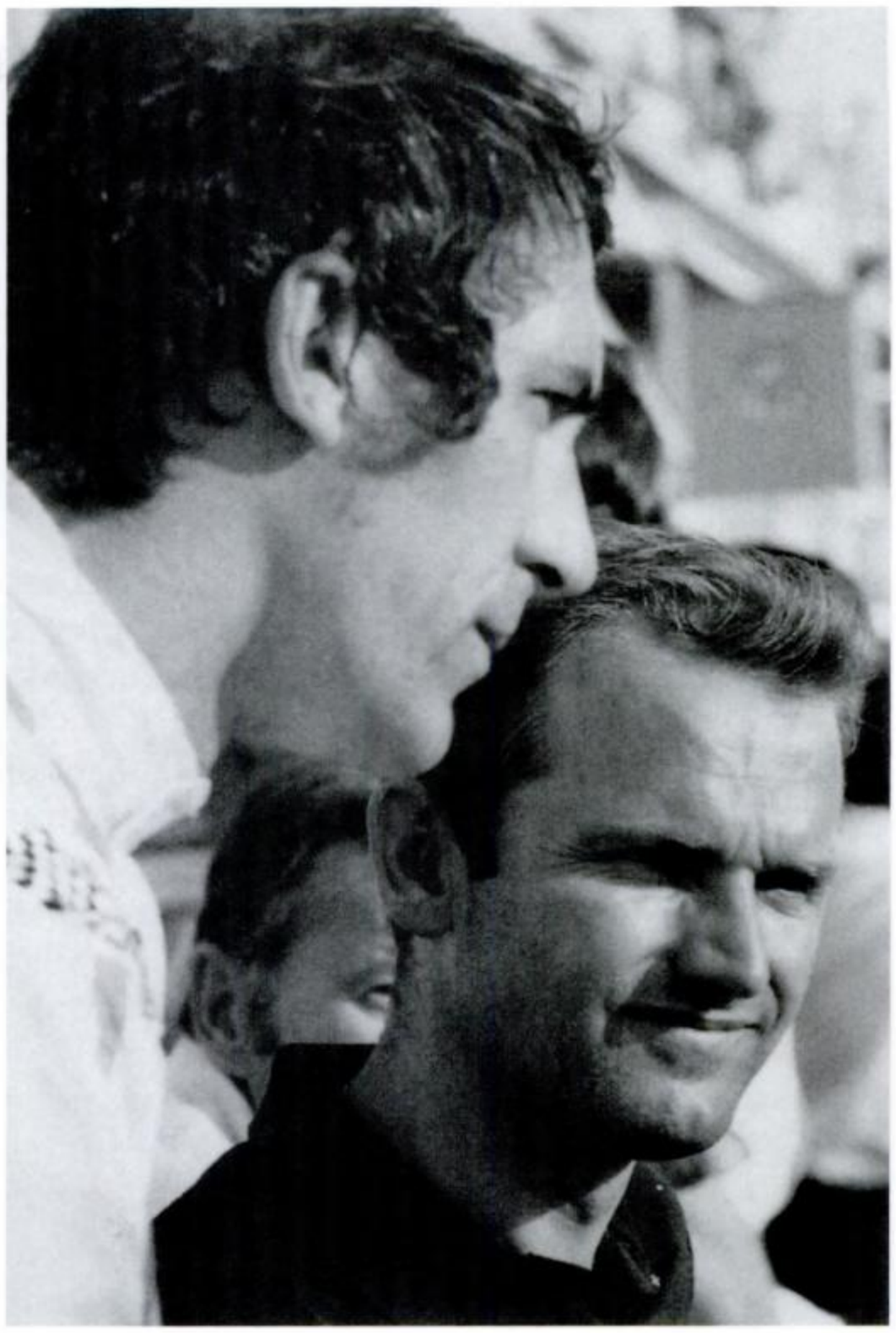
Since the first version of this book was published in 1994, cars have changed, perhaps none more so than Porsche. Looking at a current Porsche Carrera it is obvious that it belongs to the same family as the 911 that I first drove in 1966. Thanks to Bob Carlson, Director of Public Relations at Porsche Cars North America and Jeff Purner, manager of the Porsche Driving Experience, I was given the opportunity to drive the very latest cars in the best of conditions: The racetrack and controlled skid pad and slalom exercises.

The Porsche Driving Experience itself is a unique program aimed at both current and potential Porsche owners. The one- and two-day programs offer introductory and instructional driving, while the "Masters," available only to those who have previously completed a two-day program, gives students more advanced instruction, with particular emphasis on comparatively high-speed track driving.

I took part in a "Masters" program, driving the Carrera on the racetrack as well as the Cayman S, Boxster S, and

Porsche mixture, Le Mans, 1970

One of the attractions of Le Mans, especially for the spectators, has always been the wide variety of cars of different performance. Here, in a very wet race, I prepare to overtake a 911, which had a maximum speed of about 165 miles per hour compared with the nearly 250 miles per hour of my Longtail. Porsche



Ferdinand Piëch and I had a great rapport through the years we were together, especially at Le Mans, where we both believed there was no substitute for outright speed. Porsche

Cayenne on skid pad and slalom courses. I did not have time to do it all, but there is also a specialized off-road course with the Cayenne available as well.

Technical advances in the cars are now so numerous since this book was first published that although one can sample many of them in two days, it is impossible in that time to really appreciate everything they can do.

WHAT'S NEW?

Since the first edition of this book was published in 1994, automobile design has changed considerably, particularly among the leading high-performance cars. One company leading the way in technical development is, not surprisingly, Porsche.

Porsche Stability Management (PSM) is standard on all models of the Carrera and available on Cayman and Boxster. It gathers information from sensors measuring direction, speed, yaw, and lateral acceleration, from which

Porsche 917 Longtail, Le Mans, 1971

One of the most beautiful race cars ever made, the Martini Racing 917 Longtail in the pits. Porsche

This is the part of my 917 that most other drivers saw—the back end of the Longtail. Porsche

it then calculates the actual direction of travel of the car. If the car begins to oversteer or understeer, PSM will apply selective braking to individual wheels to bring it back into line.

Porsche Active Suspension Management (PASM) is an electronic control system that is optional on the Carrera and standard on the Carrera S. This is a push-button system that goes even further than PSM and evaluates and controls suspension-damper settings to each individual wheel, giving greater response and control in responding to the driver's input and style of driving.

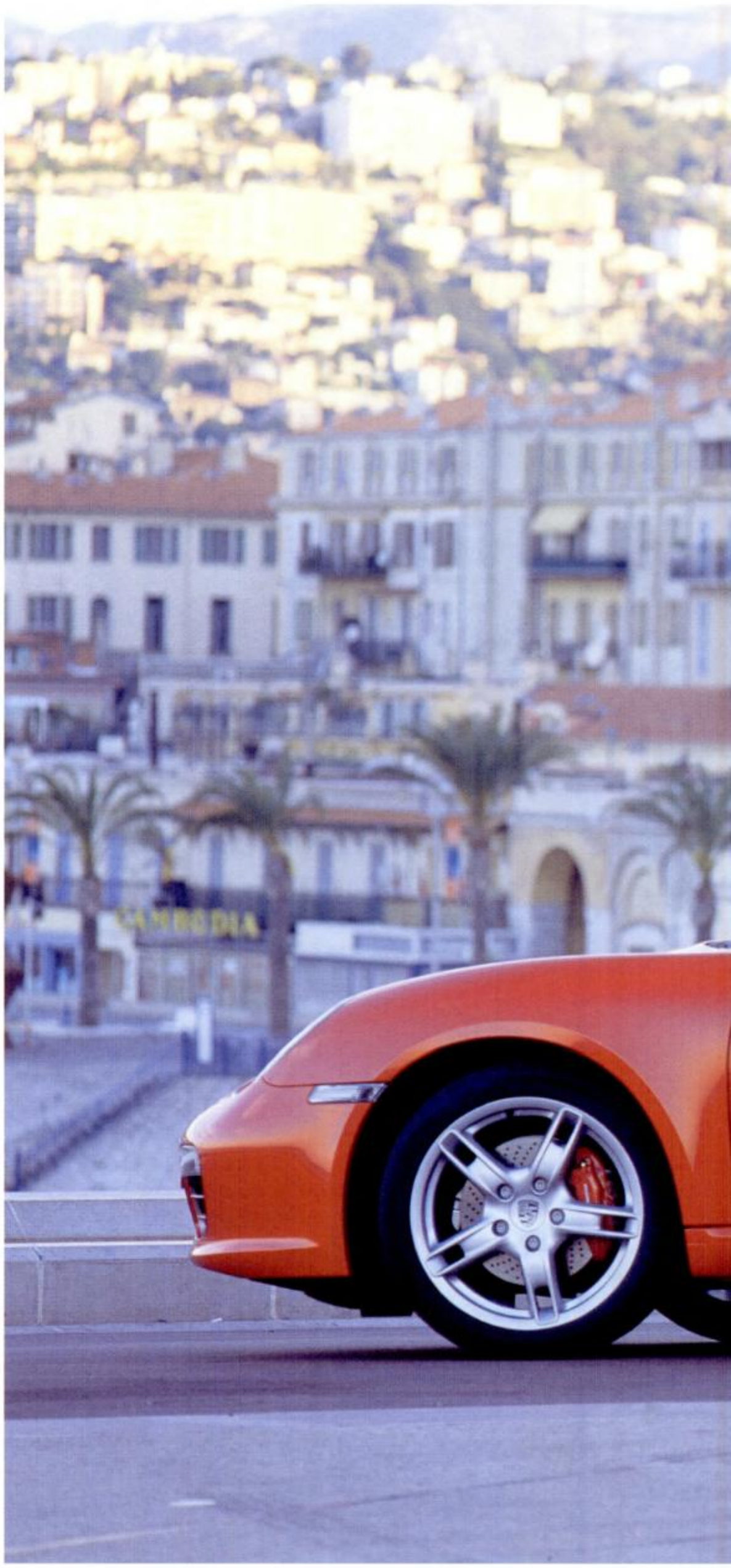
The 911 Turbo is now available only in all-wheel-drive form, and benefits further from Porsche Traction Management (PTM), which adjusts drive to the front wheels on variable- or limited-grip surfaces. It is also available with ceramic-composite brake discs, which give a huge reduction in unsprung weight and therefore even better roadholding. For pure road use, especially in the United States, their value is probably questionable. They work extremely well when hot; in fact, the hotter they are the better they work, but they do not work very well when cold, so if you live in a cold climate, you are probably better off without them.

In the following chapters we will be discussing gear changing in all its conventional forms. Sequential gearboxes have been used in racing cars for quite a few years

Above: Porsche Typ 911 debut, 1963

A proud Ferry Porsche perches on the fender of a 904 while he surveys the first 911. The car was originally intended to be known as the 901, but the name had to be changed as Peugeot had registered the sole right to use three-digit numbers with a zero in the middle to designate their road-car model names. Porsche

Right: Boxster S *(Porsche)*



and are now beginning to appear in the more up-market and sophisticated sports cars. Those of you who ride, or have ridden, motorcycles will be familiar with them, although early versions were comparatively crude compared with the high-tech ones used in modern racing cars. Gear shifting is often controlled by a lever that no longer moves in the traditional "H" or extended "H" pattern, but simply forward and back against a spring; usually backwards to change up, forward to change down. But even the lever has disappeared in many cars, replaced by "paddle" shifters behind the rim of the steering wheel; click the right one to change up, the left one to change down. Electronically computer-controlled and hydraulically/mechanically activated, these sequential gearboxes take away the need for all the delicate control that is explained in later chapters, since the computer makes all the throttle/gear/engine speed adjustments to ensure smooth gear changes virtually instantaneously.

Sequential gearboxes, like Tiptronic, cannot "skip" gears. In other words it is not possible to change directly from, say, second gear to fourth gear. The gearbox must go through the complete sequence of gears, whether it is changing up or down, but while the Tiptronic still works through a torque converter, the sequential, being electro/mechanical, is infinitely quicker in operation.

911 Carrera S

Porsche

911 Turbo

Porsche

Cayenne GTS

Porsche

Cayman
Porsche

CHAPTER 5
THE EQUIPMENT

The place: Corsica
The time: 1966
The occasion: Le Tour de Corse (Tour of Corsica)

In 1966 the Renault Alpine 110 had replaced the Renault 8 Gordini as the car of choice for the French contingent. Both were tiny by today's American standards and, like the Porsche 911, both were true rear-engined cars, which endowed them with exceptional maneuverability on the incredibly narrow twisting roads of Corsica.

Known as the Rally of 10,000 Corners, the Tour of Corsica had always been the exclusive domain of French drivers. With their driving skills developed and honed in the Alps, they had been virtually alone in the yearly quest for victory in Corsica.

But during my three bittersweet years driving for Ford I had already dispelled the myth that only the Scandinavians could drive on ice and snow and that only the French could drive in the mountains.

So why not Corsica as well?

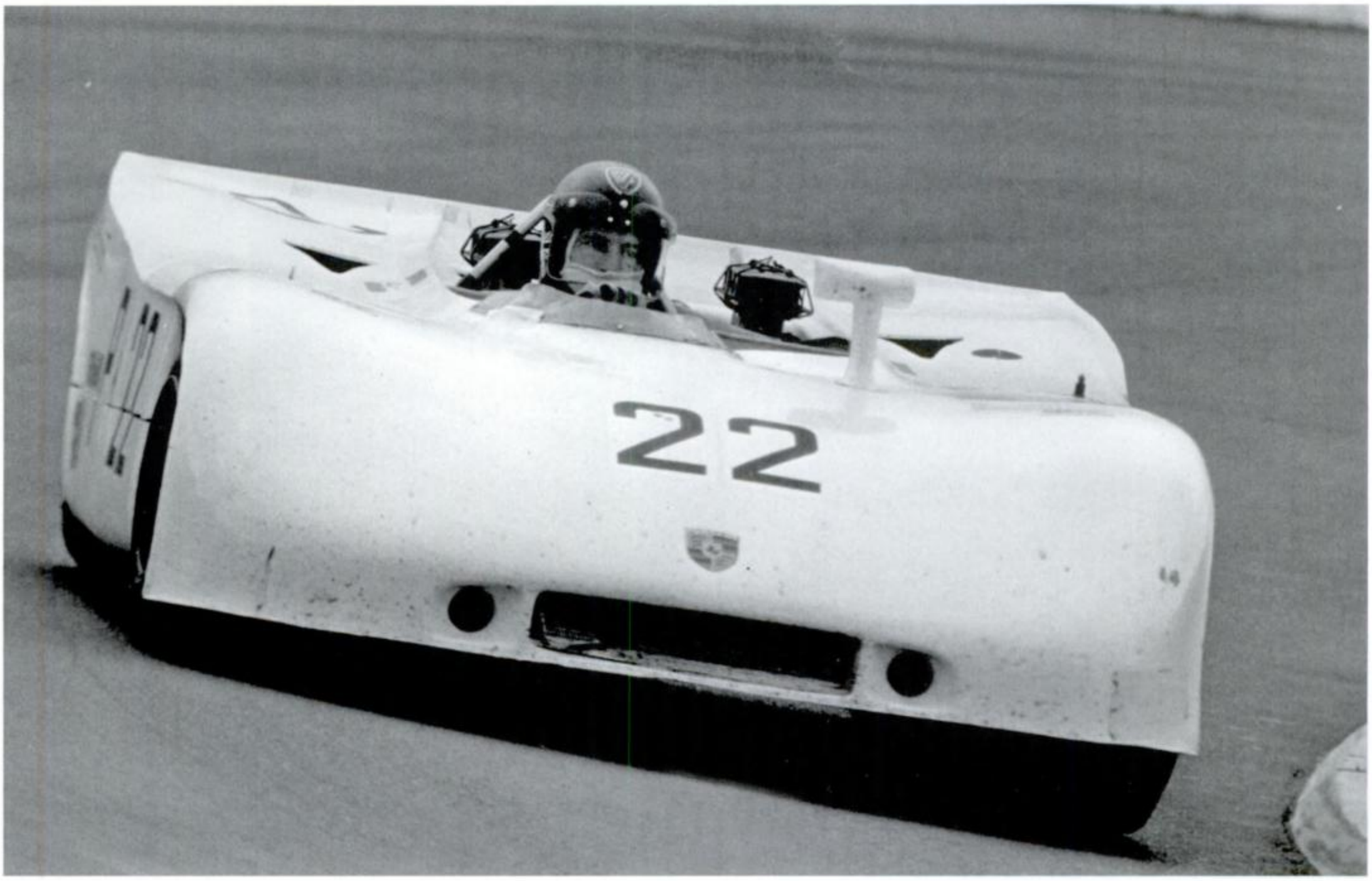
Porsche 911S, Tour de Corse, 1966

"Porsches don't break" —even in the beautiful but legendarily tough, rugged mountains of Corsica . . . Porsche

Porsche 911S, Tour de Corse, 1966

. . . and, in my first-ever drive in the car that would have such a big influence on my future, I was able to bring my beautiful 911 home without a scratch.

Vic Elford collection



Porsche 908/3, Nürburgring 1000 km, 1970

On the way to my second victory in the Nürburgring 1000 km, this time with Kurt Ahrens. Note the extreme driver-forward position, which gave superb driver visibility—especially valuable at circuits like the Nüburgring and Targa Florio. Seufert

Since my first visit to France many years earlier I had discovered a real affinity with the country and the people, so the opportunity of spending an extra week there tackling one of the most driver-intensive rallies in the world was one not to be missed.

In 1965 I had taken my own rally-prepared Ford Anglia to Corsica just to look. What a rally! I retired after about six hours of the 24-hour event with oil pressure problems but was more determined than ever to return with a car capable of winning.

I had first met Porsche competition director Baron Fritz Huschke von Hanstein some four months earlier after yet another disappointing and frustrating event in a Ford, the Alpine rally. The Porsche 911 had started to make a tentative entry onto the European rally scene, and I had been seduced by its looks, its specifications, and what I believed to be its winning potential.

Although Porsche did not really have a rally program, Huschke agreed to lend me a 911 for Corsica in 1966. There was no practice car (I would have to use a rental car), no money (I would have to pay all my expenses), and only one van with two mechanics to provide service for me and Günther Klass in a second car.

My co-driver David Stone and I had done a very serious reconnaissance in a rented Simca Aronde after which we met up with Huschke and the mechanics as they arrived with the rally cars on the quayside in Bastia. We opened up the van and looked inside to find only wheels and tires. I asked Huschke when the spare parts would be arriving, and he replied, "But there are no spare parts. Porsches don't break."

After all the ups and downs of my three tumultuous years with Ford, he had to be joking!

"Come on, Huschke, there has to be something that breaks, even on a Porsche. I'm part of the team now; you can tell me so that when something goes wrong at least I'll know what it might be."

"No, my boy," was the response, "you don't understand. Porsches, even rally-prepared Porsches, simply don't break."

I had already decided that this would be an event with no dramatics but would serve as the start of my apprenticeship in learning to drive a 911. Driving comfortably

Nürburgring 1000 km, 1970

Well-deserved rewards at the end of a hard-won race. Porsche

and smoothly, well within my limits, I still finished third behind two of the incredible little Alpines, driven, of course, by two Frenchmen. Just as important, I brought the car home without a scratch.

The following year, 1967, we went back again and were second going into the last special stage. The night had been long, wet, and foggy, and with Huschke's permission we threw caution to the wind in the effort to take first place. The road was drying a little, which we thought would favor the Porsche over the Lancia Fulvia of Sandro Munari, and I made no secret of our intentions, hoping to force him into a mistake. Unfortunately it was I who made the mistake, hitting a wet patch and spinning off into the trees (of course) at high speed. By the time I got back on the road, not only was Munari out of danger but my own Porsche teammate Pauli Toivonen had also passed me. Once again I had to settle for third place.

But Huschke was right. Even under those extreme conditions, nothing broke.

The next year, 1968, we were back again. Having proved beyond any doubt that we were strong contenders in a 911S against the French, this year we were strong favorites, especially since we were driving a new 911R lightweight prototype with a new experimental 2.0-liter twin-cam engine. The engine, which I drove here and on the Criterium des Cevennes rally a couple of weeks later, but which never saw the light of day in a production car, was an absolute marvel with power and torque from 3000 rpm all the way to what was then an incredible 8200 rpm.

But driving what we thought was an unbeatable car, we were out of the event within 15 km of the start, with what was strongly and generally suspected to be a case of sabotage, when the oil filter unscrewed itself, draining all the engine oil out of the system.

Perhaps the most incredible part of this story is that not only in Corsica, but everywhere else as well—from the rigors of Monte Carlo to the cold of Sweden in winter; from the demanding Nürburgring racetrack to an entire season of race winning in England—Huschke was right: No production-based 911 that I drove *ever* broke anything.

PORSCHE ENGINES

The first Porsche engine was in fact "borrowed" from the Volkwagen Beetle as Ferry Porsche built the first car to bear his name, using as its base the ubiquitous "people's car" designed by his father, Dr. Ferdinand Porsche. In fact, the first VW, in 1934, was originally designated "the Porsche 60" before being named as a Volkswagen.

The first *real* Porsche was the 356, introduced in 1948 with a 1,100cc engine developing 40 horsepower. By the

Porsche 911S, Stuttgart/Lyon-Charbonnières rally, 1967
One of the early victories in a 911 that helped pave the way to the European rally championship the same year. The background is typical of the French Alps.
Vic Elford collection

end of its life in 1965 it was available with a twin-cam 2-liter engine giving 130 horsepower.

In 1964 its successor, the 911, arrived on the scene with a flat-six, horizontally opposed, air-cooled 2-liter engine producing 130 horsepower. Nonstop development over the years has seen that engine evolve to the point where it now puts out 415 horsepower in the GT3 RS, which is arguably the closest you can get to a pure racing car that is street legal, and a staggering 480 horsepower in the 2007 911 Turbo.

Although it was in production for only two years, from 2004 to 2006, the Carrera GT also needs to be mentioned, especially its engine, a 5.7-liter V-10 developing 612 horsepower.

Not to be outdone by its racing heritage siblings, the Porsche Cayenne has also been growing up during its short life and now in its ultimate form boasts a 4.8-liter turbocharged V-8 engine with 500 horsepower and 516 lb-ft of torque.

PORSCHE TRANSMISSIONS

In the previous edition of this book there was a limited choice of transmissions for Porsche owners, albeit more than most other drivers had at their fingertips. There were five- or six-speed manual gearboxes, four-speed Tiptronic or a four-speed automatic exclusively in the 928.

Now, depending on the Porsche model you choose, your car will come equipped with either a five- or six-speed manual or Tiptronic S five-speed transmission, unless you choose the all-new Cayenne, which has only six-speed manual or six-speed Tiptronic.

The manual gearboxes are traditional Porsche with short-throw lever movement and solid-feeling synchro-mesh control. The Tiptronic S has made great strides since it was first introduced, when it was either in the "automatic" or "manual" mode. In its ultimate form it can still be either, although the driver can override the automatic control by using the toggle switches on the steering wheel to change gear, even though the selector lever maintains the automatic mode. Having progressed now to a six-speed version, the Cayenne with the Tiptronic S transmission is actually quicker on acceleration than with the manual transmission.

Transmission now means more than just how many gears a car has, but, particularly in the case of Porsche, how the power from the engine passes through the gears and ultimately arrives at the driven wheels. Many manufacturers offer various degrees of automatic control systems that act and react on both transmission and suspension, but alas, most of them take over control of the car to such an extent that the driver's input has little, if any, effect on what the car is doing. Porsche has always been a driver's car, so it is not surprising that the driver is allowed to keep control far longer than in other cars.

SPRINGS AND SHOCK ABSORBERS

For now we will look at suspension in its classic forms before looking at how Porsche has adapted modern technology to increase its efficiency and, coincidentally, the safety inherent in their latest cars.

Suspension usually consists of one spring, which may be in the form of a coil or a torsion bar, or even occasionally still, a leaf spring, for each wheel, one shock absorber

Porsche 908/3, Nürburgring 1000 km, 1970

And a well-earned drink. Porsche

for each wheel, and one anti-sway bar (also known as an anti-roll bar) front and rear.

Advanced technology in modern racing has rapidly changed the conception of suspension and features many advances that have already found their way into the cars we drive on the road. Since space and weight are vital factors in the design of a race car, many now use only one single spring/shock absorber unit that controls either both front wheels or both rear wheels.

Further still, Formula 1 cars do not even have springs or shock absorbers—at least not in a form that would be instantly recognizable to a lay man. Like so much else at the upper reaches of technology, suspension has now joined the ever growing list of functions on a car that are controlled electronically and activated hydraulically. One of the enormous advantages of such a system is that with the computer making thousands of adjustments per second, the ride height can be maintained absolutely at preset limits.

With aerodynamics playing such a crucial role in the performance of these cars, such a suspension can provide a big advantage over the competition.

But back to the real world.

The springs serve to absorb unevenness of the road surface, partly for reasons of comfort and partly to maintain the balance of the car. The "spring rate," which is the amount of force that must be exerted on the spring to compress it a given distance, depends on the weight carried by each individual wheel, thus controlling the balance of the car. Adjustment of the spring rate can also be used to change the understeer or oversteer characteristics of the car.

The shock absorbers do not really absorb shocks at all. What they do is *dampen* the wheel movement when it compresses and decompresses the spring. For this reason they are often referred to, especially in Europe or in racing circles, simply as "dampers."

For a practical example, just take any light coil spring a few inches long. Hold it up by one end and attach a small weight to the lower end. The effect of gravity on the weight and the resistance of the spring will find a balanced position, and the weight will stay where it is as though it were on the end of a piece of string. Now pull the weight down a short distance and let it go.

What happens?

In this case the spring is extended so the weight will be pulled briskly upward. At the top of its path it will be applying more force (due to gravity) than the spring so it will drop again, and this oscillating up-and-down movement will go on for quite a time, getting smaller and smaller, until finally twitching to a halt at the balanced position.

Without a damper, the wheel of a car would do the same thing. Indeed, you will occasionally see a car on the road, which having run over a bump, has a wheel going up and down almost uncontrollably—a sure sigh that the damper, or shock absorber, is broken or simply worn out.

Ideally, the job of the shock absorber is to allow the wheel to bounce into the air against the spring pressure when it runs over a bump and then stop at the balanced position as the spring pushes it back down again.

You can do a simple test at home to see if your shock absorbers are in good condition. At each corner (that is, at each wheel of the car) give a brisk downward shove on the fender; if the shock absorber is in good condition that corner should simply go down and then immediately come straight back up and stop at its original position. It will need quite a bit of force since the shock absorber has resistance in both directions and will therefore add to the bump resistance of the spring. In fact, if you are trying this on your Porsche and the shock absorbers are in good condition, you will probably need the assistance of a friend to get any noticeable body movement.

ANTI-SWAY BARS

The third part of the suspension is the anti-sway or anti-roll bar. It is connected to each wheel hub assembly with a flexible joint and also to the chassis through two bearing-type clamps, as far to the outside of the car as possible, which allow it to rotate, but not move, relative to the chassis.

Like the springs and shock absorbers, it is passive. It cannot do anything on its own but will react when something is done to it. When a car is cornering, the suspension will allow the mass of the vehicle to "roll" toward the outside. The outside springs will compress and the shock absorbers will dampen the movement so the car takes on a set position. While the spring and shock absorber are being compressed, the end of the anti-sway bar at that particular wheel is being pushed up. While the outside spring and shock absorber are being compressed, it follows that the lighter load allows the inner ones to extend. Since the anti-sway bar is free to rotate in its bearings on the chassis of the car, it is clear that as the outside end is pushed up the inside end is also pushing up on the other wheel. In other words, it is limiting the amount that wheel will descend and therefore the amount the car will roll. How much it limits the rolling will depend on its stiffness, or thickness, since it will twist.

As a simple experiment to get the idea of what is happening, unravel an ordinary paper clip. Get someone to hold the straight, center part down with two fingers, simulating the mounting points on the chassis. Then push up

on one end while applying downward pressure on the other end. The end on which you are pushing up represents the outside wheel which is trying to transmit that upward push to the other wheel. Of course, paper clips are not very thick so there will be considerable torsional force and only a comparatively small fraction of the upward force can be transmitted to the other end before it starts to twist. But if your paper clip were half an inch thick, a much greater percentage of the force could be transmitted. On competition cars, and indeed on some high-quality performance cars like Porsche, anti-sway bars of different thicknesses are available to help the driver adjust the handling to his or her liking according to the road conditions.

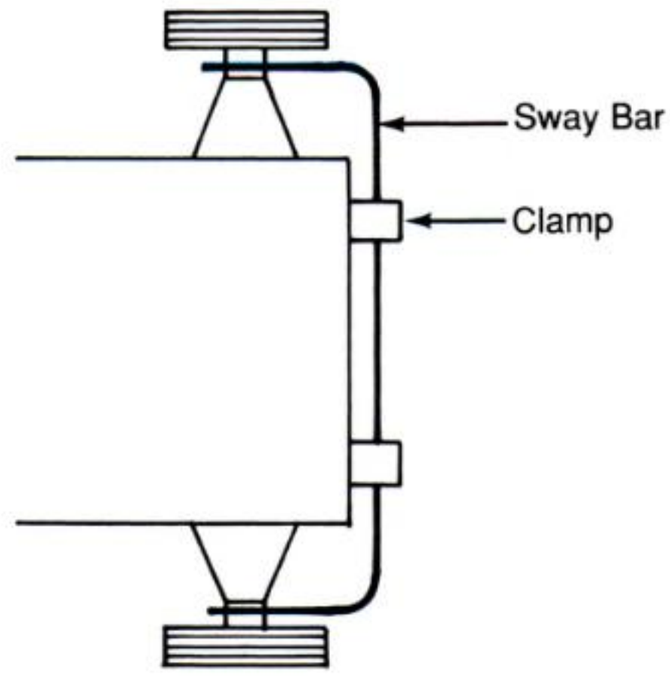
When a car starts to turn into a corner, there is a rolling, and therefore shifting of weight, toward the outside front tire. This loads the outside tire more than the inside one and allows it to do most of the steering. If we were to stiffen up the suspension resistance of the front wheels there would be less roll, less weight transfer to the outside wheel and, ultimately, less steering available. The car, instead of turning into the corner, would tend to go straight on, or at least have a much larger turning arc than that desired. That would be an example of the *understeering* condition mentioned in Chapter 4.

If you did the opposite and softened the front suspension, the car would roll more and have more weight transfer to the outside wheel, which in turn would have more grip and the car would turn sharper than desired. That would be an *oversteering* condition.

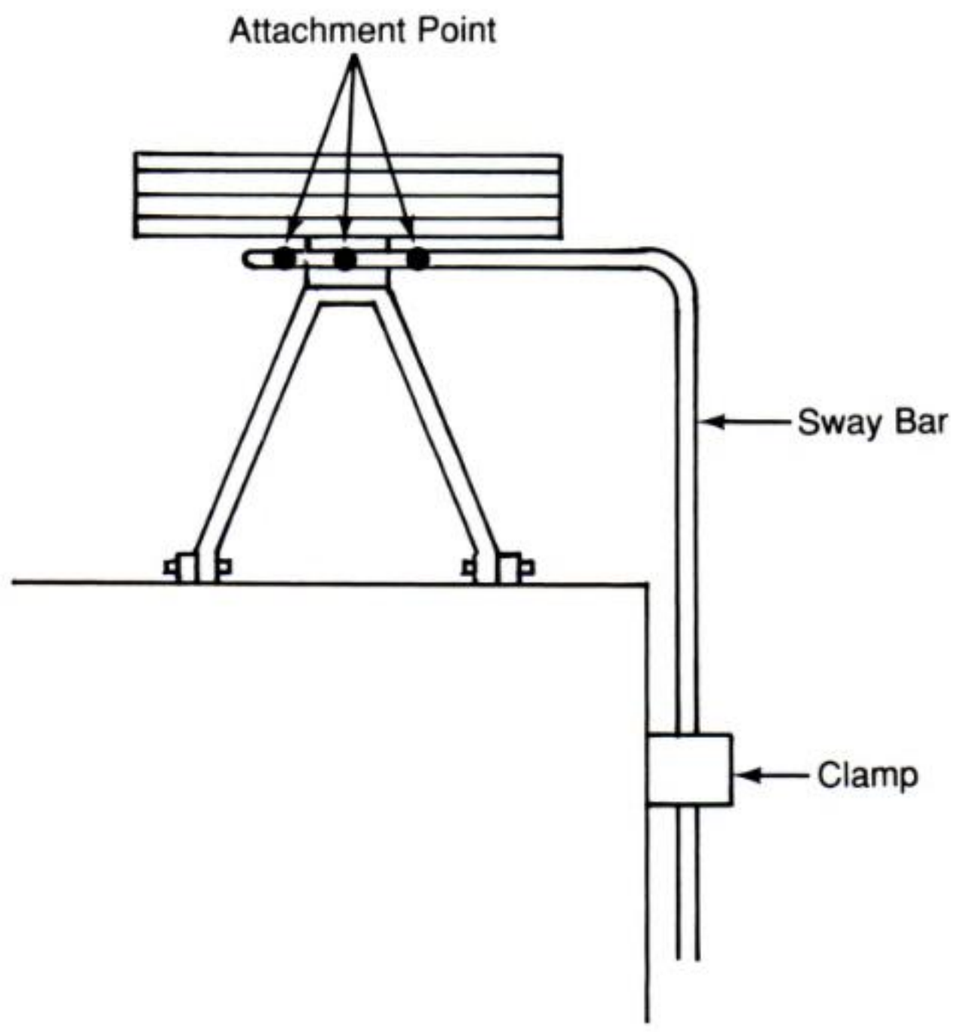
So you can see that the adjustment from oversteer to understeer, or vice versa, can be controlled by fairly simple chassis adjustments. Softening or stiffening the front springs, or eventually the rear ones, is one way to make the adjustment. Easier still, just change the anti-sway bar or simply make the anti-sway bar itself softer or stiffer. Most competition cars have an adjustment available where by simply moving the point of attachment you increase or decrease the leverage.

What you are doing in this situation is increasing or decreasing the force being transmitted through the bar to the opposite wheel. The magnitude of this force is controlled by the torque or "twisting force" applied to the bar. Torque is measured in lb-ft (force in pounds multiplied by distance in feet) and since all other aspects of the rolling action of the car are constant, you can see that when the anti-sway bar is at its "softest" setting the force being transmitted to the other side will be smallest; when it is at its "stiffest" it follows that the force will be greatest.

Remember that Porsches, most other performance cars, and virtually all competition cars have anti-sway bars at



Antisway bar and clamp setup.

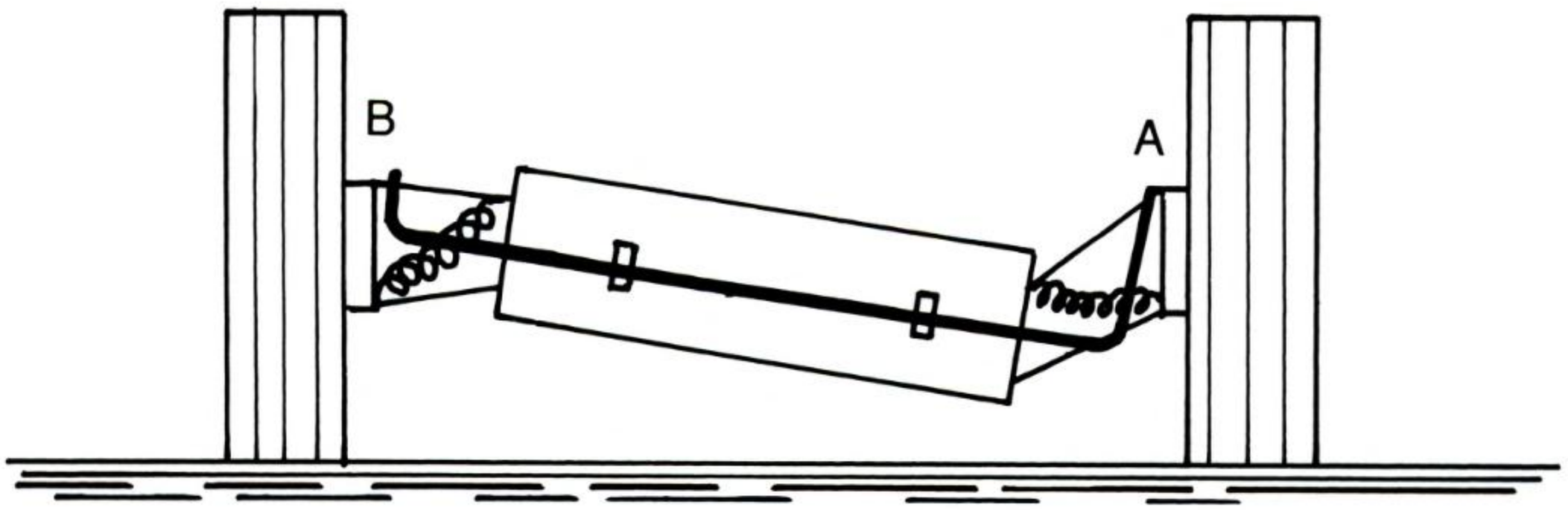


The variable attachment points that can effectively stiffen or soften the sway bar.

both front and rear. Doing something to one of them does the opposite to the other. Therefore, if you are trying to adjust the car to have more understeer, you could increase the stiffness of the front anti-sway bar, but you could also decrease the stiffness of the rear anti-sway bar; you could also do a combination of the two.

TUNING SUSPENSION

Shock absorber adjustment is more delicate and usually involves the up-and-down balance of front and rear or a combination of both. It is usually not available on production cars, but for those seeking performance beyond that provided by the manufacturer, many high-quality performance accessories are available. In the case of



In a cornering situation, the outside sway bar attachment A is forced upward by the rolling of the chassis. This will have the effect of pushing the inside sway bar attachment B upward, recompressing the inside spring and restricting the amount of roll of the chassis.

Porsche, many can be found in the manufacturer's catalog or through aftermarket suppliers.

In the case of shock absorbers, for example, you will find models with one single adjustment that stiffens or softens both "bump" and "rebound" equally. Bump, or compression, is the resistance when the wheel is bumped up; rebound is the resistance to the wheel dropping back from the bump position.

You will also find even more sophisticated, and therefore more expensive, shock absorbers where bump and rebound can be adjusted independently. Some can even be adjusted for both high- and low-speed compression and rebound movement. Depending on the level of sophistication required, some can be adjusted in place in a matter of seconds while others have to be removed from the car. The choice is yours.

Perhaps you have already "breathed" on the engine in your car to give it greater acceleration and now you have a car that squats heavily onto the rear wheels when you accelerate hard. The shock absorbers may be in perfectly good condition but just not set firmly enough to handle this extra performance. Carefully adjusting the bump of the rear shocks can return the car to an even keel.

If the front of the car rears in the air on acceleration, you can adjust the rebound of the front shock absorbers to help solve the problem. Similarly, if you have fitted oversize or otherwise higher-performance tires, perhaps for autocrossing or other sporting activity, you may find that the car will generate greater braking efficiency than before, causing the nose to dive and the rear to rise excessively under heavy braking. Now you have to do the opposite: Stiffen up the front bump and/or the rear rebound.

Remember that any time you adjust the shock absorbers, whether bump or rebound, whether on or off the car, *always* turn them back to zero and adjust from there to reach the desired level. Unless you are driving under exceptional circumstances (and I cannot think of any that would apply, apart from driving on an oval), left and right front should have identical settings, as, of course, should left and right rear.

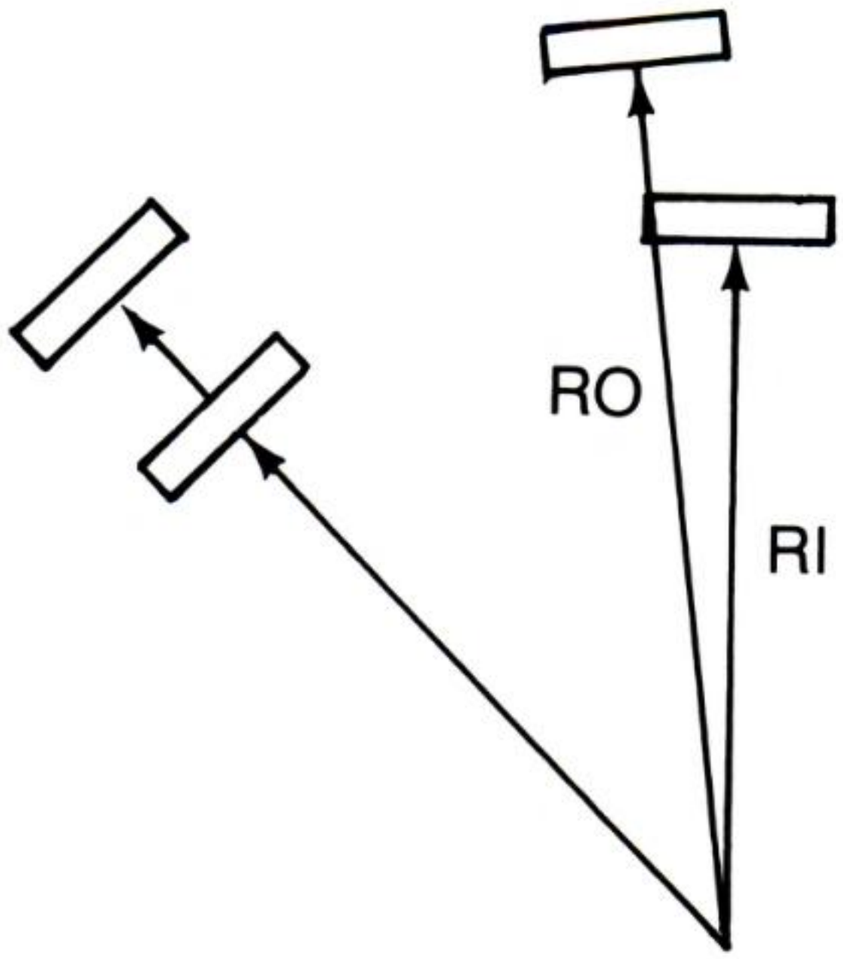
Of course, in the case of "diving" or "squatting," some of these adjustments can also be achieved by changing spring rates. The limitation here is that springs only work one way: On compression. Any adjustment in the extension department can only be made on the shock absorber—or in extreme cases on the spring rates *at the other end of the car*.

LIMITED-SLIP DIFFERENTIALS

Another thing that can greatly affect handling, particularly on surfaces with poor grip, is a limited-slip differential. When a car is negotiating a corner it is obvious that the outside wheels must travel farther, and therefore faster, than the inside ones. On the non-driven wheels—that is, the front ones on a rear-wheel-drive car, the rear ones on a front-wheel drive—that is of little importance. The wheels are not rigidly attached to each other, so the outside ones simply go quicker than the inside ones.

However, the driven wheels must be attached to each other. If they were not, you would only be able to transmit power to one wheel. This *attachment* is made by the differential. which allows a difference in speed between one and the other.

But remember when I was discussing the suspension and steering earlier and I explained that, in order to negotiate a corner, there has to be a certain amount of body roll to make the steering work? That body roll is also present to a greater or lesser degree at the rear of the car. This means that as a car goes through a corner there is more weight on the outside wheels than the inside ones.



RI is the radius of the curve traveled by the inside wheel, whereas RO is the radius of the curve traveled by the outside wheel.

From the above description of the differential you can see that any excess of power applied when there is more weight on the outside wheel will allow the inside wheel to spin. While one wheel is spinning, *no power* is being transmitted to the other one and you have no alternative but to reduce power to the level that the more lightly loaded wheel can accept and you will not be able to use full power again until the car has exited the corner onto the straight and resumed a balanced posture right to left.

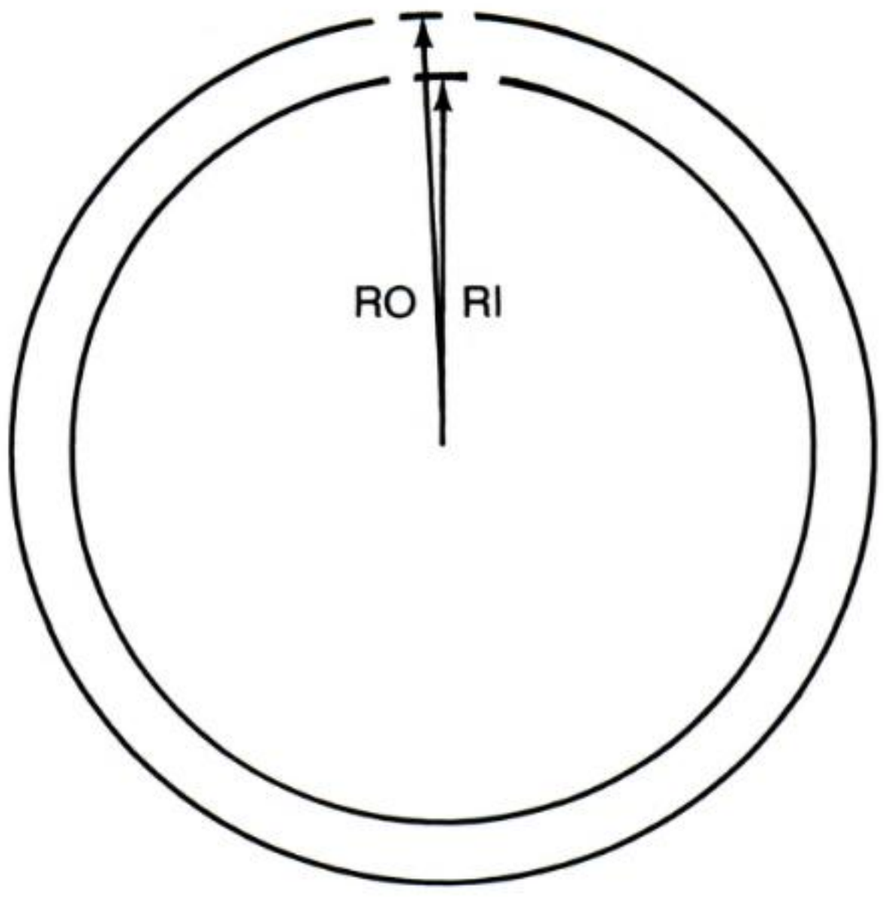
Even then, if you are accelerating hard on a poor surface—a surface that has a mixture of wet and dry or a road that has sand or dust along the edge where the right-side wheels are but is clean in the middle where the left ones are—there will be a constantly changing coefficient of friction between the driven wheels, which will take turns spinning or gripping.

The limited-slip differential is designed to eliminate this constant slip/grip situation by locking the rear wheels together so that there is no differential, or at least only a predetermined, limited differential in speed between them. Even when one wheel suddenly has less grip than the other it will still keep turning at the same, or close to the same, speed. One of them will still be spinning a little, on occasions both will be spinning, but they will both be transmitting almost equal power to the road and the driver will be able to use maximum acceleration while still keeping control of the car.

With a front-wheel-drive car, a limited-slip differential is usually a liability rather than a help. Once it has locked up, both wheels are turning at about the same speed but during cornering the inside one has less distance to cover and tends to push the outside one beyond its ideal arc, creating a case of massive understeer. Recent technological advances have helped to correct that undesirable situation with a viscous traction-control coupling allowing a distribution of power between the front wheels rather than a complete lockup.

Once again, the almost unlimited budgets and technology of Formula 1 are taking us into the future in this respect. Those cars now use a sophisticated traction-control system. Sensors at each driven wheel notify a computer when it is about to lose traction and the computer reduces the power being transmitted to that wheel only. Like the computerized suspension discussed earlier, these adjustments are made thousands of times a second, so whatever the conditions, the driver, just by putting his foot on the floor and letting the computer do the work, can always accelerate at the absolute limit of the car.

Traction control is now widely used in production road cars, but for the most part it is less sophisticated than that of Formula 1. In particular, whereas the racing version is what I would call "positive" control, most passenger car versions are what I would call "negative" control. In other words, while the racing version acts on the power, seeking to keep the maximum available at the wheels at all times, the road versions generally use the ABS sensors to apply the brake to the wheel that is trying to spin.



If the radius of the curve traveled by the inside wheel, RI, is 100 feet, the wheels will travel 632 feet in a complete circle. If the car has a "track" (width between the wheels) of 5 feet, the outside wheels will travel 659 feet.

NEW PORSCHE TECHNOLOGY

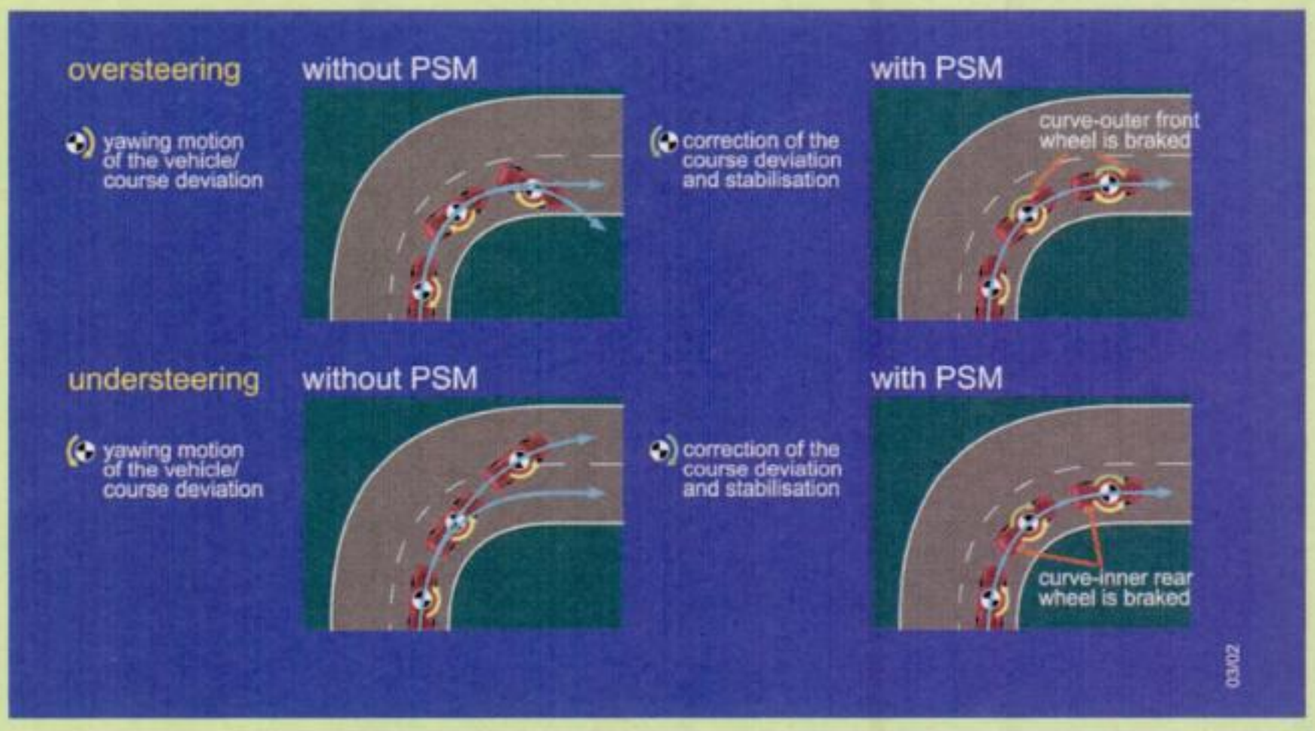
Some of the outstanding technical advances made by Porsche are available on various models, but no index is provided here as to what is available on which models, for very good reason. Since its inception and the first cars ever to carry the name, Porsche is continually in a state of development, and what may not be available on a specific model today may well be there tomorrow. So if you are looking for a specific component or system, check the description of the car before you buy.

No amount of verbal description can really explain the way the following Porsche performance "supplements" work and how they feel when they are working. Only hands-on experience at your local Porsche dealer or a visit to the Porsche Sport Driving School can give you the opportunity to learn about the systems and experience them in detail.

PSM—Porsche Stability Management

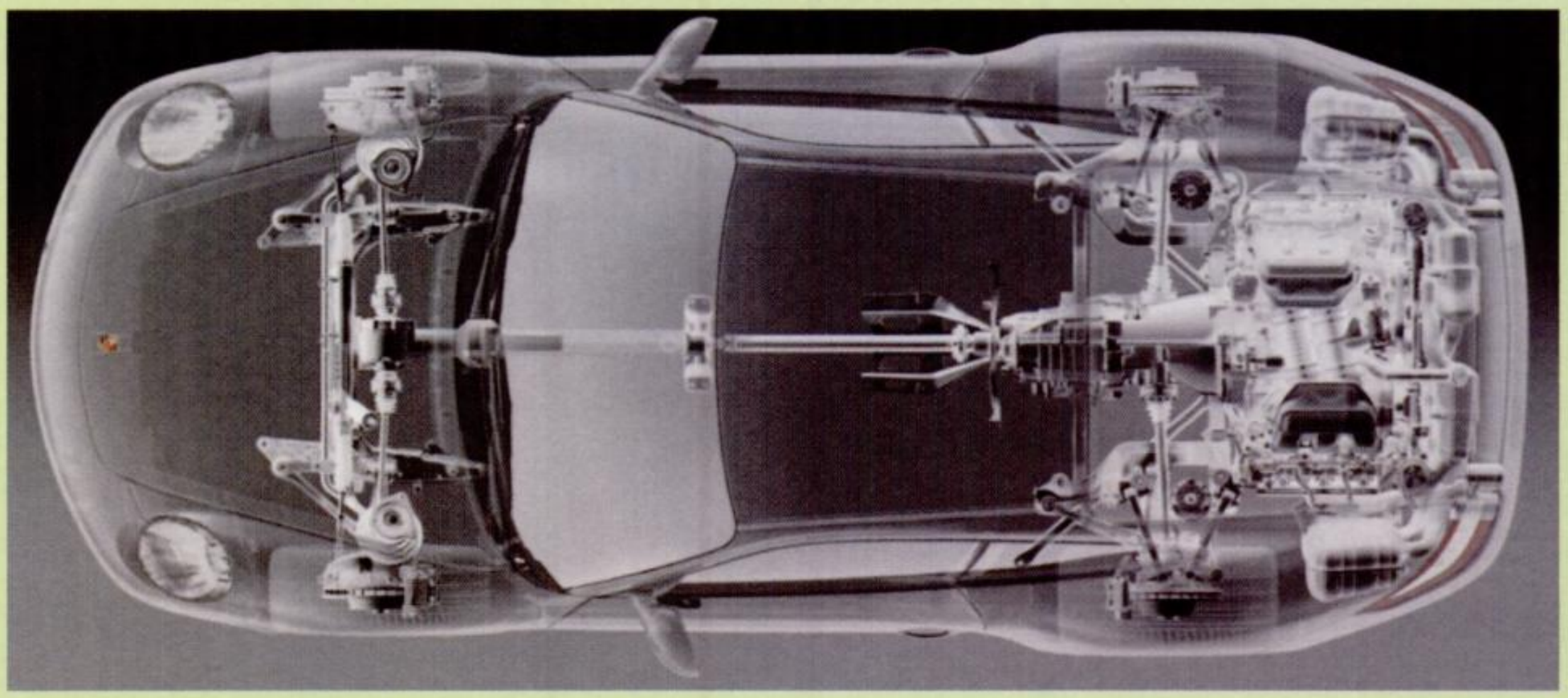
. . . is an automatic system that will take over some control if it "thinks" that conditions have gotten to the point where the driver no longer has complete control.

PSM uses a whole range of sensors that monitor the direction, speed, yaw velocity, and lateral acceleration of the car and then reacts when the car starts doing something out of the ordinary.



For example, if the car starts to understeer or oversteer the PSM will apply the brakes to individual wheels to bring the car back into line.

PSM can be switched off, although even then the automatic brake differential will remain active. Even when it is off, the PSM will still be there, lurking behind the scenes like some sort of "big brother," and if you get into heavy braking that requires ABS, it will intervene anyway.



Above and top: *Copyrighted by Dr. Ing. h.c. F. Porsche AFG*

PASM—Porsche Active Suspension Management

. . . is an electronic control system that uses continuous damper adjustment to maintain the best ride and comfort.

PASM has two basic settings, "Normal" and "Sport," which offer exactly what you would expect from their names. "Normal" provides a mixture of comfort and performance, while the "Sport" mode concentrates exclusively on providing the maximum performance under all conditions.

The sensors monitor everything that is going on with body movement and adjusts the damping force on each wheel. In the "Sport" mode, the dampers are set to a harder rate than "Normal" and the car becomes stiffer, responding more quickly to driver inputs. If the road surface deteriorates, the dampers will soften up to cope with the circumstances, but will also stiffen up again as soon as the quality of the road surface improves.

Rebound in Normal mode—damper piston with bypass valve open

Rebound in Sport mode—damper piston with bypass valve closed

Compression in Normal mode—damper piston with bypass valve open

Compression in Sport mode—damper piston with bypass valve closed

PCCB—Porsche Ceramic and Composite Brakes

. . . are a perfect example of how racing really does improve the breed. From their racing background, where cost is less important than performance they are now to be found in high-performance sports cars. The PCCB brake disc is made from a carbon fiber/silicon/ceramic compound, much harder and lighter than steel and extremely resistant to temperature. Coupled with water resistant composite metal brake pads, they provide absolutely fade-free braking under all conditions. I recently drove a 911Turbo with PCCB, pushing them past the limit that even Porsche had envisioned, to the point where they were so hot there were actually flames coming from them; but they were still stopping as well as when they were cold.

Another great advantage of the PCCB is that their light weight gives a big reduction in rotating mass and especially unsprung weight, allowing better road holding, comfort, and responsiveness.

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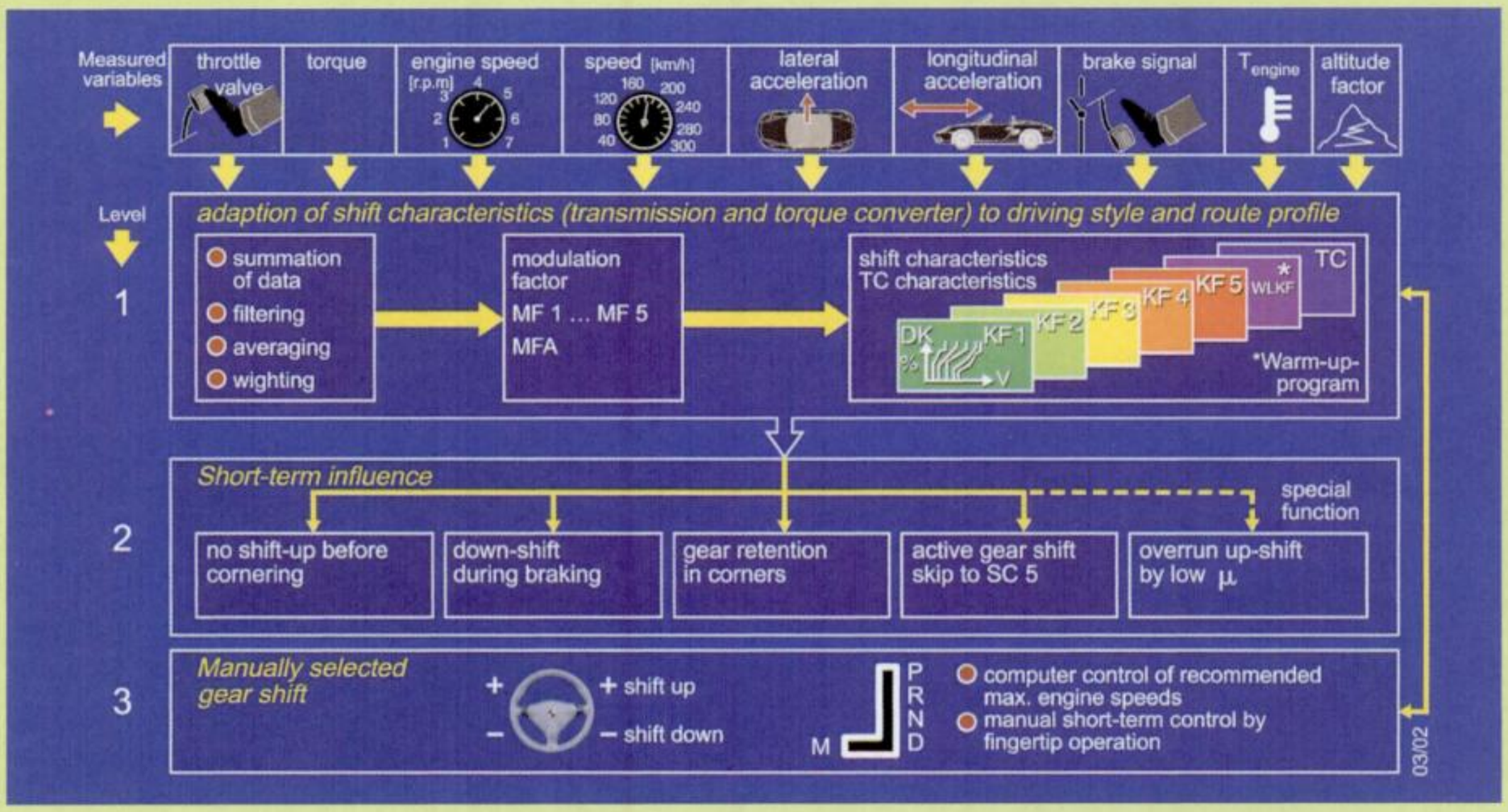
Tiptronic S

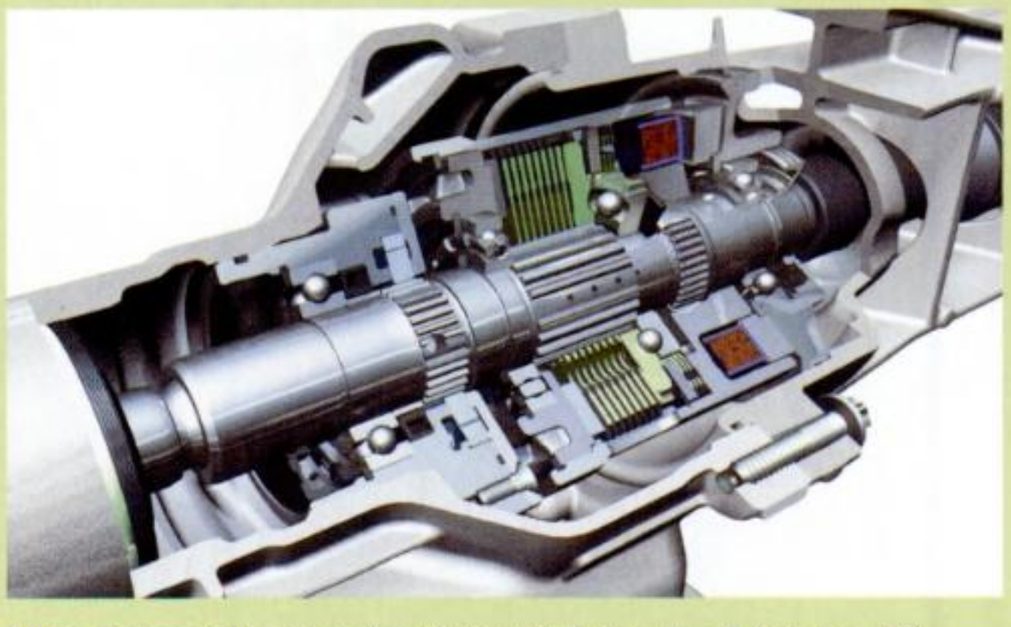
The Tiptronic transmission now has five, or in the case of the Cayenne, six gears. It still works in a similar fashion to the original Tiptronic, in that leaving it in the "D," or Drive mode, it works just like any other torque-converter transmission. Acceleration off the line in this configuration is somewhat limited as the car will normally take off in second gear. Even in the 911 Turbo, when you put your foot flat on the floor, it will start in second gear before instantly changing down to first, all of which takes time.

However, moving the lever sideways to the "M" position allows the driver to manually select first gear and as soon as the car is moving, revert to automatic to take advantage of the available acceleration. Keeping the lever in the "M" position, the transmission can be used as a normal manual gearbox, using either the shift lever or the steering-wheel-mounted rocker switches, but with the added security that, even if the driver makes a fundamental mistake (for example, moving the lever to change down a gear when the car is traveling too fast for that gear and would, in fact, over- rev the engine), the computerized controls will not allow such an action to take place (but will remember that it was asked for when the speed comes down to an acceptable range). While in automatic mode, the driver can still make manual gear changes via the rocker switches, which will temporarily over-ride the automatic control.



ASR (Anti-Slip Regulation) and PTM (Porsche Traction Management)

In the case of the 911 Turbo, further data analysis in real time allows the ASR to combine with the Automatic Brake Differential (ABD) function to limit wheel spin. PTM works most specifically when cornering in the all wheel drive cars, by adjusting the amount of drive provided to each of the front wheels to obtain optimum grip.



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CHAPTER 6
THE TIRES

The place: A Welsh Forest
The time: A Cold, Wet Night in 1962
The occasion: Birmingham Post National Rally

I was flinging my little DKW with its screaming three-cylinder 750cc two-stroke engine through the slippery, muddy logging tracks, determined to win my second national rally in as many weeks. With the front wheels alternately sliding, spinning, and gripping on the slick surface, we were once again outdistancing our competitors. The car was showing definite signs of contact with the scenery, but we did indeed make it back to Birmingham and our second successive victory.

Studded Hakkapeliitta winter tires from Finland. As you can imagine from their looks, they could be used only when the road was totally covered with ice and snow. I once used them on a Monte Carlo rally special stage that was a mixture of asphalt, ice, and snow, and, although providing phenomenal grip and performance, they were totally destroyed after 30 miles. Gisbert Watermann

Today's Bridgestone Blizzak tire provides all-around high performance in winter conditions. As with virtually all high-performance tires today, they are directional, meaning they can be mounted to run in only one direction. Bridgestone

My DKW was the only one running in the British Rally championship, so although I could compare my performance against other drivers in other cars, I had no idea how I might fare against other DKWs. Until now I had largely considered that the tires on a car were just there to keep the rims from scraping on the road and that the best ones were simply the cheapest.

A few weeks later I set off for my first real attempt at an international rally, the Tulip, where not for the last time, I was to learn that there is much more to driving than just sitting behind the wheel and pushing the pedals.

Because the DKW was such a fast and comparatively cheap car, a hoard of them was entered for the Tulip rally. I had put new tires on, of course, but they were the same large-diameter ones that I used in Britain, where ground clearance was so important for forest rallies. Here on the Tulip, all of the special stages consisted of paved hill-climbs, which meant that we needed the lowest possible gearing. In fact, changing gears within the transmission was not allowed in those days, and in any case, there were no alternatives available for the DKW, so the only thing to do was put on the smallest-diameter tires possible, which effectively reduced the final drive ratio.

The European DKW drivers who were used to competing against each other in such conditions already knew about little things like that and had all turned up with the tiniest tires available. All the way through the event I took a beating from the Europeans and went home a wiser man, determined never to overlook any possibility to make the car better and faster in the future.

Today the choice of tires is almost embarrassingly large, from the purest of deep-snow tires to treadless racing

100th anniversary of Targa Florio, 2006
A crowd surrounds the beautiful Porsche Cayman S during a refreshment stop in Campofelice. J. Tippler

Bridgestone Potenza RE050A is a high-performance, directional tire for those who drive in almost continually wet conditions. Bridgestone

Bridgestone RE-01R is a directional high-performance tire that you would use on your new Porsche Carrera. Bridgestone

"slicks," and Bridgestone is one of the most knowledgeable and advanced tire manufacturers as a result of its total continuous commitment to virtually every branch of motorsports for decades.

TIRE SPEED RATINGS

Your new Porsche comes equipped with the correct tires, but if you are equipping or re-equipping an older model, or simply replacing existing tires, you must put on the appropriate speed-rated ones. Even if the speed limit is below the potential of the car, the correct tires must still be fitted.

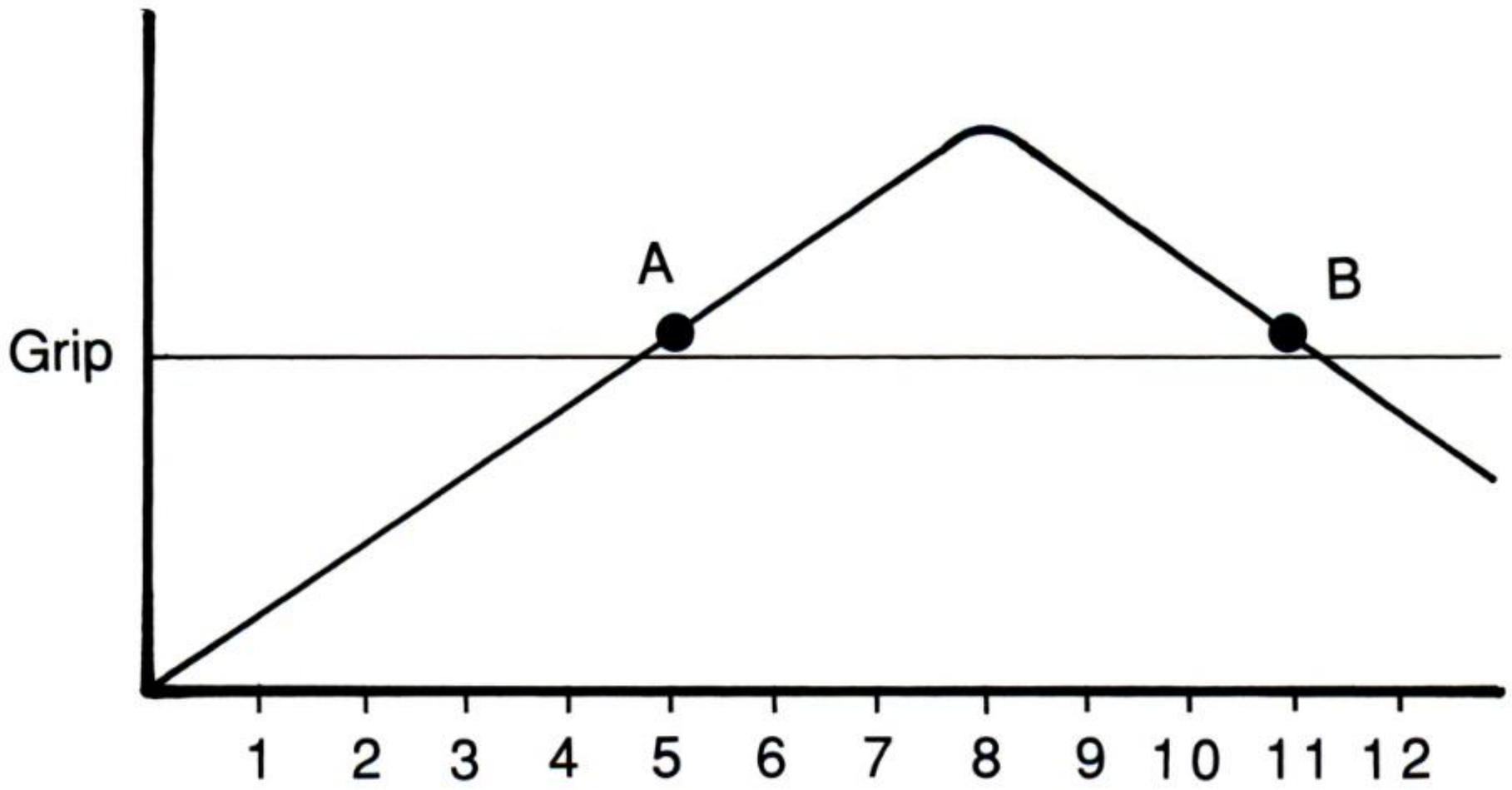
Speed ratings are given by the tire manufacturer to indicate the *maximum* sustained speed that can be used safely by that tire. The speed ratings that you need to know about for your Porsche or other sports car are probably those in the higher ranges. They are all marked somewhere on the tire, usually in the tire service description, and are shown by a letter. With the increase in performance available in many cars since the first edition of this book was published, the speed rating chart has expanded.

Speed Symbol	Maximum Speed (mph)
H	130
V	149
Z	Above 149
W	168
Y	186
(Y)	Above 186

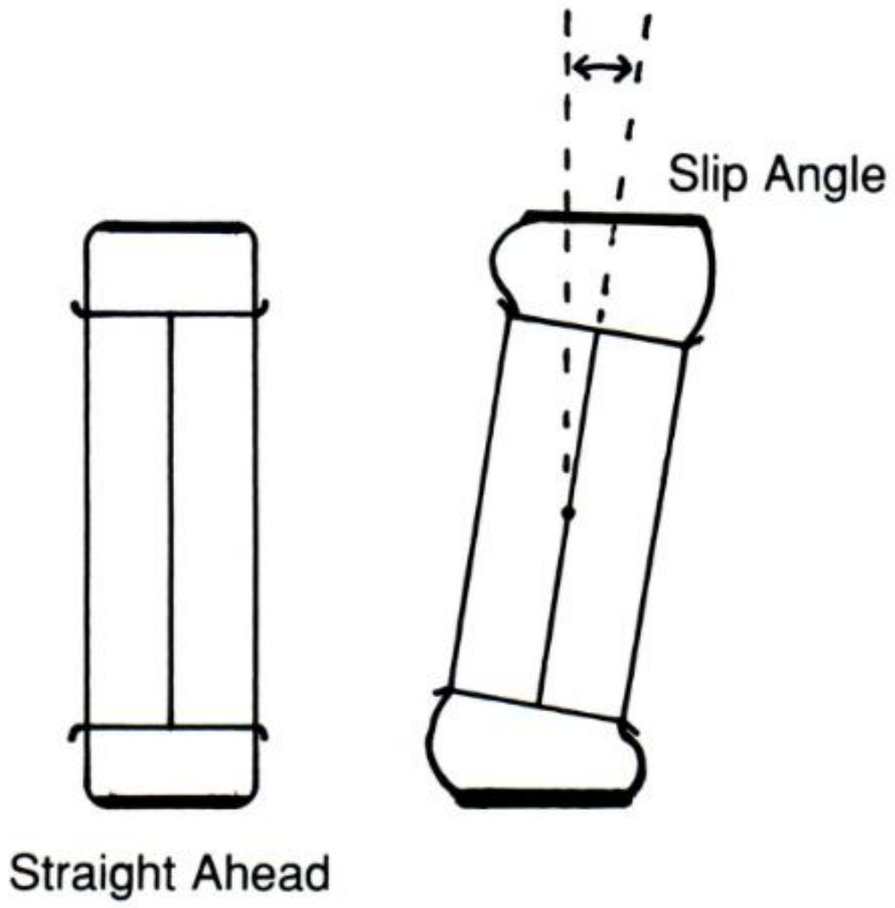
The service description also includes a further technical complication in the form of load index, which is a numerical code associated with the maximum load a tire can carry at the speed indicated by the tire's speed symbol under specific service conditions. Also in the tire Service Description is an indication of the aspect ratio, which shows how tall the tire wall is in relation to the tire's width.

So a Bridgestone Potenza RE050A radial on the rear of your 2007 Carrera will probably be marked 305/30ZR19(102Y). The (102Y) is the service description, which is load index + speed symbol, and the speed rating in this case is (Y). The "30" shows that it has a 30 percent aspect ratio; in other words the sidewall of the tire is 30 percent as tall as the tire width.

Years ago, snow tires were very narrow in order to exert the maximum possible pressure and really "dig" through the snow as far as possible. The use of studs, usually made of tungsten steel, was widespread to give the ultimate grip into ice lying beneath the snow. Today however, the use of studs is severely limited by most countries, which has accelerated the development of winter tire treads that will "dig"



As the slip angle increases, so does the grip—up to a maximum of about 7 to 8 degrees. Beyond that point, the grip will decrease. It is obvious from the diagram that the driver using about a 5-degree slip angle (A), although not yet at maximum grip, is much better placed to control the car than the driver at slip angle B. Even though the grip in both cases is the same, at A it still has room to increase, whereas at B it is already diminishing.



In the moment of transition from traveling straight ahead to cornering, the wheel has turned, but the tire is still pointing straight ahead, creating the initial slip angle.

Bridgestone PotenzaSlick, for use exclusively in racing where slick tires are allowed. Bridgestone

through snow, give grip on ice, and still provide well-balanced overall performance in wet or dry conditions.

TIRE SLIP ANGLES

Whenever you read a driving handbook, you will read about tire slip angles, a concept that is both simple and extremely complicated at the same time. Simple to explain, complicated to analyze.

When the car is going along in a straight line, neither the wheel nor tire is affected by any side forces. When you start to turn into a corner the wheel rim turns first. At that instant the wheel is turned, but the tread of the tire is still pointing straight ahead along the road.

As the slip angle increases the grip will increase as well—up to a point. Once past the point of maximum grip, the slip angle will continue to increase as the steering

wheel is turned but the grip will rapidly diminish. Winding on even more steering will simply make things worse. From then on, the greater the slip angle of the front wheels the greater the understeer will be. This is further aggravated on a front-wheel-drive car because there is more weight over the front wheel, which makes it more difficult for the tread patch on the road to follow the direction of the rim when the wheel is turned.

With a rear-wheel-drive car the opposite can be true. A Porsche 911, for example, has only about 40 percent of its weight on the front wheels, so they will turn and the tire will follow fairly easily, generating only a comparatively small slip angle. Because of this, the rear wheels will turn quickly, generating a large slip angle between them and the tires and causing the rear wheels to slide outward resulting in oversteer.

But whatever car you drive and whatever tires are on it, a tire can never do more than 100 percent of anything. It can be pushed to 100 percent of its capacity on braking or in cornering, or a combination of the two, but it can never go beyond 100 percent.

Remember this concept; it will come into focus when I discuss various aspects of handling in a later chapter.

TIRE PRESSURES

Tire pressures are also vitally important to both performance and safety. Check them regularly and never let them descend below the manufacturer's recommended pressure. If you drive in a spirited fashion and especially if you drive at sustained high speed, as you may legally do on the German Autobahn, for example, check with the tire manufacturer for specific pressure recommendations, which now go further than "just add a couple pounds," but include additional requirements based on the total service description for the tire and its use.

Underinflation or overinflation both can be catastrophically dangerous at very high speeds and have disastrous consequences.

For more information on wheels and tires, read *The Wheel and Tire Performance Handbook* by Richard Newton, published by Motorbooks.

Bridgestone PotenzaRain for use exclusively in racing, even at the level of Formula 1. It is directional and the grooves were delicately designed to channel the water away from the surface, allowing maximum tire-surface-area contact with the road.

CHAPTER 7
ACCELERATING AND GEAR CHANGING

The place: Hockenheim racetrack
The time: 1973
The occasion: Solitude Interserie race

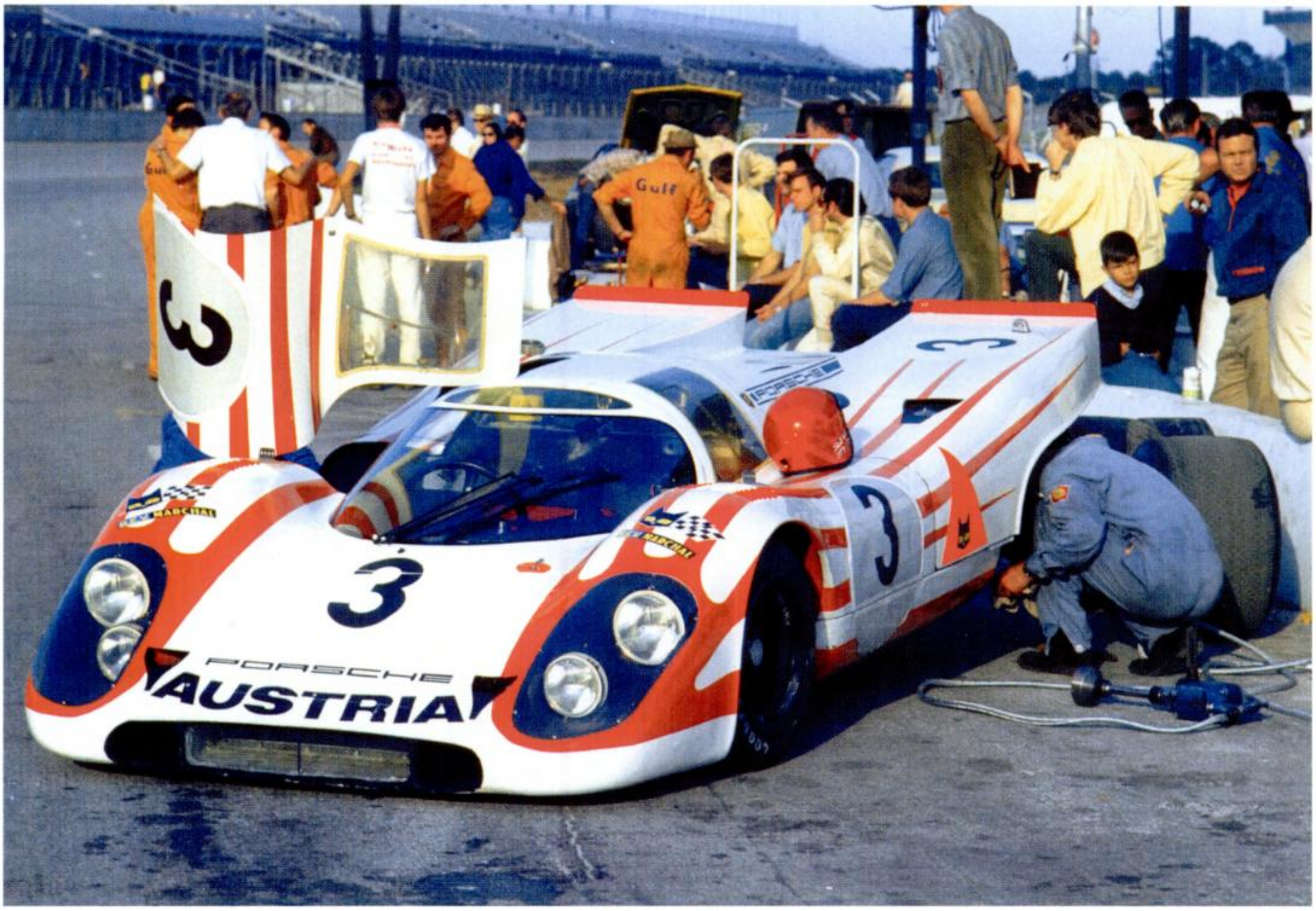
At the end of 1971 the Fédération Internationale de l'Automobile had closed the loophole in the international sports car regulations that had allowed such beautiful racing monsters as the Porsche 917 and the Ferrari 512 to be created. In fact, as far back as 1968 the FIA had started to show concern over the power and speed of prototype sports racing cars.

From 1969, racing prototypes would be limited to a 3.0-liter engine capacity, effectively eliminating such cars as the Ford GT 40s, Lolas with American V-8 power, and other such exotic cars.

A new class to be known as the "Sports" category would be introduced with a 5.0-liter engine capacity limit and a minimum production of 50 cars per year. The

Porsche 917, 1969

All 25 917 "production" sports cars lined up to be counted for homologation by the FIA. These were known as "the secretary cars" because they had been hastily assembled by anyone at the factory who could wield a wrench! Needless to say, they were all dismantled and rebuilt by the racing mechanics before ever turning a wheel. Porsche



Porsche 917, Daytona, 1970

Porsche Salzburg mechanics at work during practice for the 24 Hours. My helmet reposes on the door, and I still wear an almost identical replica when I drive in demonstrations today. Porsche

intention was to allow "real" production sports cars, made in small numbers, to compete internationally. By "real" sports cars the FIA meant things that actually existed: Aston Martin, Chevrolet Corvette, Jaguar, and others.

Unfortunately for the FIA it had not counted on the imagination of such men as Ferdinand Piëch of Porsche or Mauro Forghieri at Ferrari. A little high-speed lobbying by both men got the annual production requirements of 50 cars reduced to 25, and then they both went to work. Porsche was first, but ultimately both companies would build these big production sports (racing) cars.

Porsche duly presented the 917 at the Geneva Auto Show in 1969, where I fell in love with it at first sight. It was big, beautiful, and immensely powerful. By April all 25 "production" cars were lined up in a courtyard at Stuttgart to be counted by FIA officials in time for homologation for that year's 24 Hours of Le Mans.

Rumor has it that at Ferrari, where the parts were built in a number of different departments spread around Maranello and Modena, they got all the pieces together to assemble the cars and found they actually had enough to make 26 instead of just the 25 needed for homologation!

Now I was at Hockenheim at the wheel of perhaps the greatest racing car ever built. During its three-year reign, the 917 in all its forms had dominated the world championship sports car scene as no other car had ever done before.

With the removal of the 917 from the world championship, Porsche had started setting its sights on the North American Can-Am series, and with the turbocharged 917/10 it already had its first successes there in the hands of Hurley Haywood.

The car I was now sitting in was known as the 917/10-30. It was in fact a rolling test bed for the car that had recently gone to the United States for Mark Donohue and George Follmer, who were beginning to sweep everything before them in the Can-Am. In its present configuration, it had a long wheelbase and a 5.4-liter turbocharged engine developing over 1200 horsepower.

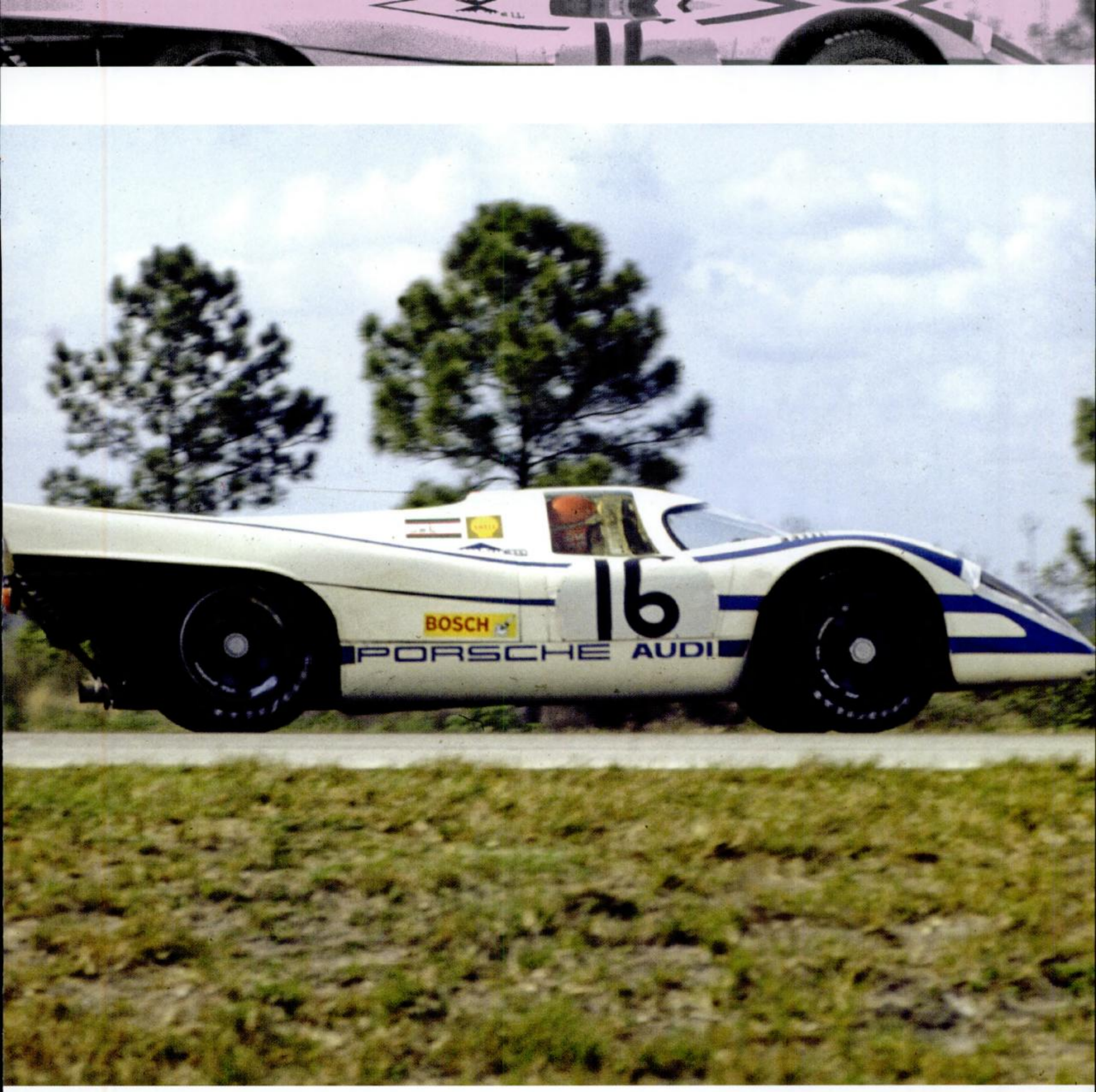
amounted to almost unlimited horsepower, which meant they could add a phenomenal amount of downforce to the car. You can get an idea of how much from the photographs, which show the big shovel nose and a rear wing nearly the size of a dining room table. The effects of the aerodynamics here at Hockenheim were such that at 180 miles per hour the car developed over 1 ton of downforce.

I had set the fastest time in practice and had Willi beside me on the front row of the starting grid, with Leo tucked in behind as we came up to take the flag at the rolling start.

In those early days of turbocharging, the "turbo lag," or the response time between opening the throttle and the engine developing power, was quite considerable. I am sure that the engineers had measured it and could put an

Porsche 917, Sebring, 1970

Another eventful race for Kurt and me was the 12 hours of Sebring, where I was the victim of a clash with a slower car, tearing off the entire left rear corner and putting us out of the race. Porsche

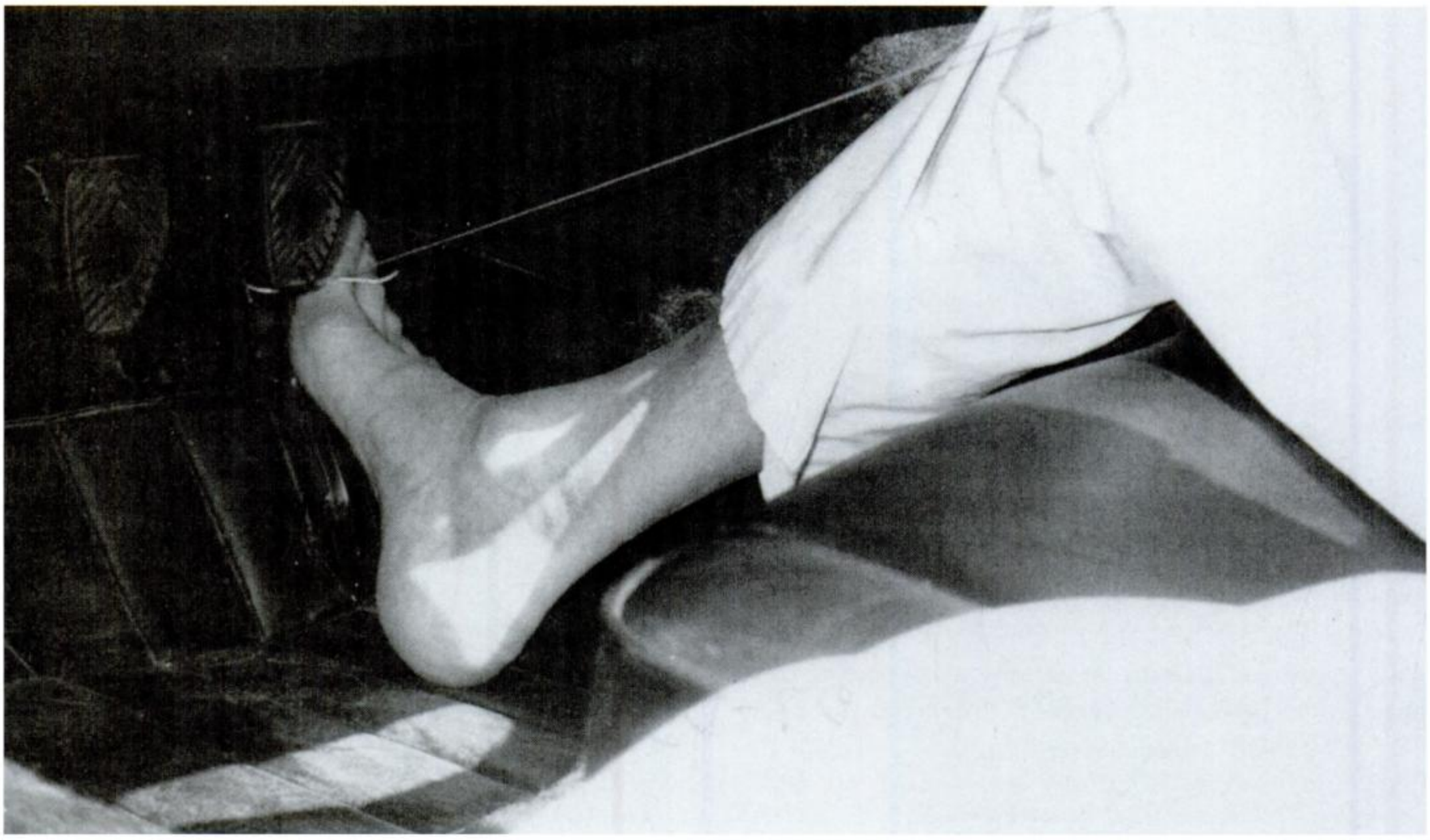


Porsche 917, Sebring, 1970

Until the aforementioned crash, the car looked and performed beautifully. Porsche

exact figure to it. But as a driver, I measured it more by instinct and reaction, and I would guess it to be about two tenths of a second. "Just the blink of an eye," you might think, and not worth worrying about. Except that in a race car you must judge the exact turn-in and acceleration points for a corner within inches, and at 120 miles per hour you travel 35 feet in two tenths of a second.

I had talked to Norbert Singer, the factory engineer in charge of the car, about getting a jump at the start. If I waited for the green flag before putting my foot on the throttle I would have to wait about two tenths of a second before anything happened. "Could I approach the start with my left foot on the brake to hold the speed down and my right foot on the throttle pedal to keep the turbo



Tie a piece of string from the bottom of the steering wheel to your big toe as a test. With the steering wheel straight ahead, the string allows full throttle. Whether it is on the throttle or the brake pedal, the position of the foot is governed by the amount of steering being used. Vic Elford collection

Now with the steering wheel turned, full throttle is no longer possible. Vic Elford collection

floor. It is only as the car begins to straighten out after the corner that the string will allow the right foot to go progressively back to maximum throttle.

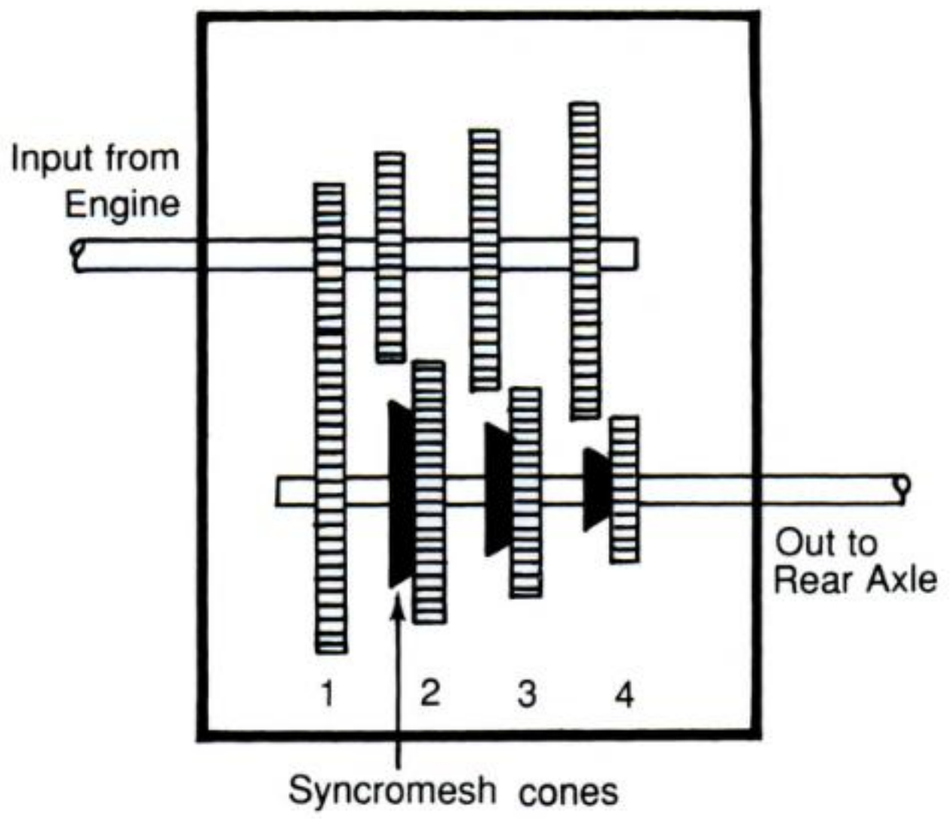
SYNCHRONIZING GEAR CHANGES

Performance driving means being able to drive fast and safely, but it also means driving in such a way that the car is not being ill-treated mechanically. It is amazing how many novice drivers think that getting the most out of a car on acceleration means snatching the gear lever from one gear to the next with as much force and speed as they can muster.

Virtually all modern cars have a system inside the gearbox called synchromesh. It does exactly what its name implies and *synchronizes* the *meshing* of the gears. In fact many, many cars use a Porsche synchromesh system, which was pioneered by Dr. Porsche in the 1930s, then patented and sold under license to the majority of the world's automakers.

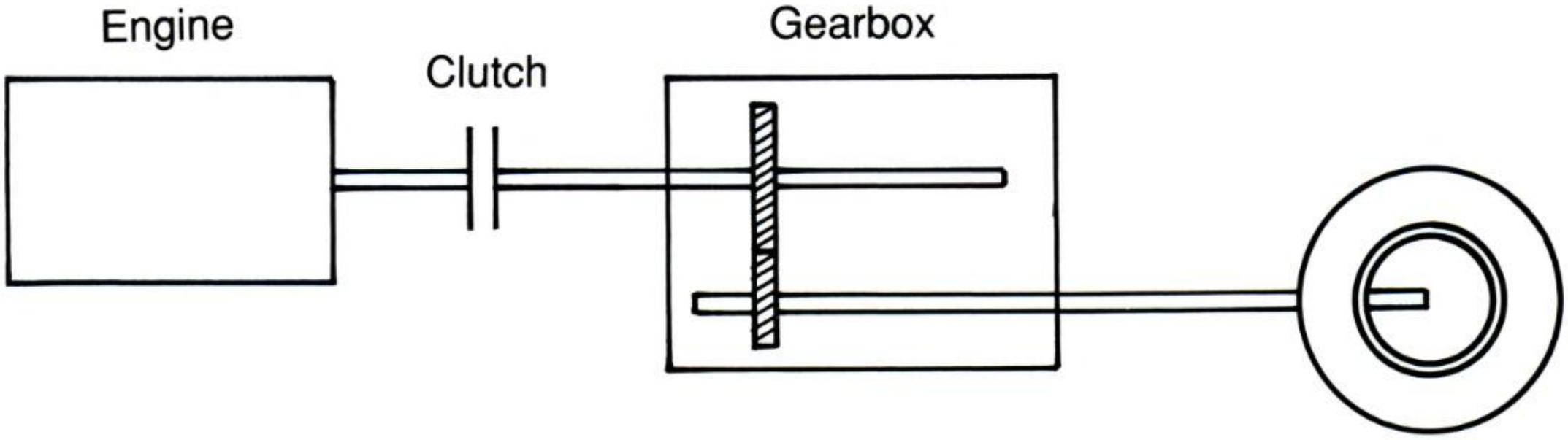
For example, if the engine input shaft is turning at 5000 rpm and the transmission output shaft is turning at 3000 rpm, moving to the next higher gear will require the output shaft speed will remain at 3000 rpm, but the input shaft speed will drop to (say) 4000 rpm. The synchromesh cones move ahead of the input gear so that when the latter arrives it is turning at the correct speed to mesh with the constantly turning output gear. Trying to change gear faster than the synchromesh can do its job will mean a noisy clashing of gear teeth, excessive wear and tear on both the synchromesh and the gears, and eventually a premature and expensive transmission rebuild.

Most racing cars do not have synchromesh, for a variety of reasons. First it adds weight, and race car designers are constantly striving to get down to a weight limit. If they are able to design their cars to be under the weight limit for a particular formula, they then, to make the car legal, have the luxury of being able to add the necessary weight exactly where they want it to be in order to give the car the best possible balance and performance.

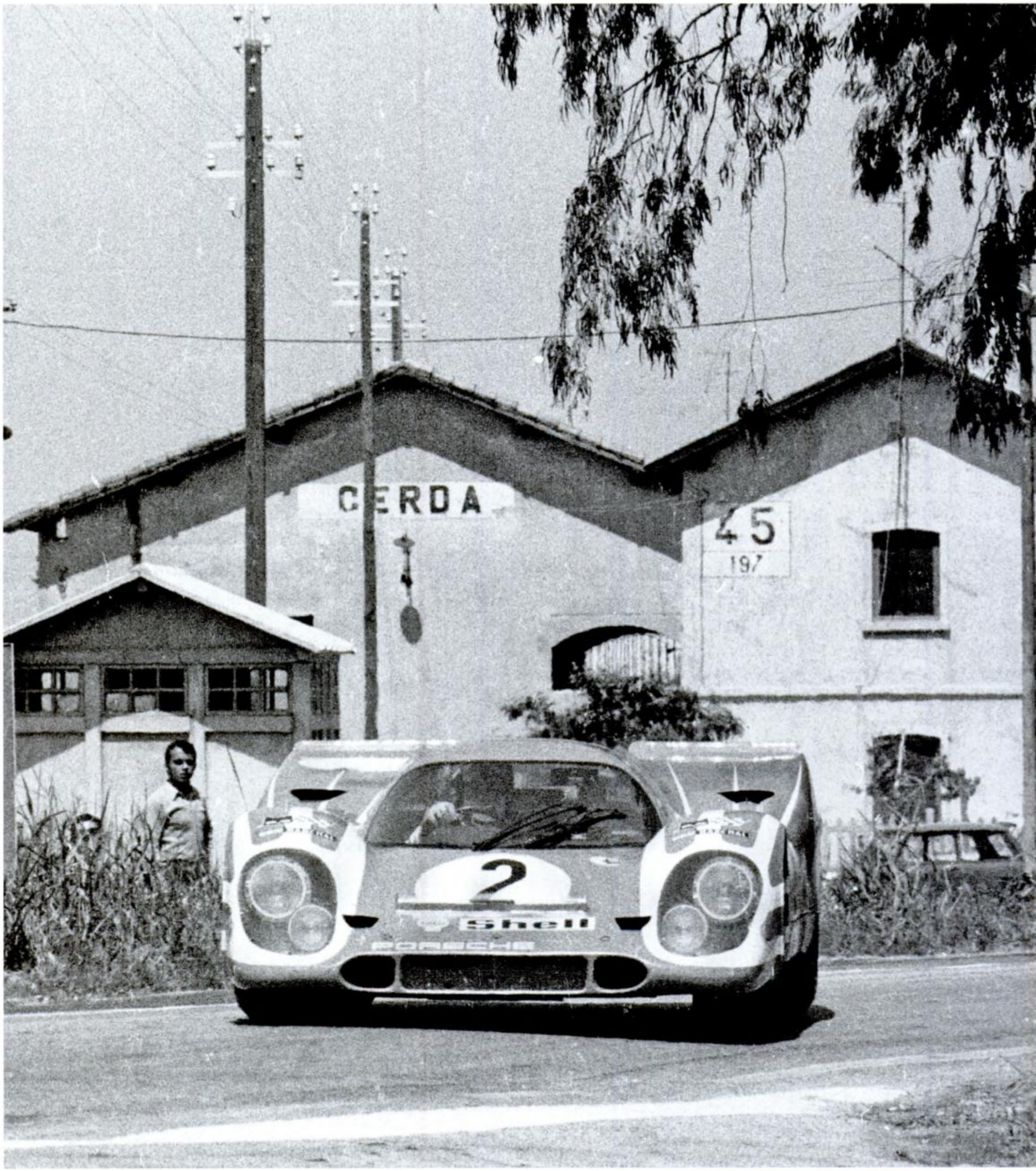


During a gear change, the entire cluster of gears on the input shaft moves. The synchromesh cones on the output shaft are connected to the input gears and move ahead of them, mating into the output gears so that the output gears are speeded up or slowed down to exactly match the speed of the input gear when it arrives.

The second reason synchromesh is rarely used on race cars is that a skilled driver can actually synchronize the gear speeds faster than a synchromesh system. Every engine has a flywheel attached to the crankshaft that helps to keep the engine turning smoothly. The one on your road car is comparatively heavy, so when you put your foot on the throttle it will take a little time for the engine to "wind up" through the rev range. Conversely, when you lift your foot off the throttle at high speed the



Typical engine/clutch/gearbox layout.



Porsche 917, Targa Florio, 1970

A war of words going on between Ferdinand Piëch and John Wyer even led me to drive one lap of the Targa Florio in this 917, "just to see." Although probably the most unsuitable car imaginable for such a track, I knew it so well and was so comfortable there that I actually set the fifth fastest time overall during the official practice. Vic Elford collection

momentum of the flywheel will only allow the engine to slow down comparatively slowly.

On the other hand, the flywheel on a pure racing engine is relatively light, which means that opening the throttle allows the engine to speed up very quickly and closing it gives very rapid engine deceleration. These rapid changes in engine speed also help to account for the fact that the racing driver, or to be more precise the *good* driver, driving a pure racing car can often change gears quicker without synchromesh.

So when you are accelerating hard in your Porsche and you change from first to second gear at maximum revs, don't thrust or grab the gear lever as hard and as fast as you can. Move it firmly but gently and you will actually be able to feel the synchronizers at work as they match the gear speeds within the transmission and allow the next pair of gears to mesh smoothly together.

If you are driving a race car without synchromesh, you really need to learn how to double declutch in order to perform smooth, noiseless gear changes, a technique discussed in the next chapter.

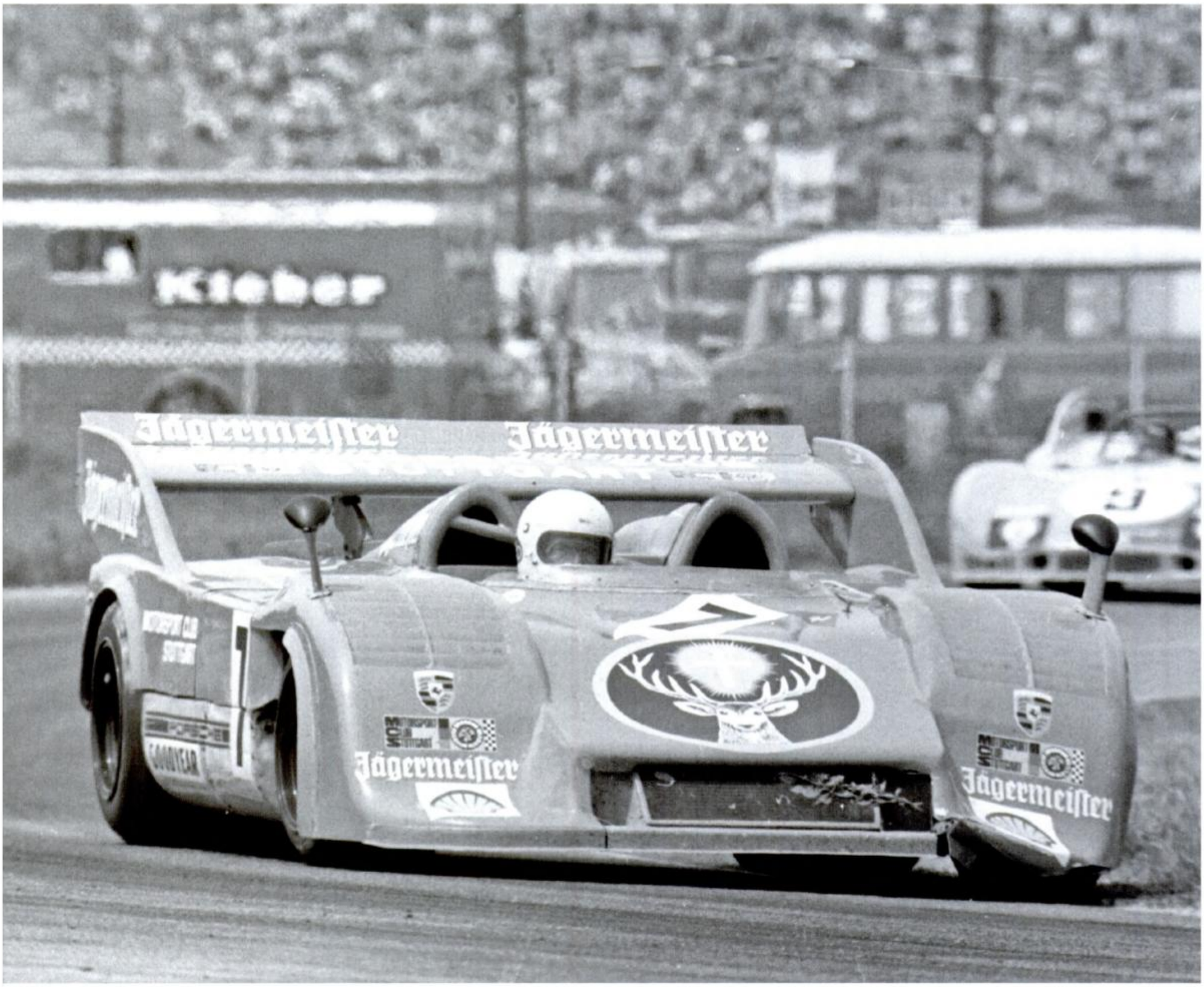
Despite the advantages of "straight cut," non-synchromesh gears for racing, Porsche, having invented it, always used synchromesh gearboxes in all its racing cars. In the case of the 917, especially the turbo versions, the gearboxes were of massive construction in order to cope with the power and torque of the engines. I, along with many of the other factory drivers, pleaded constantly with the engineers to give us non-synchromesh transmissions so we could change gears faster and lower our lap times, but such was the integrity of people like Piëch that they steadfastly refused. Their argument was that racing both developed and showcased the breed. Anything that was developed from racing and which could ultimately find its way into a production car, would. Similarly, any past developments now used in road cars that could also be incorporated into the racing program, where it would undergo even further development, would do so as well.

SMOOTH GEARSHIFTS

For this example let us just use a synchromesh gearbox for the moment. When accelerating as fast as possible, the revs in first gear will quickly reach maximum. As they do, the change to second gear must be done with careful coordination of both feet as well as the gear lever. The right foot should release the throttle pedal at the same instant as the left foot declutches. By declutching I mean pushing the clutch pedal in to the stop. While these two actions are taking place the gear lever can be moved to the neutral position.

Porsche 917, Watkins Glen, 1971

As soon as Ferrari arrived on the scene with the 512, things got very tough and physical at the front. This was a typical first corner elbowing session as we headed into the esses at Watkins Glen, with Jo Siffert and Pedro Rodriguez in the Gulf-Wyer 917s, and Mario Andretti and Jacky Ickx in the Ferrari 512s. Michael Keyser



Porsche 917/30, Hockenheim, 1973

Here you can see evidence of contact with the similar car of Leo Kinnunen, who braked just before I anticipated he would. Eberhard Strähle

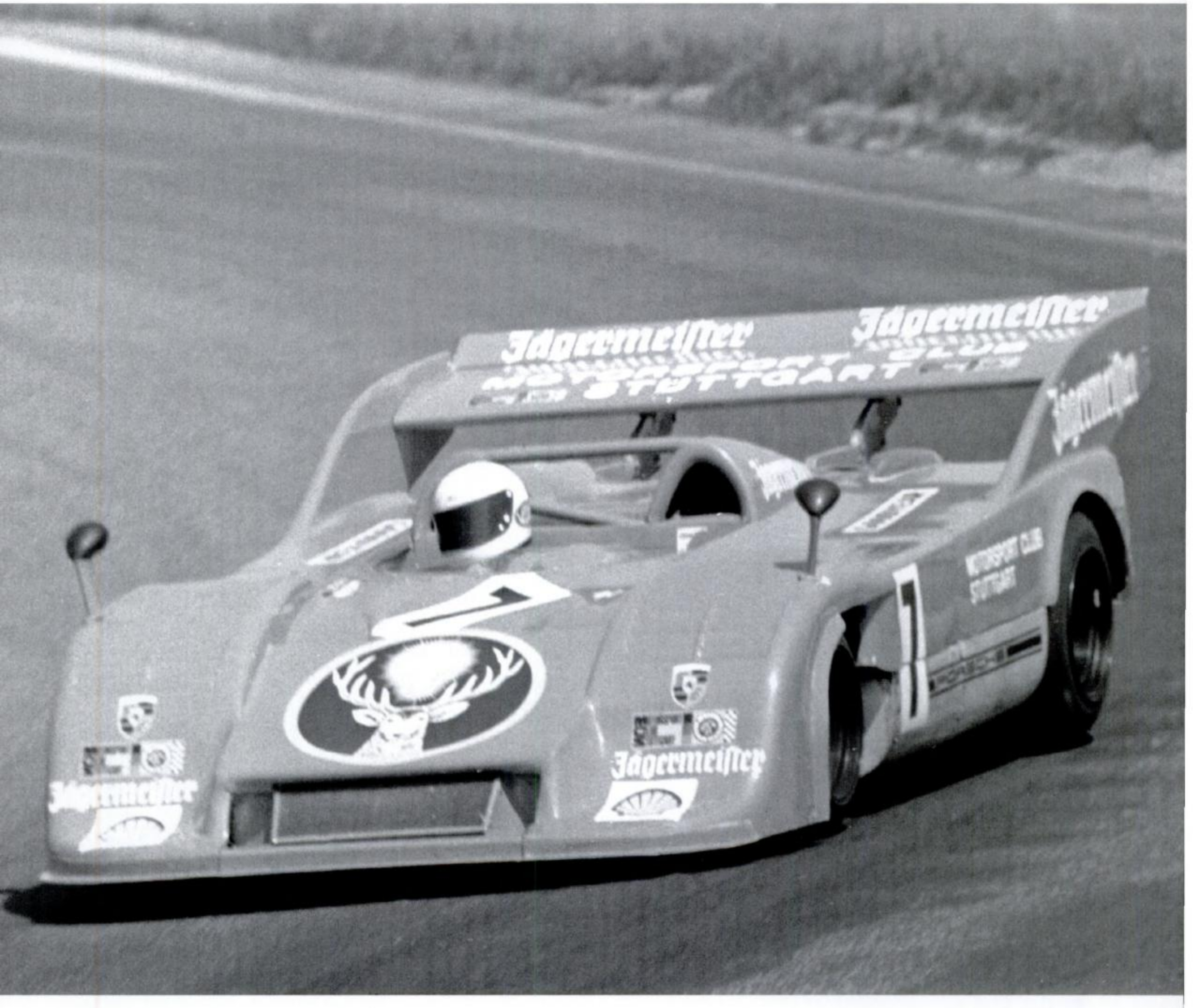
Then, continuing the movement of the gear lever toward the next gear, a slight resistance will be felt as the synchromesh cones go to work. As soon as the resistance diminishes the gear lever will slip smoothly and easily into the next gear. At this point the clutch pedal should be let out and the throttle pedal put smoothly down so that there is a perfect match of gear speed and engine speed as the clutch is fully home. If the car lurches nose down as your foot comes off the clutch you changed gear too slowly and allowed the engine speed to drop too low. If the car surges forward and the engine and/or clutch spins, you put your foot back on the throttle before the clutch was fully home. Try it at low speeds first until you are absolutely sure you can get it right every time, then slowly work up to maximum revs.

Now let's do it without synchromesh.

You will see from the diagrams that although the gears still slide back and forth on their respective shafts, there are no synchromesh cones attached to them. You must use the engine to adjust the speed of the revolving gears so that they will mesh smoothly together. Incidentally, even though your road-going Porsche has synchromesh, you can still go through the motions of changing gear without synchro.

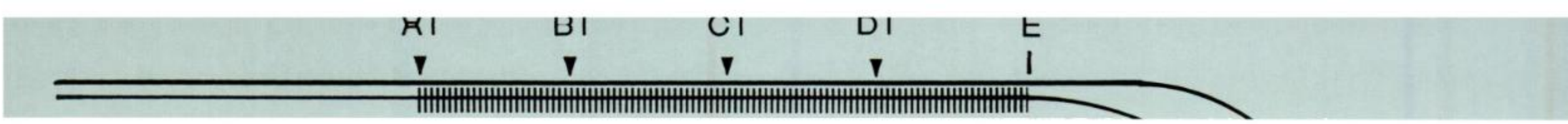
Now the sequence for shifting while accelerating without synchromesh is as follows:
As you reach the rev point at which you wish to change gear:

1. Right foot off the throttle, left foot in on the clutch pedal, and gear lever to neutral (all three actions taking place simultaneously).
2. Left foot off the clutch pedal, which allows the engine to adjust the gearbox input shaft to the new, slower engine speed.
3. Left foot in on the clutch and gear lever immediately into the next (higher) gear selection.
4. Clutch pedal out and, as soon as the clutch is fully engaged, right foot back in on the throttle pedal.



Porsche 917/30, Hockenheim, 1973

I came out of retirement to drive this wonderful monster at Hockenheim. 1250 horsepower from the turbocharged engine and unheard of downforce made it a real pleasure to drive. Eberhard Strähle



CHAPTER 8
BRAKING AND HEEL-AND-TOE GEAR CHANGING

The place: Sebring
The time: 1971
The occasion: Sebring 12-hour race

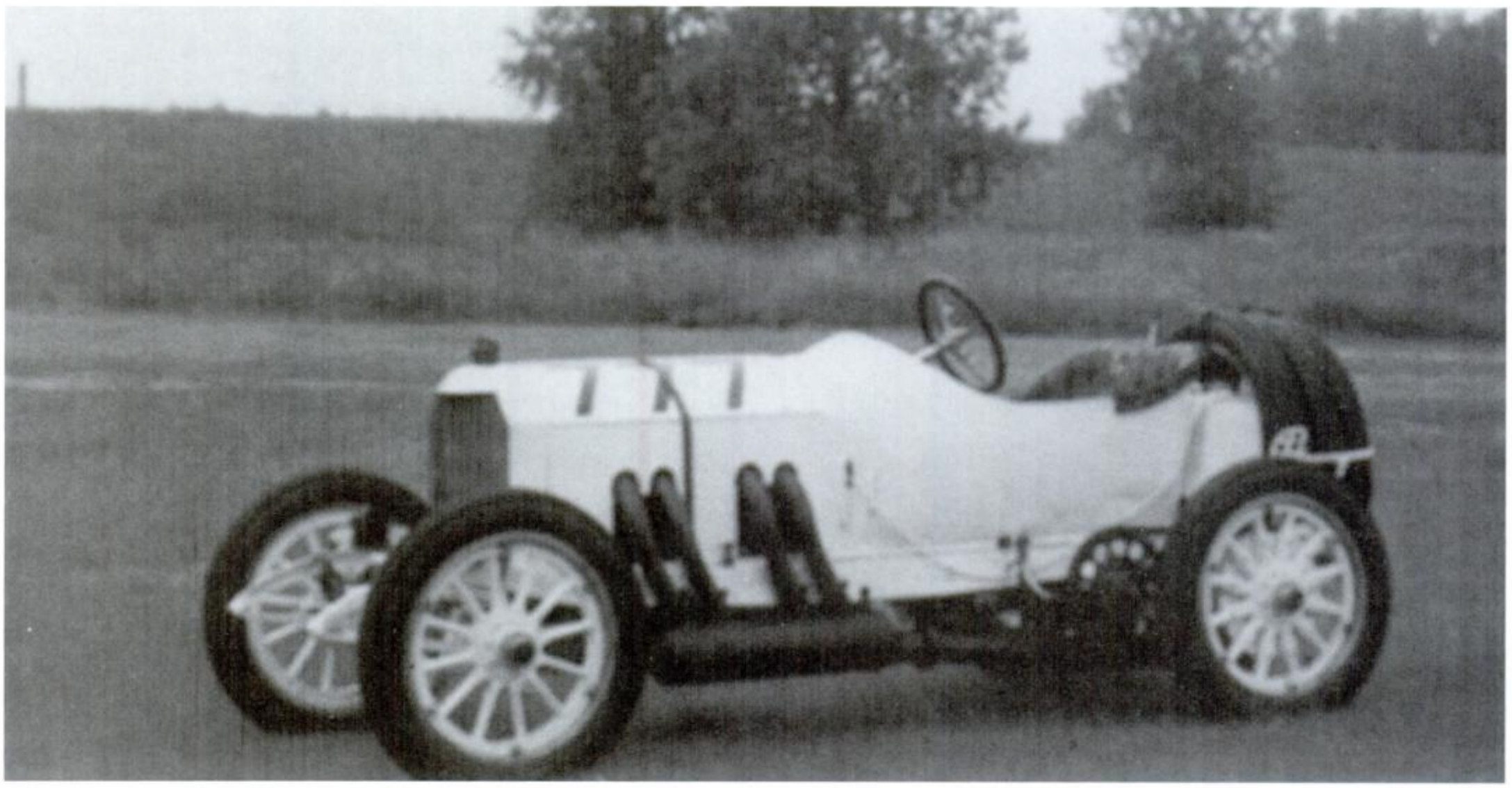
My second ever visit to the United States was for the Sebring race in 1968 and a second place with Jochen Neerpasch. The race in 1969 was less kind; a broken chassis led to a bizarre-handling car that Richard Attwood and I could only bring home in seventh place.

The 1970 race was even worse.

Sam Posey in a Ferrari 512 and I in the Porsche Austria 917 were both taken out by the inattentive driving of someone in one of the numerous small Italian cars. I was behind Sam, preparing to lap him when we came up behind a 911 on the approach to the hairpin. We followed the 911 around the corner, and as it accelerated along the left side of the road Sam and I went to the right (inside). Ahead of us on the inside was a little Italian car. Just as Sam had cleared the 911 and I was alongside it preparing to flick left and right to go past the Italian, the latter suddenly braked.

Both Sam and I were much too close and going far too fast to be able to stop. Sam swerved to the right and went off the road, and although he was able to get back to the pits, the damage to his car was such that his race was over.

I swerved left and tried to make it through the rapidly diminishing gap between the Italian car and the still accelerating 911, but there just wasn't room. There was a rending crash as my left rear wheel hit the right front fender of the 911 and I spun. I got going again thinking that I had



This Mercedes, which won the French Grand Prix in 1914, is an example of the vintage of vehicle that spawned the term "heel-and-toe." It is now owned by George F. Wingard.

probably just punctured a tire and made my way slowly back to the pits. This was in the days before crew/driver radios, so the mechanics were surprised to see me limp slowly into pit lane.

As I rolled to a stop in front of the pit, the mechanics rushed around to the rear of the car—and then did nothing. Peter Falk, the engineer in charge of my car, came back around and opened my door. Leaning in, he said, "You've lost a wheel." Frustrated at the delay, I remember saying, "So, put another one on!" "No, you don't understand. The entire rear corner has gone; wheel, suspension, brake, driveshaft. . . . There is nothing there to attach a wheel to."

As I had tried to pull out in front of the 911, its front bumper had gone inside the middle of my wheel and simply ripped it completely off, taking everything else with it.

Sam and I roamed the pit lane for an hour after the incident hoping to lay eyes, and frankly hands, on the culprit. But the incident had happened so quickly that nether of us had seen the car's number. All we could remember was that it was "a little red Italian car." We didn't even know if it was an Alfa Romeo, a Fiat, or a Lancia. Perhaps fortunately for the driver, we never found him.

Now a year later I was back in my favorite state, Florida. You will remember that I cannot stand the cold and for me anything less than 75 degrees Fahrenheit is cold. That's one of the reasons I like Florida so much. That and the easygoing lifestyle, although where there always used to be plenty of time and no one was ever in a hurry, sadly, this is no longer true in the Miami area where I now live.

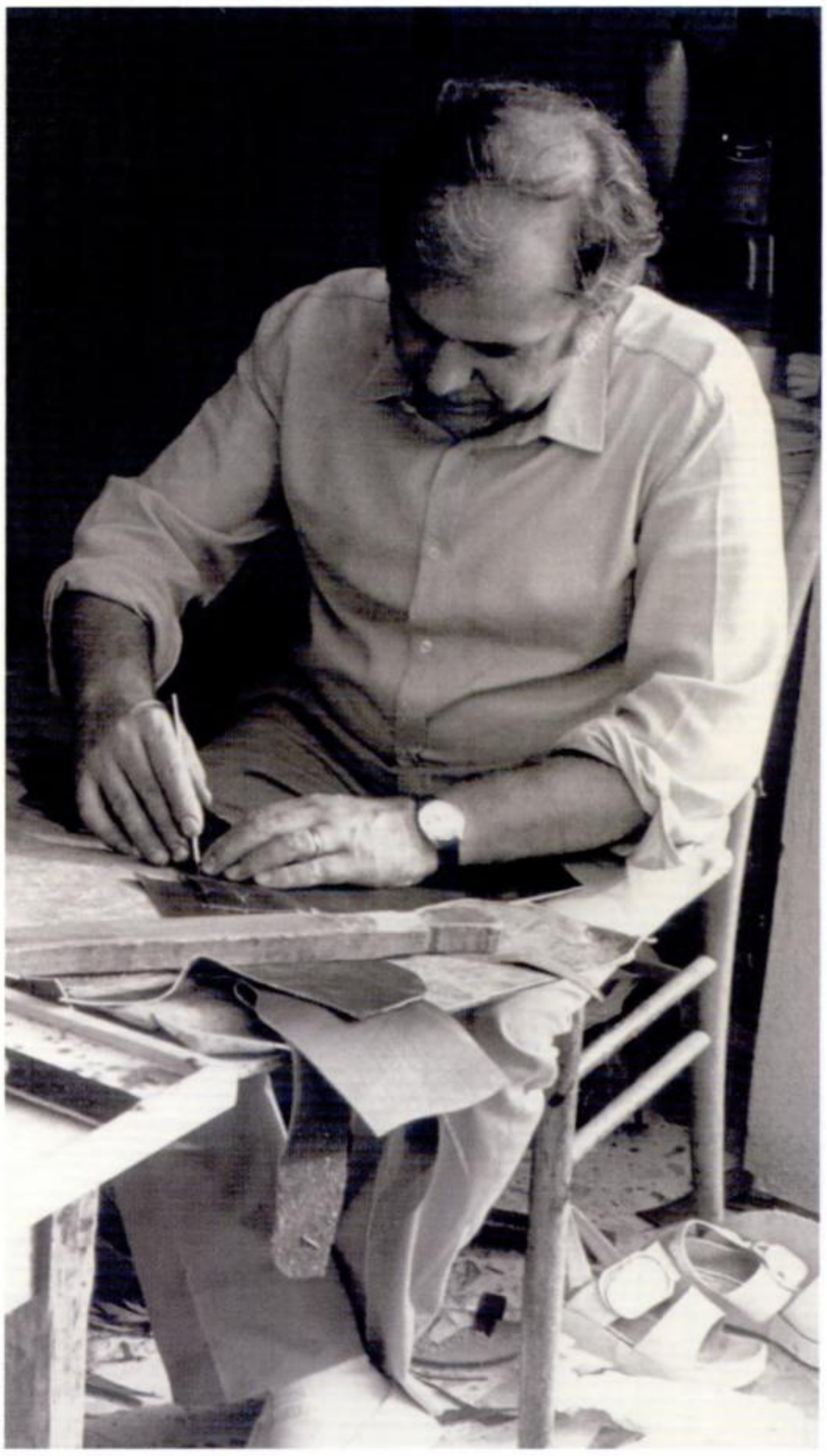
Once a year, the sleepy little town of Sebring comes alive and the restaurants resound with as much French, German, and Italian as English. All the foreigners get to try grits for breakfast, usually only once. The drivers' medical checks used to be performed on the second floor of the local fire station, which then gave us all the opportunity to slide down the firefighters' emergency pole through the hole in the floor when it was over.

To crown it all, the technical inspection was also carried out downtown so those who chose to do so also got to drive their race cars the 6 miles or so to the circuit afterwards, escorted by the local police and sheriff departments.

Porsche had been spending too much money on racing over the last few years, and starting in 1970 the "official" factory team was run by John Wyer with Gulf sponsorship. With lead drivers Jo Siffert and Pedro Rodriguez, it was a formidable combination.

In 1970 I had signed with the Porsche Salzburg team, owned by Louise Piëch, sister of Ferry Porsche and mother of Ferdinand Piëch, but after one year that team, too, had disappeared. Martini & Rossi came to the rescue for the 1971 season. Having been present as a sponsor for a number of years, they had gone a step further and created the Martini Racing Team with factory support from Porsche, and now I was driving for them.

The Daytona race in 1971 had been an expensive disaster for the Martini team, with both cars suffering severe damage, and we were reduced to just one car for Sebring. After having passed many years as friends and fierce competitors, I now found myself with Gérard Larrousse as my co-driver.



A Sicilian Legend—Ciccio

In 1968, I won the Targa Florio wearing new driving shoes that were handmade by Ciccio in his tiny workshop in Cefalu. The instant publicity that ensued meant his shoes became famous overnight, and the list of drivers for whom he subsequently made them is huge. Elegant ladies shoes are also one of his specialities. Vic Elford collection

Porsche 908, Sebring, 1969
The last Le Mans–type start at Sebring. Obviously, the open cockpit of the Porsche 908s gave their drivers an advantage. Here, Jo Siffert is already in front, followed by Gerhardt Mitter in number 29 and myself in number 30.
Bill Warner/Dennis Kirkland

Porsche 917, Sebring, 1971
The start of the 1971 Sebring 12 Hours. Leonard Turner

Memories of my three-wheeled 917 from the year before flooded my mind, but this time, after nothing more than a quick unscheduled pit stop to tape up the nose, we were running again and slowly reeling in the leaders. The task was made easier when Jo's 917 ran out of gas on the circuit; Pedro and Mark were racing so fiercely that they collided, necessitating long pit stops for both; and Mario had an oil cooler break.

All this left two Alfa Romeos in first and second place, but they were no match for the Martini Racing 917, and before half distance Gérard and I were firmly in the lead, never to lose it.

Lap after lap, day and night, the chassis, and above all the brakes, were tested to their limits as we repeatedly had to slow the car from speeds approaching 200 miles per hour on the unbelievably rough concrete surface. But apart from one small delay in changing a recalcitrant brake pad, everything ran like clockwork, and the Martini 917 was still stopping as well after 12 hours as it had at the start of the race.

Since I had started the race, the honor of receiving the checkered flag fell to Gérard, and the entire Martini team watched and cheered as he crossed the finish line and set off on his victory lap. I headed for the winners circle and the podium to join Chris Economaki and wait for Gérard . . . and wait . . . and wait. After what seemed an eternity he finally arrived, and as we were receiving the victory garlands and champagne he confided sheepishly in my ear that he had been so excited at winning his first world championship race that he had spun on the cooling-down lap.

SMOOTH BRAKING

In the last chapter we saw how important smoothness is in accelerating. If anything, smoothness is even more important when it comes to braking at the limit, also known as "threshold braking," since it means holding the brakes absolutely at the threshold of their limit while still keeping control and not locking wheels.

Imagine for the moment that you are driving along a rain-swept, slippery highway at 65 miles per hour, or on a wet racetrack or German autobahn at 150 miles per hour. Imagine also that you are driving a Porsche 911, an older one without ABS, which in static form has only about 40 percent of its weight on the front wheels.

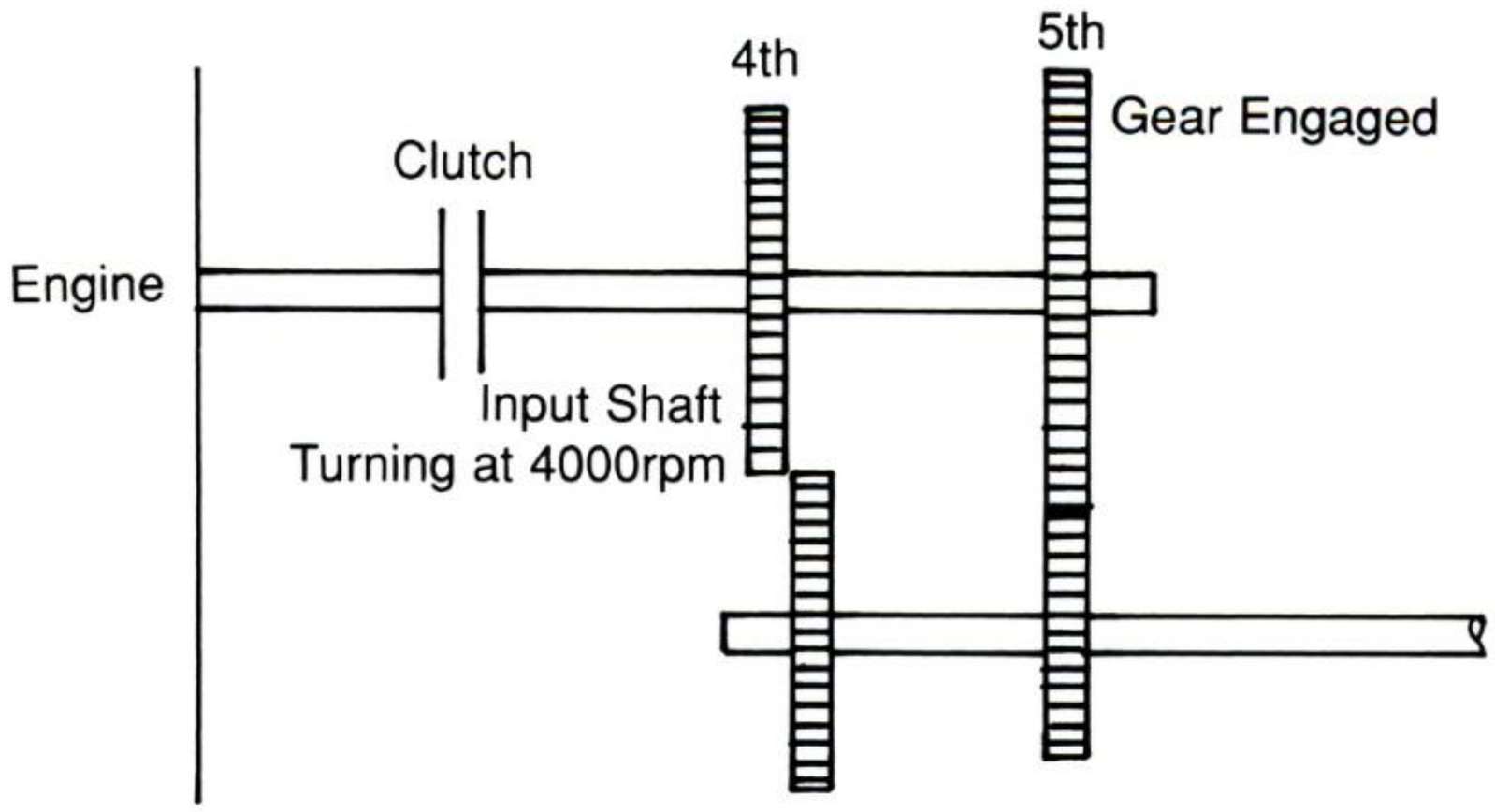
Because of an obstruction in the road or an approaching corner on the racetrack, you need maximum braking. If you slam your foot as hard as possible on the brake pedal, what will happen?

If you replied, "The wheels, at least the front ones, will lock up and the car will just slide," you are right. If you answered, "The car will spin," you are not necessarily right.

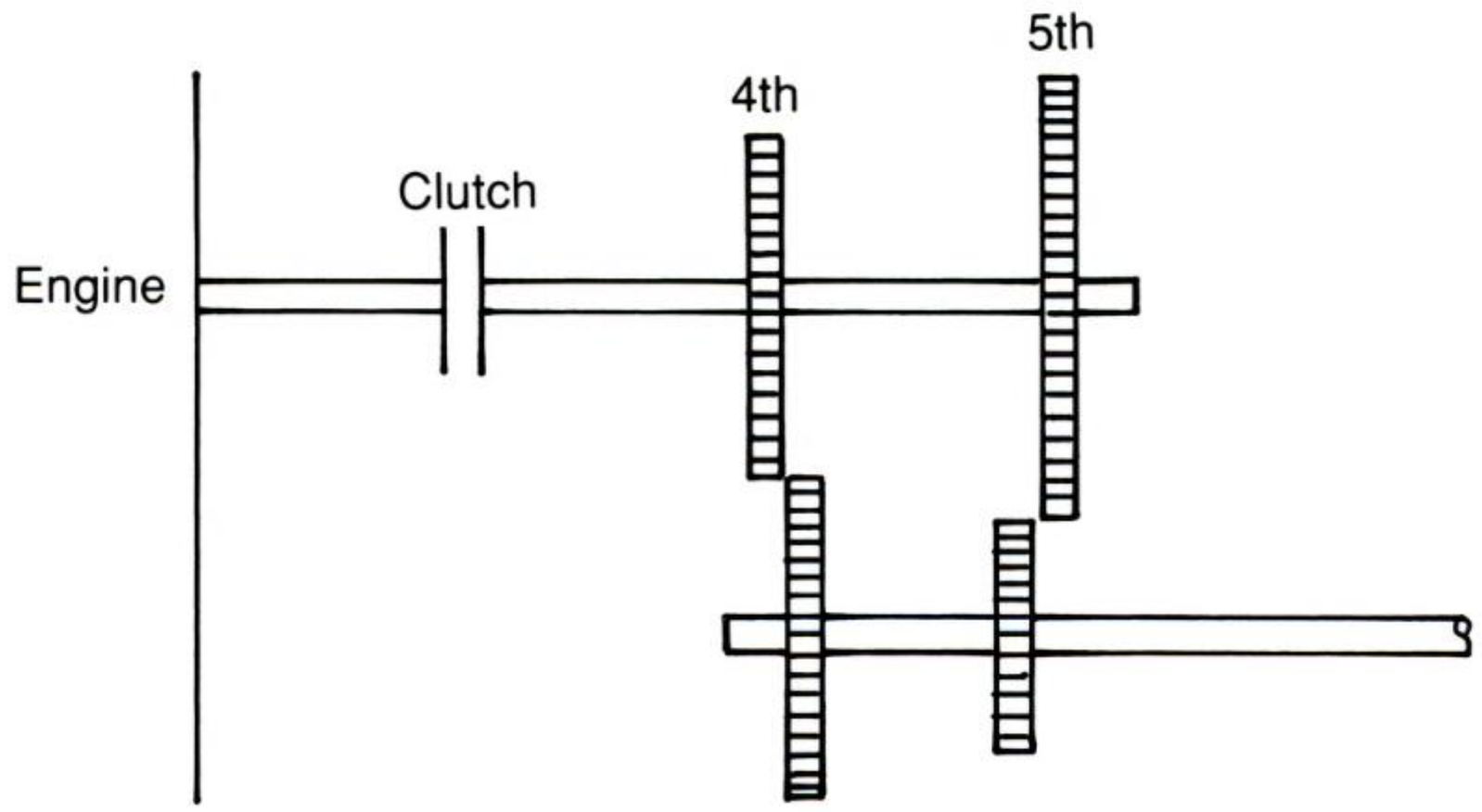
When the road is completely flat and you are going absolutely straight, the car will not spin. Some outside influence must act on the car for it to spin. If the road is steeply cambered, for example, or if you are in a corner, then it probably will spin.

Some of you have probably been told by well-meaning, but misinformed, friends that the best way to stop from high speed or under difficult conditions is by so-called "cadence" braking; stabbing away at the brake pedal,

Fifth gear engaged with the input shaft turning at 4000 rpm.



The gears in neutral while the clutch is out and the throttle is blipped to bring the input shaft up to 5000 rpm.



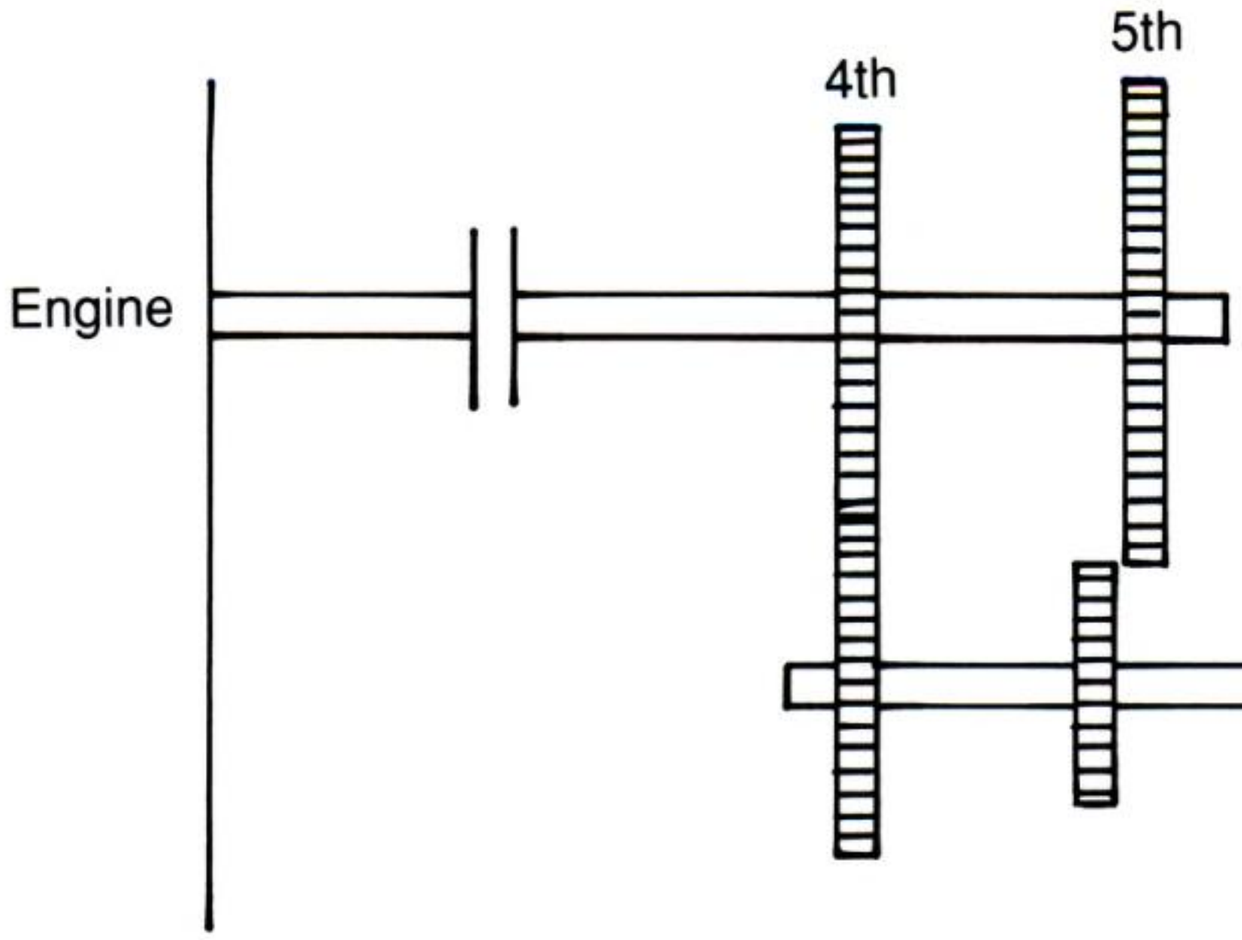
you must adjust the engine speed. Suppose that 4000 rpm in fifth gear is the equivalent of 5000 rpm in fourth gear. To change gear you must push the clutch in at the same time as you lift off the gas pedal; almost simultaneously you move the gear lever from fifth to the neutral position and then smoothly into fourth gear, remembering to let the synchromesh cones do their work. By now the engine speed will have dropped to idle and if you let the clutch out the wheels and transmission will have to speed the engine up to 5000 rpm.

You can do it that way, but letting the clutch out quickly will result in a screech of protest from the driven wheels and the car will try to stand on its nose. Letting the clutch out slowly will help, but it is still uncomfortable and will unbalance the car. In both cases, if the road is slippery there is a very good chance that the wheels will lock momentarily, which could well send you into a spin or, in a front-wheel-drive car, send you straight on out of control.

The best, and correct, way to do it, having accomplished the actual gear change, is to give a little "blip" on the throttle with the clutch still held in to bring the engine speed up to 5000 rpm. Now engine and transmission are all turning at matching speeds and as you let the clutch out everything will mesh together smoothly with no jerkiness at all.

To accomplish the same maneuver with a non-synchromesh gearbox requires a little more concentration, but once mastered will give you a feeling of satisfaction every time you do it correctly.

With a synchromesh gearbox the cones slide ahead of the gears, so that when the gears arrive the input and output shafts are already turning at matching speeds and the gears can mesh smoothly together.



With the input shaft at 5000 rpm, fourth gear engages cleanly.

Without the synchromesh cones you must add a couple of extra steps in the middle of the operation and take some positive action to get the input shaft turning at the correct speed before engaging the next gear.

Look at the diagrams again. You are driving along in fifth gear at 4000 rpm. This time when you push the clutch pedal in and move the gear lever to neutral it is impossible for the next set of gears to mesh correctly since the input shaft must be turning at 5000 rpm for this to happen (remember my previously stated assumption that 4000 rpm in fifth gear is the equivalent of 5000 rpm in fourth gear). In order to obtain that speeding up of the input shaft you must do it with the engine.

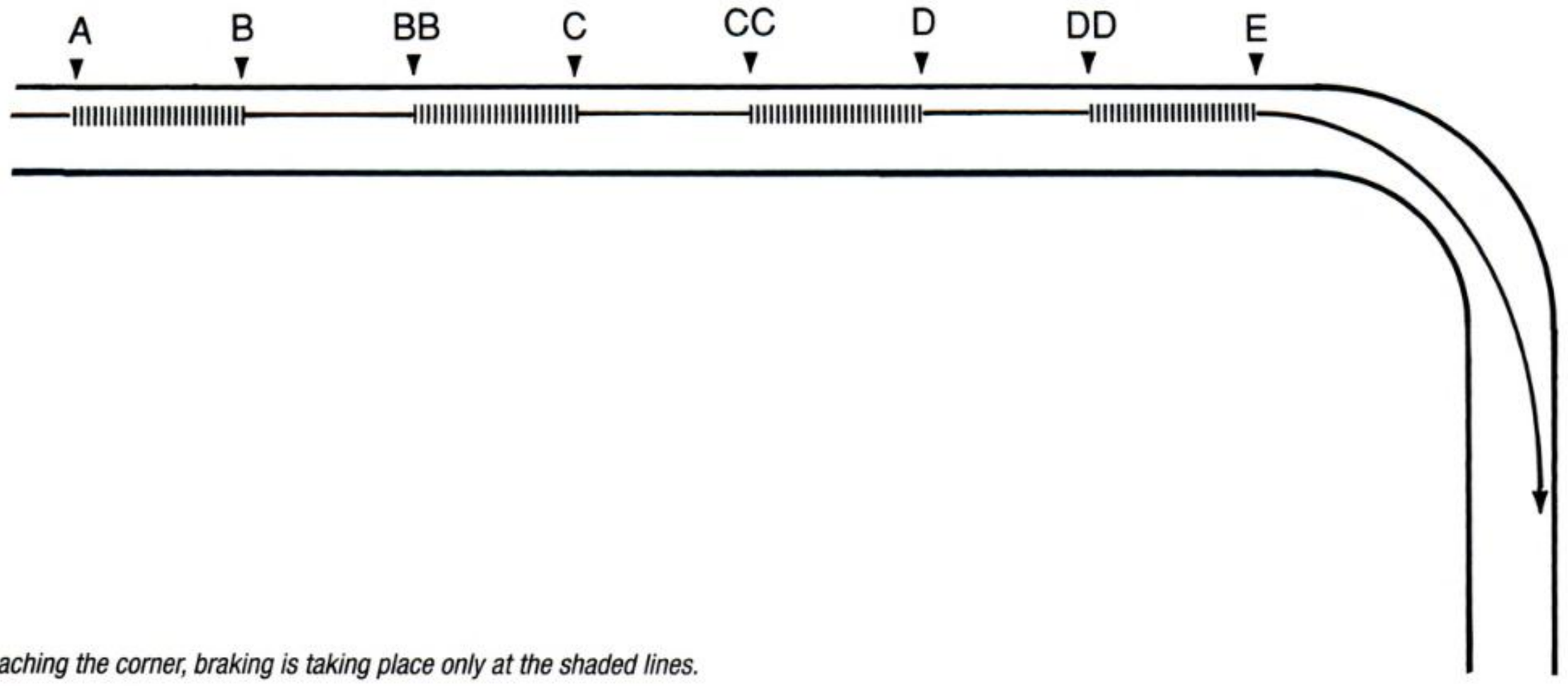
The sequence without synchromesh is as follows:

1. Clutch in, foot off the throttle, gear lever to neutral.
2. Clutch out (that is, foot off the clutch pedal) so the input shaft is turning at the same speed as the engine again.
3. "Blip" the throttle to bring the engine *and* the input shaft up to 5000 rpm (or a little over).
4. Clutch in, gear lever to fourth gear.
5. Clutch out, foot back on the throttle pedal.

BRAKING WHILE DOWNSHIFTING

Assume you are on the main straight of a racetrack traveling at about 150 miles per hour in fifth gear. The corner you are approaching must be taken at about 40 miles per hour in second gear.

At point A you start to brake as hard as possible (see diagram). By the time you reach point B you are within the speed range for fourth gear, so you must come off the brake, execute a smooth double de-clutch gear change, and then go back to maximum braking again. You are now at point BB, and when you reach point C you must repeat the operation in order to engage third gear, getting



Approaching the corner, braking is taking place only at the shaded lines.

back on the brakes again at point CC. One more time between D and DD, then a little more braking and you arrive at point E, where you will turn into the corner.

The only problem is that from a performance point of view all the time spent between B and BB, C and CC, and D and DD was time wasted. Since you had to release the brakes during those periods in order to get the gear changing done, they were periods during which you were not braking.

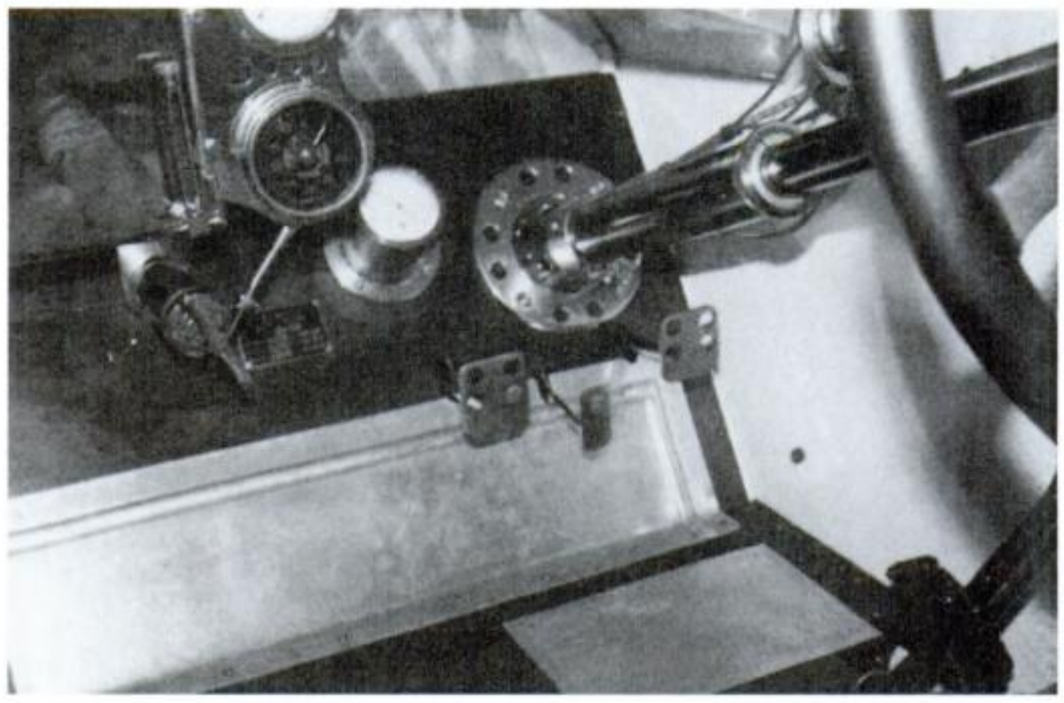
If the first gear change at point B took place at 120 mph, the second at point C at 90 miles per hour, and the third at point D at 60 miles per hour, and if each gear change took one second to execute, you will have traveled no less than 396 feet without braking during the gear changing operations.

Now suppose you could continue braking while you did the double de-clutch gear shifting; you would then be able to go 396 feet closer to the corner *before* putting on the brakes. At 150 miles per hour it takes 1.8 seconds to travel 396 feet, so on just one corner of the racetrack you could save 1.8 seconds by braking to the limit and double de-clutch gear shifting at the same time. If you can use heel-and-toe gear shifting you can save that wasted time.

HEEL-AND-TOE GEARSHIFTING

The name "heel-and-toe" seems like a misnomer, since you use neither the heel nor the toe, but whoever first discovered and mastered this technique most certainly did.

Today, all manual-transmission cars have the pedals arranged the same, clutch on the left, brake in the middle and throttle on the right, but it wasn't always this way. I

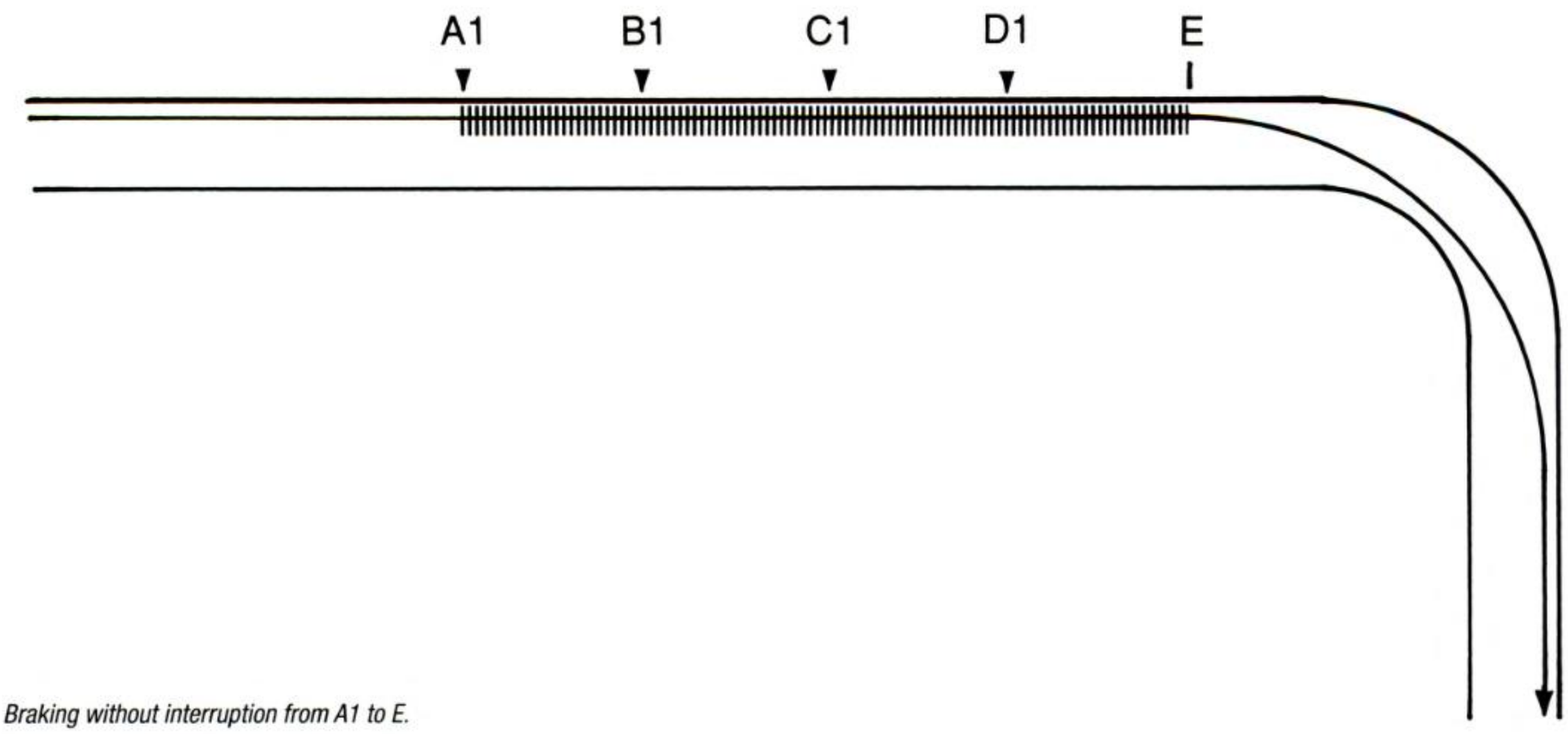


This is how the pedals used to be arranged: clutch on the left, brake pedal on the right...and throttle pedal in the middle. Vic Elford collection

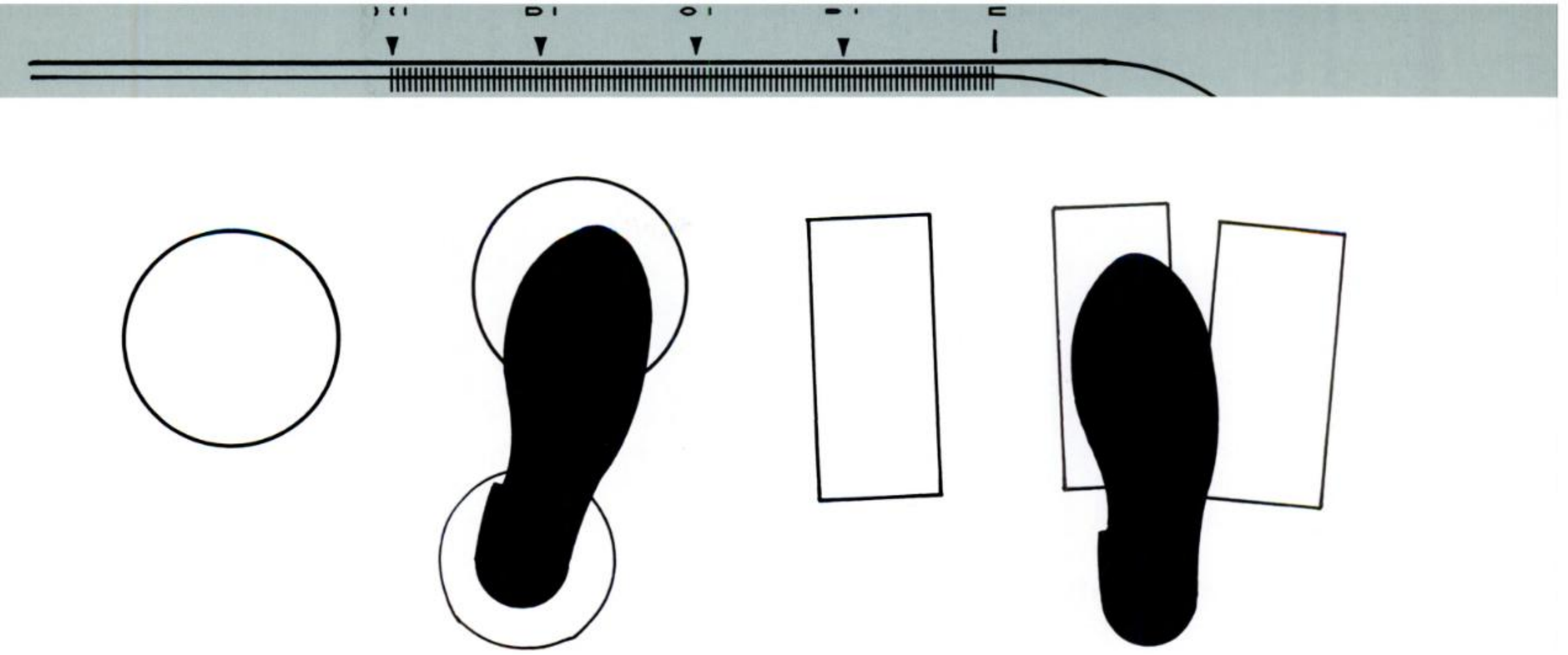
remember when I was first allowed (or sometimes not allowed, but I got there anyway) behind the wheel of our first family car, which was a 1934 Morris 8 two-seater convertible with two "dickey" seats in the trunk. The clutch pedal was on the left, the brake pedal on the right, and the throttle in the middle. Then drivers really did use their heels and toes to cover both throttle and brake pedals at the same time.

Let's go back a bit to where you were approaching a corner on a racetrack at 150 miles per hour. Because you will not lose time while changing gears, the reference points will now be A1, B1, and so on (see diagram).

At A1 you apply the brakes, but at B1 you do not release them, instead continuing to brake while simultaneously doing the double de-clutch gear change as above.



Braking without interruption from A1 to E.



In the olden days, with pedals like these it really was heel-and-toe shifting.

Today, it is actually a ballet dance on the toes.

"Not possible," you say. "There are three pedals and I only have two feet."

Remember in Chapter 1 I talked about the possibility of doing some "minor surgery" to the pedals and I said "don't rush out and do it until you have read Chapter 8?" Well now is the time to do it. In addition to putting blocks on the pedals if necessary, you could also enlarge the pedal area or approach the pedal surfaces relative to each other so that when the right foot is hard on the brake pedal you can still rotate it by flexing your ankle and "blip" the throttle with the right edge of the foot.

You can see that braking will be done with the ball of the foot while the right edge of the foot, probably just behind the little toe, can still reach the throttle pedal.

Let's go back to point B1 above where with the ball of the foot still hard on the brake pedal you make the first double de-clutch downshift. This time the blip is done with just the right edge of the right foot while it's still holding in the brake pedal.

The sequence now becomes as follows:

1. At A1, foot on the brake, building up to the limit of threshold braking and keeping it there from now on.
2. At B1, clutch in and gear lever to neutral.
3. Clutch out (that is, foot off the clutch pedal) so the input shaft is turning at the same speed as the engine again.
4. Blip the throttle with the right edge of your right foot to bring the engine and the input shaft up to 5000 rpm. You do not need to look at the rev counter to do this but should learn to do it by sound and feel alone.
5. Clutch in, gear lever to fourth gear.
6. Clutch out.

With constant braking throughout the maneuver you change down to third gear at C1, to second gear at D1, and at E you are ready to turn into the corner—and you just gained a 1.8 second advantage in only one corner over your competitor who cannot do heel-and-toe gear changes.

HEEL-AND-TOE SHIFTING WITH TIPTRONIC

Many of you who now drive Porsches, or even other marques with Tiptronic transmission, are probably wondering if you can apply the same technique on downshifting. The answer is yes, in a slightly modified form, you can.

You already know that when changing up with Tiptronic you can do so at full throttle with just a "tip" forward on the gear lever so that there is no time lost in acceleration. When you are changing down you will find that you can actually feel the electronic contact as you "tip" the lever backward. The "blip" should be done at precisely that moment to balance engine and transmission speeds. It might take a little time to develop the feel for that electronic contact because it is very delicate, but it is there.

TRAIL BRAKING

Remember that a tire can only do 100 percent of anything. If it is being used to provide 100 percent braking, it cannot steer. So if you are at absolute threshold braking in a straight line you cannot steer the car. "Trail braking" is the term applied to gently "trailing off" the brakes as you increase steering into a corner.

If all the braking is done in a straight line, then at the turn-in point for a corner no more braking is required. However, first turning into a corner is very gradual and very transitional, so the turning effort required from the tires is relatively small.

Obviously things do not go along in 10 percent increments, but the diagram will show you what I mean. At the

turn-in point for a corner the steering effort required is perhaps 10 percent, which still leaves 90 percent of the tires' traction available for braking. The deeper the car goes into the corner the more steering is required and thus less is available from the tires for braking, which is allowed to trail off. When you arrive at the apex of the corner (see Chapter 9) you are using the steering to the maximum and therefore have no braking ability left. All the way from the turn-in point to the apex you reduce by trailing off the braking as you increase the steering.

ANTI-LOCK BRAKING SYSTEM

Those of you who drive late model Porsches, as well as many other fine cars today, have ABS or anti-lock braking system. In fact, anti-lock braking system is something of a misnomer, since it does not actually stop the wheels from locking. What it does do is stop the wheels from *staying* locked. This means that each wheel is equipped with a sensor that recognizes when the wheel is locked and immediately sends a message to the central computer, which in turn releases the pressure to the brake cylinder at that wheel. As soon as the wheel is rolling free again, the brake fluid pressure is restored to the wheel. On Porsches and other high-performance cars, each wheel feeds information and is fed instructions independently and each one can react many times per second. So if you are driving with the two left wheels on dry asphalt and the right ones on loose gravel at the edge of the road, the ABS might well be working on the right side wheels but not the left. But at the limit of braking, each of the four would have the maximum grip available to it.

The only disadvantage of ABS is the feeling generated beneath the foot and occasionally the noise that accompanies it, although some cars have even engineered those problems out of the system. Because the brake pressure at one or more wheels is constantly being released and restored, it feels as though the pedal is pushing back jerkily on the foot. At the same time, when the brakes and the ABS are working at the limit, you will hear the tires "chirping," and as you develop your sensitivity you will actually feel the wheels going round in little jerks as each one locks, is released, then locks again.

When I wrote the first edition of this book there was a television commercial suggesting that nobody had feet that could move fast enough to beat an anti-lock braking system. You remember I said earlier that you probably have well-meaning but misinformed friends who have told you to use "cadence" braking? If you try to stab away at the brake pedal like that repeatedly, then I agree, you will never be able to stop shorter than the ABS. But with one exception, which as I mentioned earlier I will discuss in Chapter 11, stabbing away at the brake pedal repeatedly is *not* the quickest way to slow down.

Getting to the 10 level on my scale and holding it there is the quickest way to slow down. Holding the pressure at the 10 level is done by controlling the pressure on the brake pedal, not by the number of times you stab at it. Since you control the pressure with the sensitivity in the ball of the foot, the number of adjustments you can make per second is *infinitely variable.*

Clearly a skilled driver can stop more quickly than a mechanical system that is limited in the number of times per second it can react.

A highly skilled driver can probably stop a car without ABS going 60 miles per hour in the rain about five feet shorter than the same car with ABS. However, having said that, I acknowledge that the undeniable advantage of ABS is that anyone and everyone can use it to its maximum all the time. A highly skilled driver on a racetrack has all his or her concentration focused on driving the car. On the road it is wishful thinking to imagine that even the same highly skilled driver applies the same amount of intense concentration to his driving, and that is where ABS braking really comes into its own. With ABS, even when the brakes are on hard it is impossible to lock a wheel, so you can still steer around objects or out of trouble.

LEFT-FOOT BRAKING

You saw in Chapter 4 that front-wheel drive has certain advantages in normal transportation cars. Front-wheel-drive cars are cheaper to build, they allow more useable space within the vehicle, and they are inherently safe. However, from a performance point of view they leave much to be desired. As you now know, a tire can only do 100 percent of something, and therein lies the weakness of front-wheel drive.

With a weight bias over the front wheels, while braking, and especially trail braking, the front tires are being asked to do much more than those at the rear. You can easily overstep the very fine line between having the front tires working at 100 percent of their capability and asking them to do more than 100 percent with both steering and braking combined, and you will then find yourself winding on more and more steering with less and less effect.

So how do you get a front-wheel-drive car around a racetrack quickly? If you are a rally driver, how do you get around slippery corners quickly and efficiently?

It would be nice to be able to say, "Easy, just use your left foot on the brake." In fact you do have to use your left foot on the brake—but it isn't easy.

Porsche 917, Sebring, 1971

Here we are interviewed by Chris Economaki after my partner, Gérard Larrousse, finally made it to victory lane. Vic Elford collection

The first problem to overcome is the fact that if you are used to driving "conventionally," the right foot is used to sensitive operation of both throttle and brake pedal. The left foot, on the other hand, is used to rapidly pushing the clutch in and equally rapidly letting it our again after a gear change. When you stop at a red light the left foot pushes the clutch in briskly just before you stop in order not to stall the engine. It is not used to sensitivity when it pushes.

When I first learned to use the left foot on the brake, it took me about three months before I got to the point where I could come smoothly to a stop. In my early attempts the car would slow down reasonable smoothly until just before actually stopping, whereupon my left foot would suddenly think it was on the clutch as usual and would give a hefty shove, locking up the wheels with a screech and sending the occupants flying toward the windshield.

So if you decide to learn left-foot braking, *make sure everyone is wearing a seatbelt* and practice when there is no other vehicle near you.

exhaust and transmission problems. My co-driver that year was Brian Redman, who suffered his own bizarre misery. Driving through the flat-out left turn in the infield in the middle of the night the fire extinguisher went off on its own accord. Blinded by the vapor and groggy from the gas it gave off, poor Brian went off the road and got thoroughly stuck in the mud. Because outside assistance was forbidden, he first had to get the tears out of his eyes and then get some fresh air back in his lungs before eventually getting unstuck and making it back to the pits.

The 1970 race wasn't much better. Although Kurt Ahrens and I stayed in contention with the Gulf-Wyer cars well into the night, Kurt had a puncture just after passing the pits, which meant he had to do almost an entire lap with the body dragging on the ground. Unfortunately it wasn't just the body but the fuel tank as well. By the time he made it back to the pits, there was a sizeable hole out of which the fuel was leaking—taking all our hopes with it.

With Gijs van Lennep as my co-driver in the Martini Racing 917, I had the pole position for the start of the 1971 race. Mark Donohue was alongside me in the beautifully prepared Penske Ferrari 512. Pedro Rodriguez and Jo Siffert, of course, were lined up side by side in the second row.

With a rolling start, the driver in pole position has the luxury of controlling the speed at the start of the race and by now I knew enough about the performance characteristics of the Porsche 917 and the Ferrari 512 to make sure that the speed and the gear we were in across the start line was perfect for the Porsches and less than ideal for the Ferrari. As the green flag waved I jumped into the lead, taking Jo and Pedro with me. They streamed down into Turn 1 so close behind me that Mark had nowhere to go and was elbowed back into fourth place. Jo Bonnier in a Lola T70 was also in the hunt up front and the race immediately settled into a five-car battle.

One of the problems with the 24 Hours of Daytona compared with Le Mans is that the driver is always busy. At Le Mans there used to be plenty of time to relax, although that has changed a little with the speed-sapping chicanes now installed on the Hunaudières straight. Although it may sound incredible to the uninitiated, all the way down the old Mulsanne straight, even at over 240 miles per hour, the driver had little to do except to keep the car pointing in the right direction and check that all is well with the instruments. From the Mulsanne corner to Indianapolis, although the car is accelerating all the way there is still not much to do, and from Arnage back to the Porsche curves the same situation exists. No physical effort and, depending on traffic, not much mental effort either.

Porsche 907, Daytona, 1968

My winning car at speed on Sunday morning in the 24 Hours of Daytona. Vic Elford collection

Porsche 917, Daytona, 1970

My Porsche Salzburg 917 at speed on the banking during the 24 Hours of Daytona in 1970. Kurt Ahrens and I were forced to retire after he suffered a puncture and drove an entire lap with the bodywork, and the fuel tank, dragging on the ground. Dave Friedman

But at Daytona the driver is busy all the time. Even down the back straight (there was no chicane in those days), although physically you can relax, mentally you are preparing yourself for the entry to the east banking flat out at 220 miles per hour. And no matter how many times you have already done it, you still have to convince yourself each lap that it is possible, especially at night. If there is traffic in front as you approach, it is even more difficult psychologically. You wonder if the slower driver has seen you coming; wonder if he or she will stay low so that you can take the high line; try to recognize the car and even the driver's helmet; and even try to remember what that driver did the last time you came up behind.

Shades of our little red Italian car at Sebring.

It is also difficult to set up the car for Daytona because of the mixture of the banking and the flat infield road section.

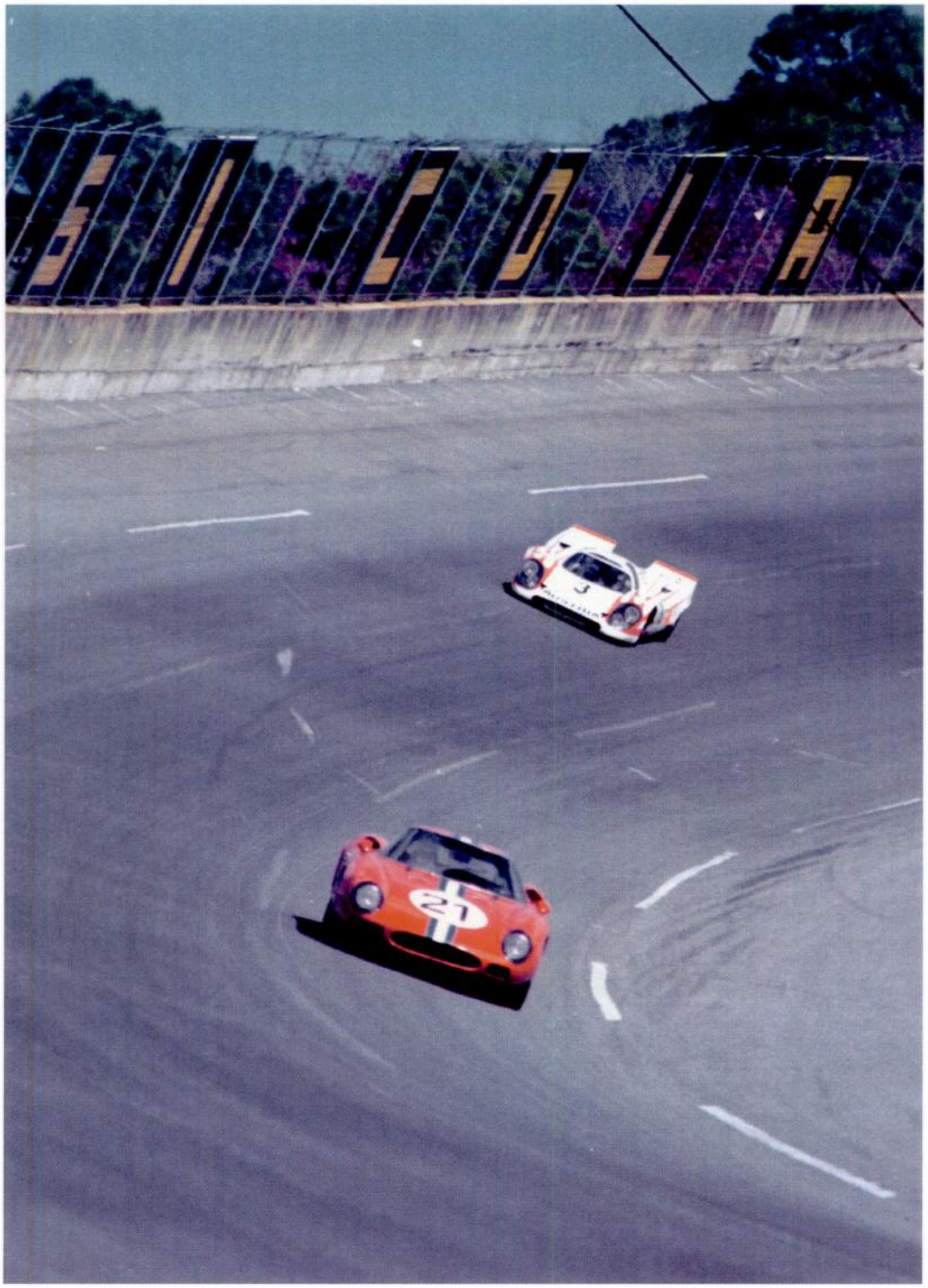
A couple of years earlier Jo Siffert and I had done some testing at Daytona and we discovered an interesting fact: The time spent on the nearly 2.5 miles of the oval was almost identical to the time spent on the 1.2 miles of infield road. Because of the very high speed on the banking, the cars were always set up to understeer fairly heavily, which made them very difficult to drive on the infield. Jo and I reasoned that there was perhaps room to improve the overall lap time if we could negotiate the infield quicker, so we set up the cars to handle better around the slower corners.

Then we went out and tried it, and both of us came back after a couple of laps white-faced. Having taken out some of the built-in understeer, the car would not stay down in the groove, and we found the tail coming out and oversteering. In other words, the car was getting sideways at 220 miles per hour on the banking. Needless to say, we rapidly put the car back to its original setup and just made do the best we could around the infield.

Now, fifteen minutes before midnight, attrition had already started to take its toll. Many cars were already

parked in the garage, many drivers were already in bed back at their hotels, and traffic was light. Gijs and I were running in a comfortable second place behind the Gulf-Wyer car of Jo Siffert and Brian Redman. As I built up speed on the back straight there was nobody in front of me, just the 31-degree banking in the distance, which I sensed rather than saw in the headlights. Having learned from some of the stock car drivers when I did the Daytona 500 a couple of years earlier, I used to dive in low and then let the car drift up almost to the wall.

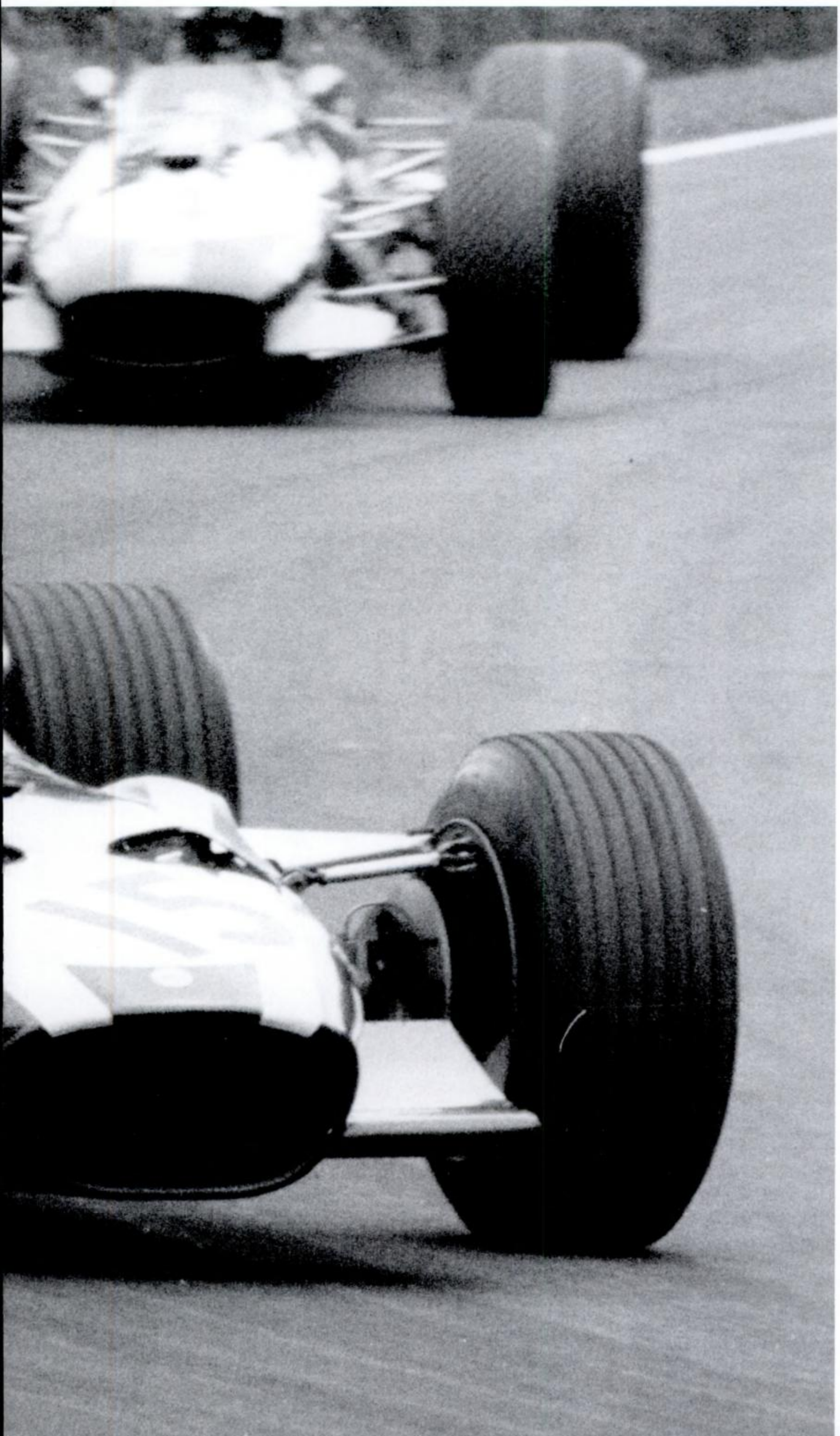
This time as I neared the wall all hell broke loose. With no warning the car was suddenly spinning and I was thankful for my couple of stock car races and particularly the advice offered by Richard Petty. At my first Daytona 500 "rookie" drivers meeting he had said, "If you get into a spin on the banking, turn left and put your foot hard on the brake. The car will continue to spin but gravity will take over and it will slowly come down to the grass at the



Porsche 917, Daytona, 1970
My Porsche Salzburg 917 chasing down a 275LM Ferrari at speed on the famous high banks of Daytona. Leonard Turner

Porsche 917, Daytona, 1971

The Martini Porsche 917 that I shared with Gijs van Lennep heads into the infield from the banking at Daytona. A failed wheel led me to a monster spin in the middle of the night, almost totally destroying the car. Dave Friedman



Cooper F1, French Grand Prix, 1968

I started last in my first-ever Grand Prix, but thanks to the rain, finished fourth. I drove on intermediate tires, while the Brabham behind me is on full rain tires. Vic Elford collection

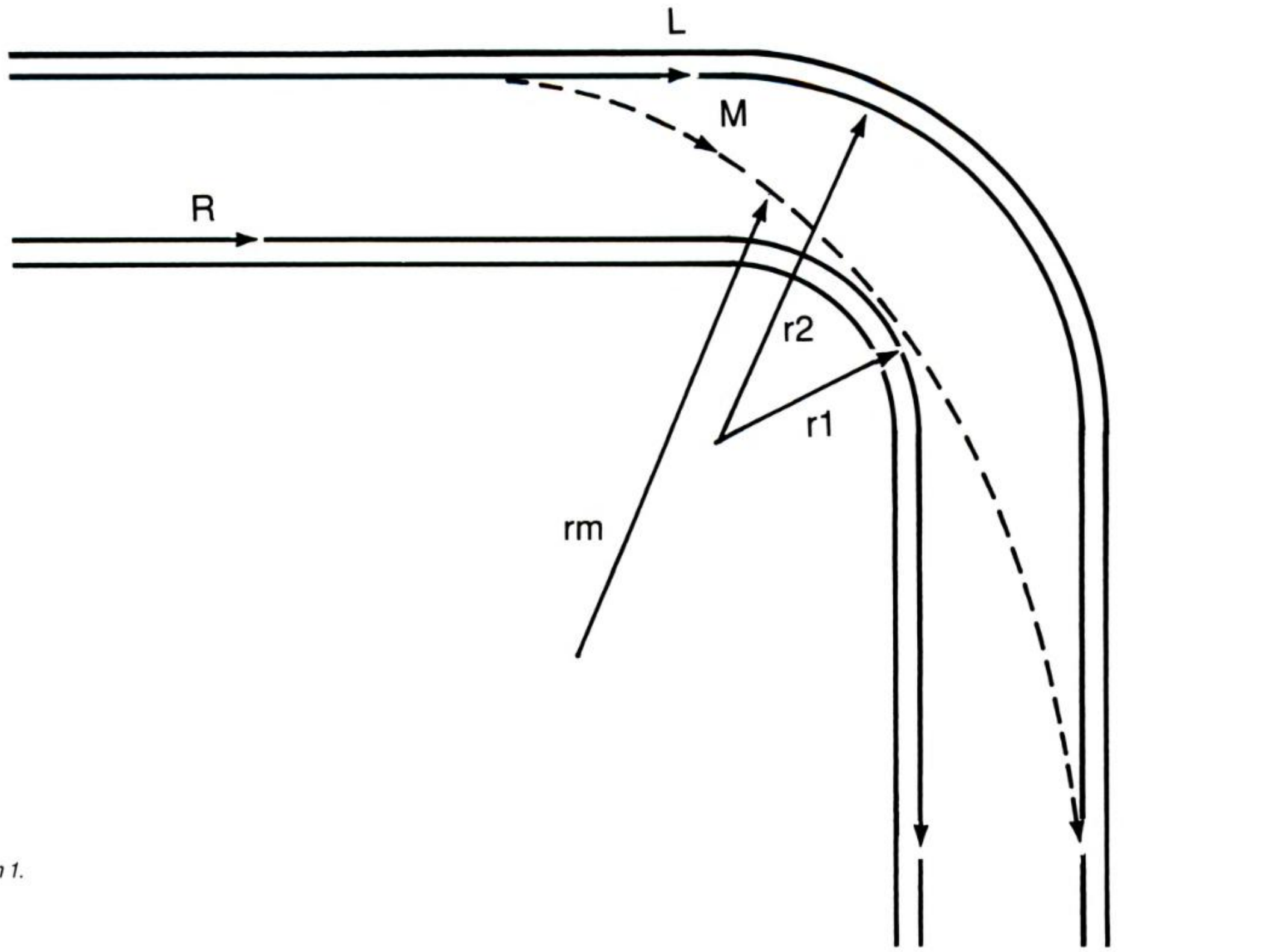


Diagram 1.

about all the possible consequences if something were to go wrong or if some vital part were to break. But apart from that there is no great skill required to go fast in a straight line. Anyone can do it.

Going round corners however is something else. Between driving in an absolutely straight line and driving around a tight corner, many different forces come into play concerning your car and your driving technique.

SPEED AND CORNERING

Some years ago the great pre- and postwar Italian Grand Prix driver Piero Taruffi came up with a formula that explained how fast a car could go in any given circumstance. By eliminating all the known constants from the equation it boils down quite simply to the fact that the larger the radius of a corner, the faster you can drive around it. Or conversely, the faster you are going, the larger the radius of the corner must be to negotiate it safely.

Let's look at a typical corner again. There are many ways you could drive around the corner. You could just stay to the right and follow the R path. You could stay to the left and follow the L path. The radius of the corner that you are actually driving will then be r1 or r2 depending on which you choose.

But from the formula above you know that the *larger* the radius, the faster you can go. Or if you are not interested in speed, the larger the radius the less stress you place on the car and therefore the *safer* it will be for a given speed. So if you take the line M you will have the largest possible radius rm through the corner and therefore the fastest, or the least stressful on the car if you are driving at a predetermined speed.

Although this applies primarily to the racetrack, the same theory can also be used on the road. You have to remember that there might be someone coming in the opposite direction, so be careful to use only your half of the road and don't go wandering over the yellow line.

BALANCE AND CORNERING

Cornering, you might think, is really quite simple. You slow the car down, turn the steering wheel, and the car will go round the corner.

That is one way, but put that simply, it means you are making the front tires do all the work in getting you

around the corner. The faster you go using that basic technique, the more you will load the front tires until eventually they will be screaming at you.

To corner comfortably at the limit of the car—and more particularly at the limit of the tires—you have to go all the way back to balance, which we discussed in Chapter 2. Because a tire can only do 100 percent of something, if you can help the front tires by using the *balance* of the car to help it rotate you should also get through the corner more quickly and comfortably.

Let's refer back to the braking-without-interruption diagram from the last chapter. You are approaching the corner at 150 miles per hour in fifth gear, but the corner must be taken at 40 miles per hour in second gear. From A1 all the way to D1 you were braking and downshifting using the heel-and-toe technique. From D1 onward you were still braking, preparing for the crucial point E where you start to turn, still trail braking, into the corner.

The car is turning more and more sharply as it approaches the apex of the corner and the brakes are trailing off. What you do now, at the apex of the corner, will determine your speed through that part of the corner and especially your speed out of the corner.

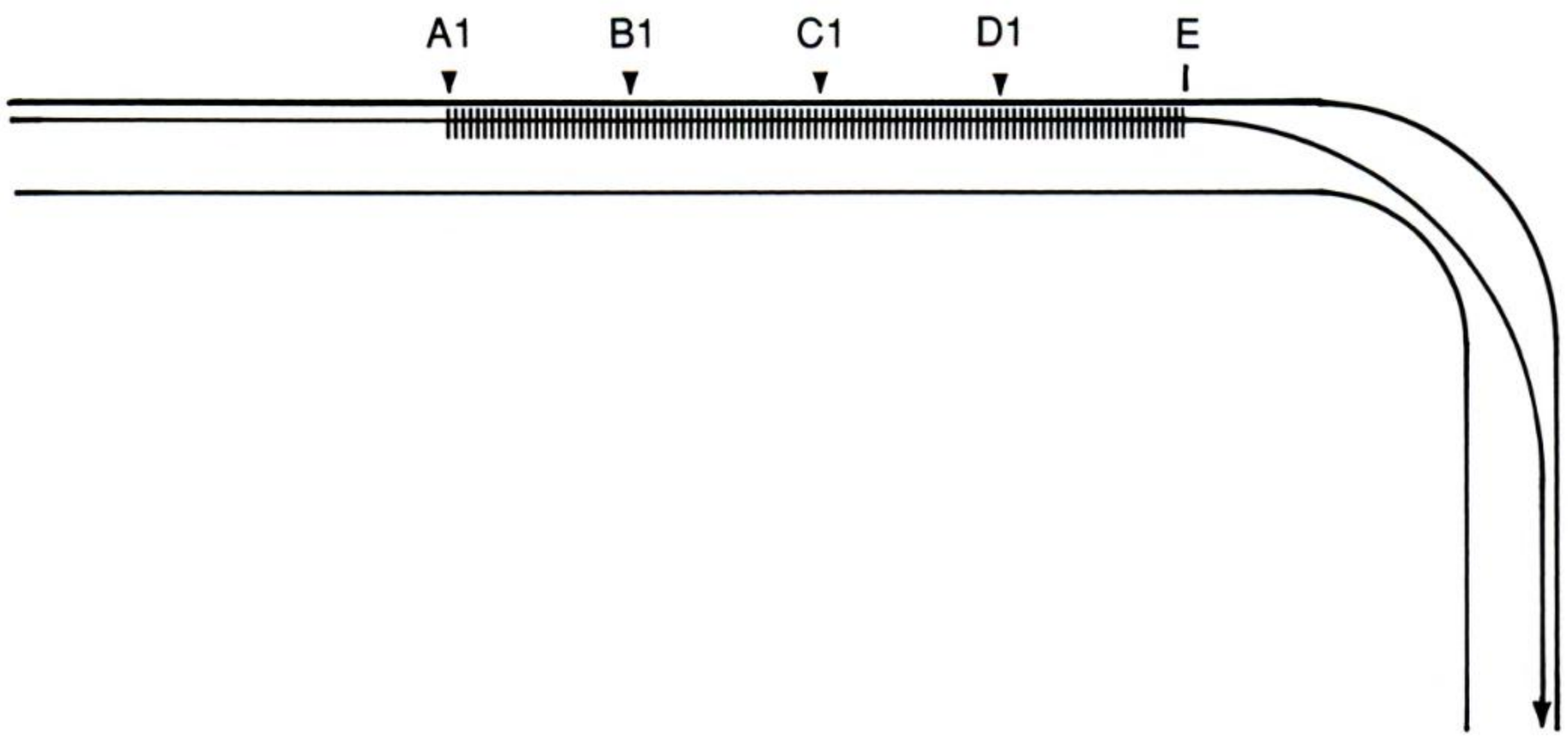
If you are like most people, you take your foot off the brake, jam it down on the throttle pedal, wrench the wheel around more, and start powering out of the corner, at which point you will be asking the front tires to do much more than the 100 percent they are capable of doing.

Right at the apex is where you need maximum steering ability, but jamming your foot down on the throttle will give an instant weight transfer to the rear wheels and will take away a lot of the front wheels' ability to steer. The harder you accelerate, the more steering you will have to wind on and the less effect the steering will have because the weight transfer leaves the front wheels with less and less grip. The car will start understeering, the front wheels will be literally "pushing" toward the outside of the corner, and the front tires will start screaming—for help.

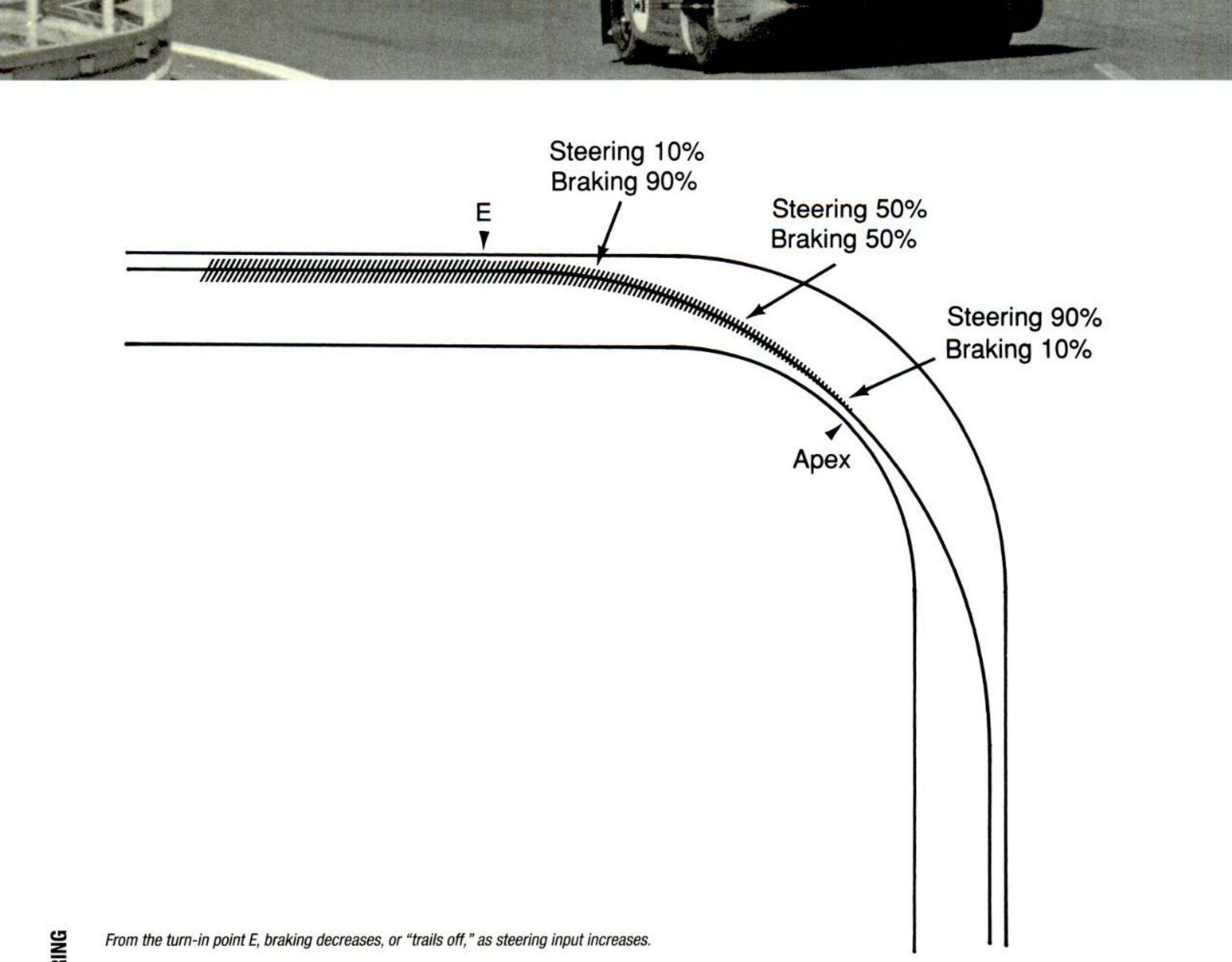
By delicately changing the balance of the car during the entire cornering operation you can help rotate the car by gentle persuasion rather than force.

As you approach E the front tires will be fully loaded and using 100 percent of their ability in braking. At E the brakes will start to trail off and the steering will start to be applied. If you come smoothly off with the brakes and smoothly on with the steering all the way to the apex, the last adjustment to the balance will be made.

At the instant you release the brakes completely, a last transfer of weight toward the rear wheels will occur. During this weight transfer there will be a moment when the front tires have maximum steering ability and at that point you will actually feel the car rotate around the apex. Now, remember the piece of string around the big toe discussed in Chapter 7? Once the car has rotated you can gently apply power as the steering wheel unwinds until



Braking without interruption from A1 to E.



From the turn-in point E, braking decreases, or "trails off," as steering input increases.

you reach maximum power as the front wheels arrive at the straight-ahead position.

You can gain a better understanding of the dynamics of what is happening and a comprehension of what I will call "the 100 percent tire rule" through a simple graphical description known as the "friction circle."

If you tie a string to your rearview mirror and hang a heavy metal ball (or other object) from the other end, what will happen when you exert a force on it?

When you are braking heavily, the ball will swing toward the front of the car. Accelerating will make it swing toward the rear of the car. Turn left and it will go to the right; turn right and it will swing left. If you combine braking and turning, as in trail braking into a corner, it will swing both forward and sideways and lean toward one front corner of the car. As you accelerate and unwind out of a corner it will swing back and sideways. In the diagram you can see that when maximum braking is used in a straight line the position of the braking force is at Bm. As both trail braking and steering are applied for a left turn, the amount of braking moves back to position B1, and if the maximum use is being made of the tires the steering input will be at L1. The resultant force will be at position 1. Further into the corner the braking will be at B2 and the steering at L2, giving a resultant at 2.

Similarly, exiting a right turn just after the apex, steering effort will be at R1, allowing acceleration to be more at A1. Further out of the corner, the acceleration will have increased to A2 as steering diminishes to R2. When the car is finally totally straight again, the reading on the R scale will be zero and on the A scale it will be Am.

If you are using the tires to their maximum ability at 100 percent and were to plot the friction resultants an infinite number of times, you would finish up with a perfect circle joining the infinite number of dots. Anything less than 100 percent, whether it be on braking or acceleration, or in the cornering force applied, will give a resultant somewhere inside the friction circle. In actual fact it will

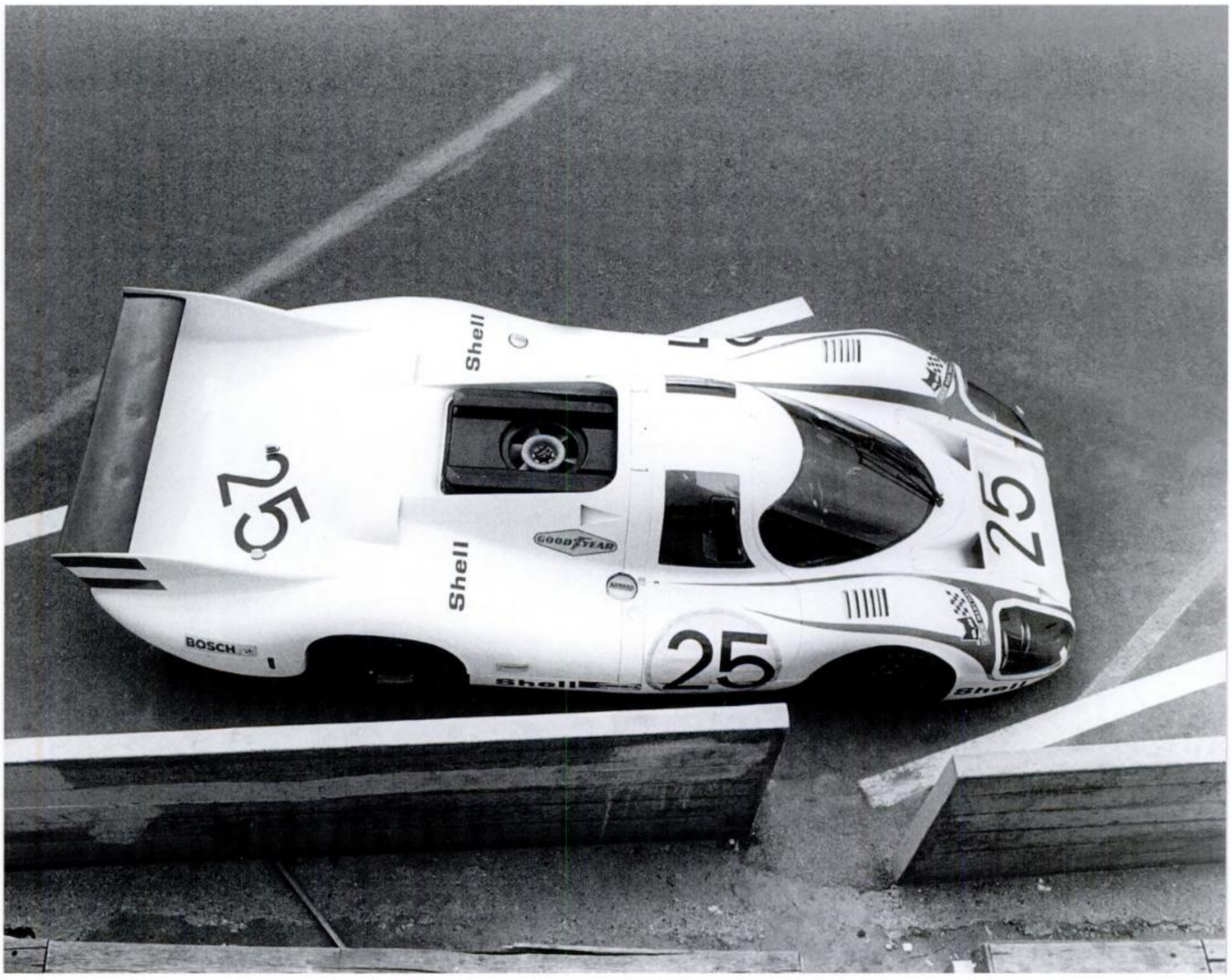
not be an exact circle but slightly elliptical, or even egg shaped, as tires can generate more g force under braking than acceleration and in both cases, more than in a corner.

Interestingly enough, although the friction circle was originally understood and used by high performance driving instructors, SPEED Channel has now incorporated it into the analysis of the car and driver performance at varying points on the track during their presentation of Formula 1 World Championship broadcasts, where it really gives the viewer a feeling for the forces being exerted.

No matter what car you are driving, under reasonable road conditions this technique does not change. Even in the wet the procedure is the same, but in order to go quickly, you must develop a very sensitive touch and feel for what the cars is doing.

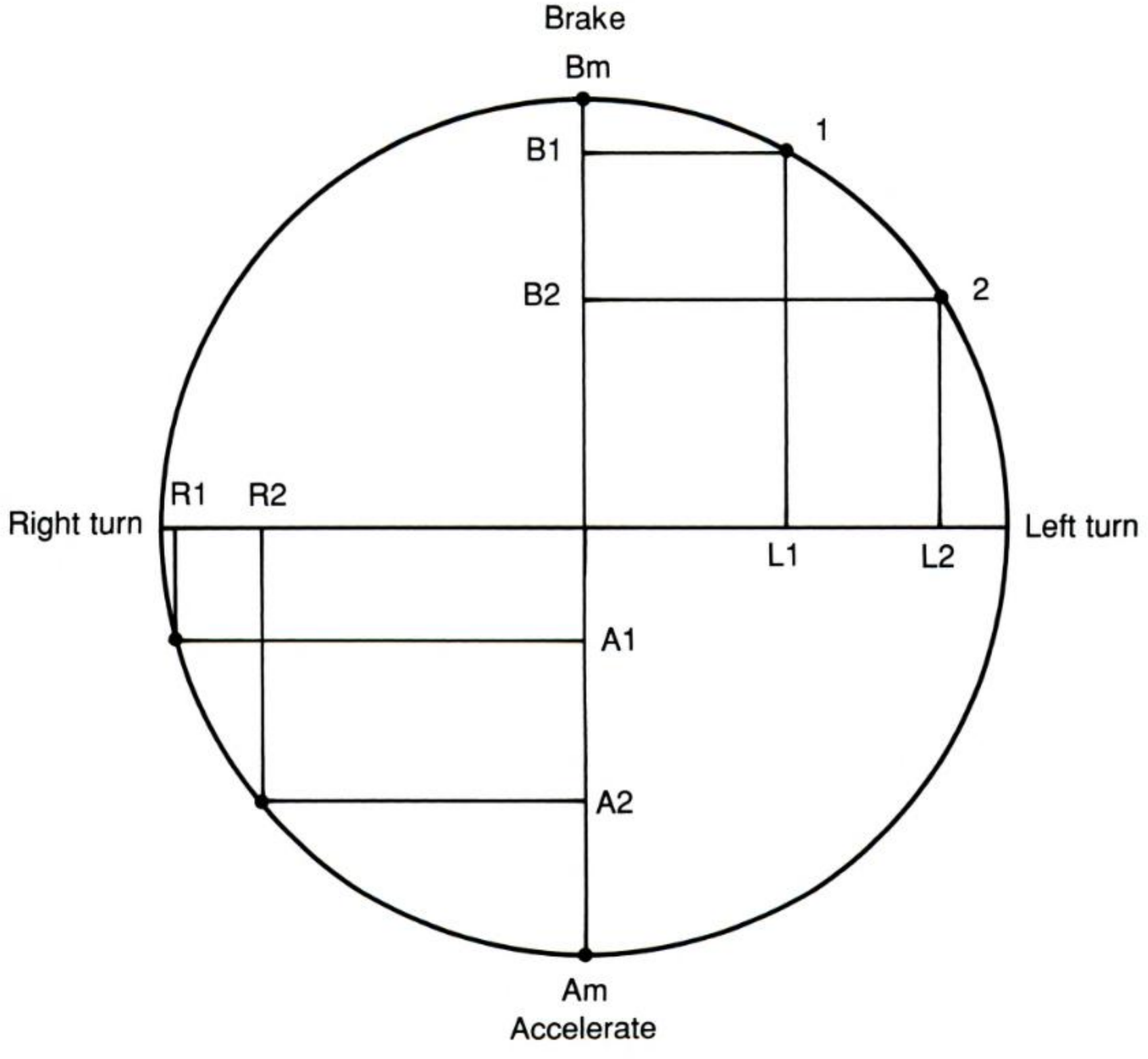
In a car with high downforce, such as a Formula 1, Indycar, or Sports Prototype racer, it is true that you need a fair amount of pure physical force to drive it, but the Porsche you drive on the street needs little force, just balance.

In 1976 I was the team manager for the French Inaltera sports car team. Inaltera was a manufacturer of high-quality and expensive wall coverings and had decided to invest in a brand-new two-car team for the 24 Hours of Le Mans. The attempt was a success, and with Inaltera about to expand into the American market, we also came to the 24 Hours of Daytona in 1977. Although from a racing point of view we went away empty handed, with neither car finishing, from a commercial point of view the company was delighted with the results. Because such a high percentage of racing fans in the United States are women,



Porsche 917, Le Mans, 1970

My 917 Longtail at Le Mans in 1970. Even standing still it looks fast. And it was, giving me the first-ever lap around the Circuit de la Sarthe at over 150 miles per hour average. The car figured prominently in the opening laps of the Steve McQueen film Le Mans. Porsche



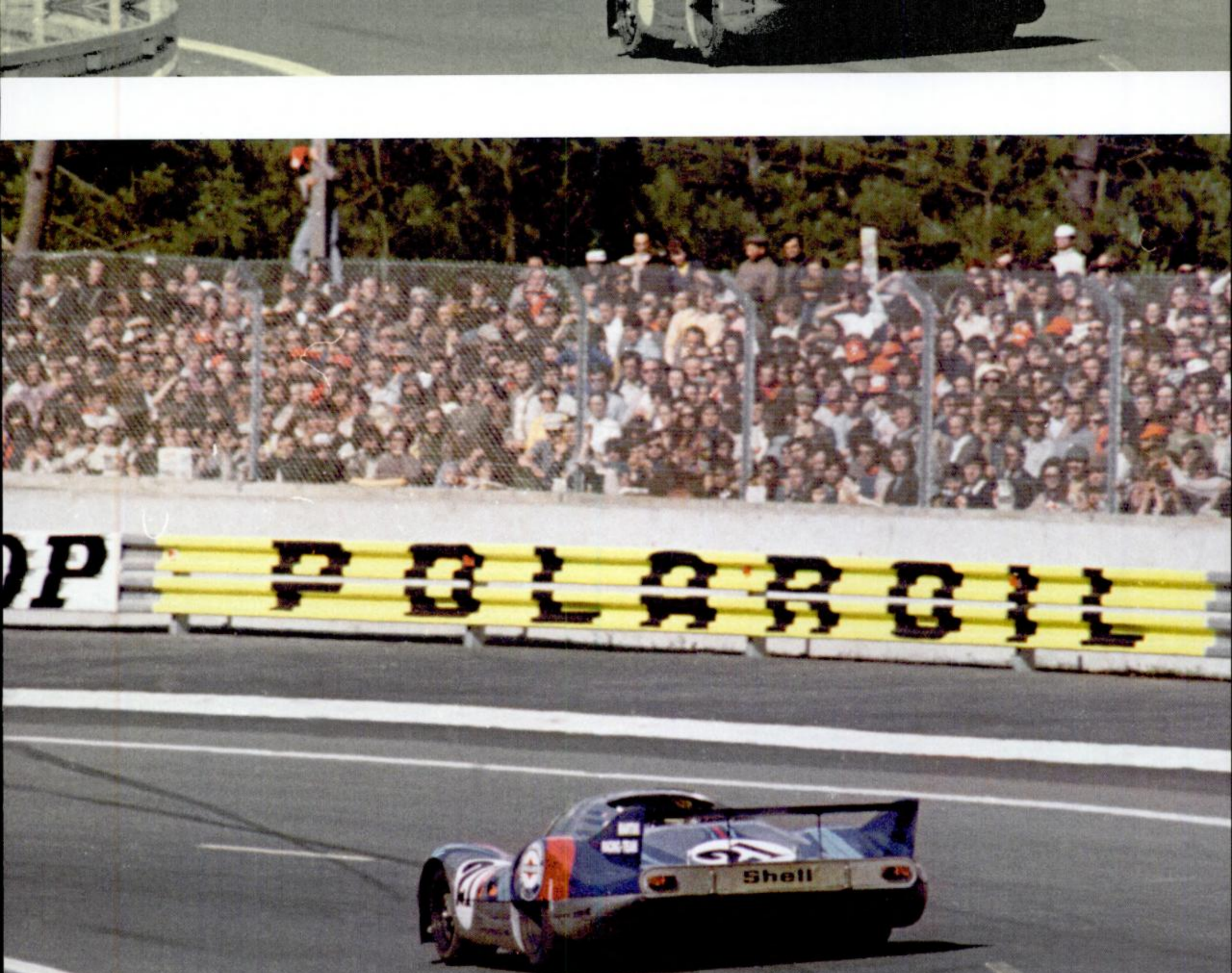
The friction circle demonstrated by tying a weight to your rear-view mirror.

who of course have a lot to say in buying products like wall coverings, we decided that one of the Inalteras at Daytona would be driven by an all-female crew: Christine Beckers from Belgium and Lella Lombardi from Italy. Lella incidentally was, and still is, the only woman ever to score a point—or a half point to be exact, as the race was stopped because of rain—in a Formula 1 world championship event. The Daytona organizer, the late Bill France Sr., loved the extra exposure that such a team gave to the race, and when both the women expressed an interest in stock cars he invited them both back for the Firecracker 400 in July.

Neither Christine nor Lella were amazons; I doubt that either of them was more than about 5 feet tall and 100 pounds in weight, and both were looked upon with a certain amount of awe in the NASCAR garage area.

At a press conference a couple of days before the race, Lella was asked how an itsy-bitsy little girl like her was going to compete with all the big husky male drivers in 2-ton stock cars. She replied, "But I only have to drive the car, not carry it," and even the most chauvinistic reporters were rolling on the floor in laughter.

That both were able to run at a very competitive speed in the race underlines the fact that balance is of far greater value in driving well than brute force.



Porsche 917, Le Mans, 1971

The view that most drivers had of the beautiful Martini 917 Longtail I shared with Gérard Larrousse. Although easily the fastest cars there, all the factory Longtails retired early with cooling fan problems. Porsche

CHAPTER 10
SLIDING, SKIDDING, AND THE ART OF CAR CONTROL

The place: Sweden
The time: A cold, cold winter in 1967
The occasion: The Swedish Rally

I had been to Sweden for the Swedish rally once before, in 1966 in a Lotus Cortina. Remember when Ford gave me a practice car with no heater?

This time, David Stone and I had been able to practice in a civilized car lent to us by the Porsche importer. It even had the additional cold weather package and its little gasoline-fired heater.

Those of you who have owned older Porsche 911s with the heavy-duty cold weather package will remember that little heater. For those of you who do not, it had its own little compartment tucked away under the carpeting of the front luggage trunk. If the heater was not there, the compartment was just empty and apparently served no useful purpose. A few years later I was to find there were some enterprising people who had presumably discovered a practical, if somewhat rather less than legal, use for it.

In 1970 I left England to make my home in France in the little town of Annemasse, just over the border from Geneva, Switzerland. For shopping, visiting friends, or simply going to lunch or dinner, I used to cross the border almost daily and sometimes even two or three times a day. I was soon on quite friendly terms with all the French customs officers, who would usually recognize me and the car and just wave me through.

One day however, a customs officer whom I knew well pulled me out of line and started asking questions about where I had been and what I had been doing in Switzerland, while all the time casually looking around inside the car. Suddenly, he asked me to open the front hood. He pulled aside the carpet and went straight for the auxiliary heater compartment. I told him that the car didn't have the extra heater and he just smiled and replied that it wasn't

Porsche 911, Monte Carlo Rally, 1968
High in the mountains above Monte Carlo on the way to winning the rally, with a picturesque Provençal village framed in the background.
Porsche

off the throttle will cause what is known as trailing throttle oversteer.

A good way to experience this and to practice control is to find a deserted, closed-off parking lot, buy yourself a few traffic cones, and set up a slalom exercise as shown. First, practice driving through the slalom at fixed speeds, starting at, say, 15 miles per hour, then increase to 20, then 25, and so on, doing a number of runs at each speed and moving on to a higher speed only when you are comfortable. Then start the slalom at, say, 15–20 miles per hour and try to steadily increase the speed all the way through.

When you are comfortable with that, it's time to go to the next exercise and make the car slide. Again, start into the slalom at 15–20 miles per hour and increase speed as you go, but this time as you turn the wheel to go around the third traffic cone, snap off the throttle pedal completely.

What will happen?

Because snapping off the throttle gives an instant weight transfer to the front of the car, the front wheels suddenly have more grip to steer with, the rear wheels will have less grip and will immediately slide outward. This is trailing throttle oversteer.

REGAINING CONTROL FROM A SKID

What do you do when the rear of the car slides outward?

You probably remember from driver's education in high school that you are supposed to steer in the direction of the skid. But you were probably not told much else, as though steering into the skid was some sort of magic remedy and everything would then be all right. In fact, there is more to do than just steering into the skid—and some things *not* to do in order to regain control of the car.

The whole process is described by the acronym CPR. This is not the medical variety; in this case CPR stands for Control, Pause, Recovery.

Control is the first movement: steering into the direction of the skid. Pause is the waiting period while the car loads up the suspension and takes on a "set" position. Recovery is slowly unwinding the steering wheel as the car starts to go in a straight line again.

Those are the things you *must* do. What you *must not* do is touch the pedals. No clutch, no brake and above all, no throttle. You must master the situation you have created for yourself with just the steering wheel and the balance of the car. Touching any of the pedals will only add further instability making recovery almost impossible.

Back in Chapter 4, I mentioned that one of the problems many drivers have is not moving quickly enough. In this exercise, the Control movement must be almost a reflex and must be done virtually instantaneously. The Pause will vary in length according to the car, the tires, and the surface conditions. The Recovery must be, as is so often the case, a smooth, gentle transition back to the straight-ahead position.

REGAINING CONTROL FROM A SPIN

With your first attempt at CPR it is quite likely that you will not react quickly enough and the car will start to spin. If this happens and you are reasonably sure that you are indeed beyond the point where you might regain control, keep in mind the saying that most racing schools use: *In a spin, both feet in.*

Left foot in on the clutch pedal, right foot hard on the brakes. By disengaging the clutch you will hopefully keep the engine running so that when the spin ends you will be able to drive away again. By locking up the brakes you ensure that the car will stop in the shortest possible distance. At the same time you also ensure that it keeps going straight, by which I mean in the direction it was going when it started to spin.

Do not be tempted, as the speed is scrubbed off, to think that you can let off the brakes and have control again. Even at low speed, the combination of the car rotating and the fact that you will probably not know which direction the front wheels are pointing could result in the car jerking dangerously to one side or the other if you let the brakes off. Wait until it has *totally* stopped before trying to drive off again.

This is particularly important on a racetrack.

On a flat surface, when the car is spinning with all four wheels locked, it will always keep going in a straight line, which means that drivers following you can take avoiding action and be reasonably sure that they are going to miss you. Thanks to my monumental spin at Daytona and Richard Petty's advice, I know that on a banked track a car will come down the banking while it spins and is therefore also reasonably predictable for the following drivers trying to miss the spinning car.

It is possible during your first attempts at CPR that you will overreact with the first Control action but not get the Pause quite right, in which case the rear end will swing rapidly and viciously back the other way. If that happens, you have almost certainly lost control of the car. Don't even *think* about trying to recover, just put *both feet in* as fast as possible and wait for it to stop. In fact, most road accidents involving skidding cars come as a result of overreacting to the first skid and then not knowing what to do

and about 5000 feet, sent me to bed with a touch of sunstroke. With Bill in attendance to oversee the logistics, the rest of the team left to start driving over the route. Leon and I left Nairobi some 36 hours later, determined to drive day and night until we caught up with them.

We were just 30 miles from their second overnight stop at Elgon when, on a steeply downhill, heavily cambered right-hand bend leading to a small bridge, I lost control of the car at about 60 miles per hour, spun, rolled, and somersaulted over a river, crashing upside down onto a huge tree stump on the other side.

Remember the seatbelt discussion from Chapter 1? Well, Leon and I were groggy; we both had blood pouring down our faces. But having been strapped in, we were both still alive and still conscious.

A group of youths approached down the track, singing drunkenly after a night at the local bar, and I admit to being a little apprehensive at the possible outcome of their finding two apparently rich foreigners with their car upside down beside the road. Leon, who had previously lived in Kenya, told me not to speak and proceeded to negotiate in Swahili in order to get the car turned right-side up again. After a quick check on the oil level to make sure it had not all drained out through the filler cap, we were under way again. Leon drove as the blood on my face was coming from the region of my right eye, which was already swollen and closed, leaving me half blind.

Straight to the hospital we went and presented our sorry selves to the "emergency department." Remember this was a hospital in Africa in the 1960s. The only doctor/ surgeon on duty had just finished performing a cesarean operation, and he told us we would have to wait a few minutes, as they were just cleaning up the operating room. Through the open door we could see attendants washing down the walls, ceiling, and floor with a high pressure garden hose.

A few minutes later Leon and I were both overcome with an excess of politeness when the question was raised as to who should go first. My face and eyebrow were soon stitched up, but poor Leon, who had a deep gash in the middle of his scalp, was less lucky aesthetically. They had to shave all the hair away first so that when he was finished he looked like a Mohican in reverse—no hair back to front down the middle of his head, but hair sprouting all around on either side.

That was the sight that confronted Bill Barnett when he opened the door of his hotel room.

The car, of course, was a write-off, so after a few hours sleep it was back to Nairobi for another one. But every cloud has a silver lining, and we were treated to a low-level two-hour flight to Nairobi in a little Cessna. We flew over a perpetually changing wildlife scene, the most impressive part being the thousands of pink flamingos on the shore of Lake Naivasha.

The Safari rally was unique in the world, in that although the cars are racing around the clock, the roads *are not closed to normal traffic*. In fact, that is less dangerous than one might expect because, since the first "Coronation Safari" was held in 1953 to mark the accession to the British throne of Queen Elizabeth II, the rally had taken on a totally national aspect, originally involving all three East African countries and more recently just Kenya. It was held during the weekend of Easter when everyone is on holiday and virtually the entire population either stays at home or seeks out the ideal, or the nearest, spot (depending on their means) to watch the cars go by.

Easter normally means the rainy season, but this year as we left Nairobi it was still dry. The first 36-hour leg of the rally led us northward into Uganda and then up into the wild northeast frontier territory bordering Ethiopia and Somalia. There our first real setback occurred when we broke a steering arm and, out in that moonscape, I had to drive a hundred miles with steering on only one wheel. We made it to the next service point, but the time lost dropped us way back in the field. Repairs were made and we started to slowly claw our way up again.

By the start of the second leg the long-awaited rains had arrived with a vengeance. As we drove into the night, what had been well-defined tracks just days earlier became unending bodies of water. At one point I came across the Ford team leader, Henry Taylor, hopelessly bogged down in a seemingly boundless muddy lake. I stopped, got out the tow rope and dragged Henry to apparently solid ground, where I promptly got stuck myself. Whereupon Henry unhitched the tow rope with the words, "Well, of course, with your problems on the first day you're out of it now so I can't waste time helping you," and promptly drove away. Not all Englishmen are gentlemen . . . far from it. As so often happens in Africa, some potential pushers materialized from nowhere, and with Leon's knowledge of Swahili and some of the shillings from our kitty of "push money," we were soon on our way again.

The water had been so deep when we initially stopped that just opening the doors had allowed it to flow through the car almost up to the level of the seats. Trying to dry out my shoes in those conditions was, of course, just an exercise in futility so I simply took them off and drove the next 36 hours barefoot. While I would not recommend it for everyday driving, you would be amazed at the increased sensitivity you feel when there is not even a thin sole between your feet and the pedals.

Subaru, East African Safari Rally, 1984

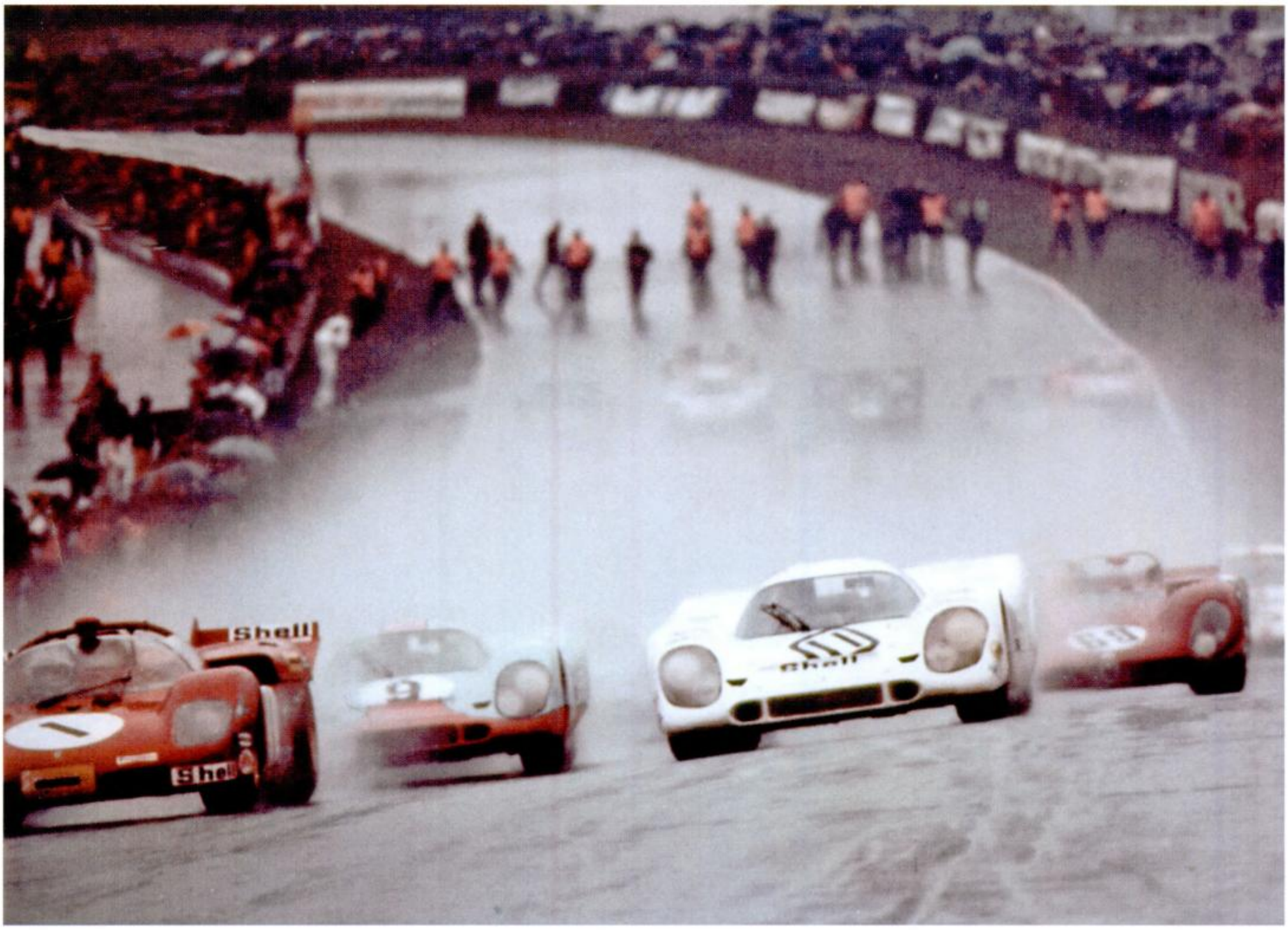
Many years later I would return to East Africa driving a Subaru all-wheel-drive coupe. The car was very light and fast, and, with my co-driver Chris Bates, an English ex-pat living in Kenya, we actually led the rally after the first southern loop to Mombasa and back to Nairobi, before having problems on the northern sector. Vic Elford collection

DRIVING IN RAIN AND WATER

Driving in wet, muddy conditions like that is something of a challenge. First you have no idea where the track is—if indeed there *was* one there to begin with—nor how deep the puddles are as you drive into them. If you are driving a front-engine car with the radiator and cooling fan up front, you must be careful to balance the need for speed with the need to keep the engine dry and running. You must keep the speed up so that in the event of the wheels getting into some particularly slippery slime you will have enough momentum to carry you through it. On the other hand, you must not just charge in blindly, as the water is likely to come rushing through the radiator and then get sprayed all over the electrical system causing complete ignition failure. If that happens, you have only one choice: Open up the hood and completely dry the entire system, which if it is still raining is a lot easier said than done.

If you know in advance that you are likely to meet such conditions, it might pay to wrap all the electrical leads in silicone grease or use a silicone spray to insulate them. The only problem with that treatment is that any moisture already inside the system will be trapped and could itself cause problems as it heats up and vaporizes and then can't get out.

Another problem in torrential rain, particularly when the temperature is high, which happens frequently in Africa, is keeping the inside of the windshield clear. Today there are many proprietary products on the market. However, one of the most effective ways of keeping the windshield clear is just plain old household soap of the sort that your grandmother might have used to scrub the kitchen table many years ago. Just rub it all over the inside of the windshield with a damp cloth, let it dry thoroughly and then, with a soft dry cloth, gently polish it off, taking care not to smear it.



Porsche 917, Brands Hatch, 1970

My 917 is side by side with Chris Amon's 512 Ferrari as we leave the start in perhaps the wettest race I ever drove, the BOAC 1000 km at Brands Hatch. My co-driver, Denny Hulme, hated the rain, as did Pedro Rodriguez' co-driver, Leo Kinnunen. The result was that Pedro and I each drove about 5 hours and 40 minutes of the 6 hour race! He won and I was second. Eric della Faille

Above all, when you are driving in the rain make sure you do everything *smoothly*. Tire grip goes away in the rain, of course, but it goes away much less in a straight line than in the corners. You can still accelerate fairly quickly in the rain, and once you develop the feel for threshold braking, you can still stop quickly too, but you must be very gentle and sensitive in the corners.

AQUAPLANING

For either normal road driving or on the racetrack, you must be aware of "aquaplaning," or "hydroplaning" as it is sometimes erroneously called. This occurs when there is standing water on the road that the tire is unable to penetrate, making it lose contact with the surface underneath. When the tire is separated from the road it has literally no grip, so it just slides along on top of a film of water between it and the road surface.

Under these conditions there is absolutely nothing you can do until the tire eventually makes contact with the road surface again. To limit the possibility of losing control of the car, make sure that the wheels are pointing straight ahead, so if you had been turning bring the wheel back straight. If you had been accelerating or braking when it happens, get your feet off the pedals immediately and just sit and wait until the contact and the grip come back again.

One of the problems with aquaplaning is that it happens almost exclusively at fairly high speed so, unlike other driving situations where you can experiment slowly at first and build up to practicing maneuvers at higher speeds, you have to be ready to act almost instinctively when you aquaplane for the first time.

Another problem that arises when driving in conditions conducive to aquaplaning is the use of "cruise con-

In figure B the forces are F1, still due to the initial momentum, and F2, due to the power being applied to the rear wheels. The resultant is FR, and at this instant the car is traveling exactly in the direction of the arrow (vector) FR.

As the car goes around the corner, the momentum as well as the amount and direction of the force being applied to the rear wheels are all constantly changing. At any given instant there is an F1, an F2, and therefore a resultant FR. If you were to take the infinite number of FR arrows (vectors) and connect them you would finish up with the line followed by the car around the corner as shown in figure C.

Once you understand the principle and have mastered the technique, you can use this skill to adjust the angle of attack of the car, even when the corner opens or tightens.

In the corner shown, the car is carefully balanced with a mixture of power and steering with the steering being into the skid, also known as opposite-lock steering.

If the car is at the absolute limit of speed and adhesion all the way from A to B where the corner tightens up, how can you slow down and turn the car enough to avoid going off the road? By unwinding the steering a little—in other words turning the wheel *into* the corner—you will have a larger side contact area presented by the front tires to provide more friction and the rear of the car will want to slide out further. Depending on the surface, you may have to lift off the throttle pedal for an instant, creating the trailing throttle oversteer that you learned about earlier—but be ready to get back on the throttle the instant the car has started to rotate.

This is one of the circumstances where the Porsche PSM or PASM will not allow you to go to such extremes because the system will "think" that you are going beyond the car's limits. You can switch it off, but it still remains in a "sleeping" mode, analyzing and keeping an electronic eye on everything the car is doing. If you push the car to the point where you exceed a tire slip angle of about 7 degrees, which is about the point at which maximum tire grip is achieved and beyond which it starts to diminish, or if you go to the brakes, the PSM will activate anyway.

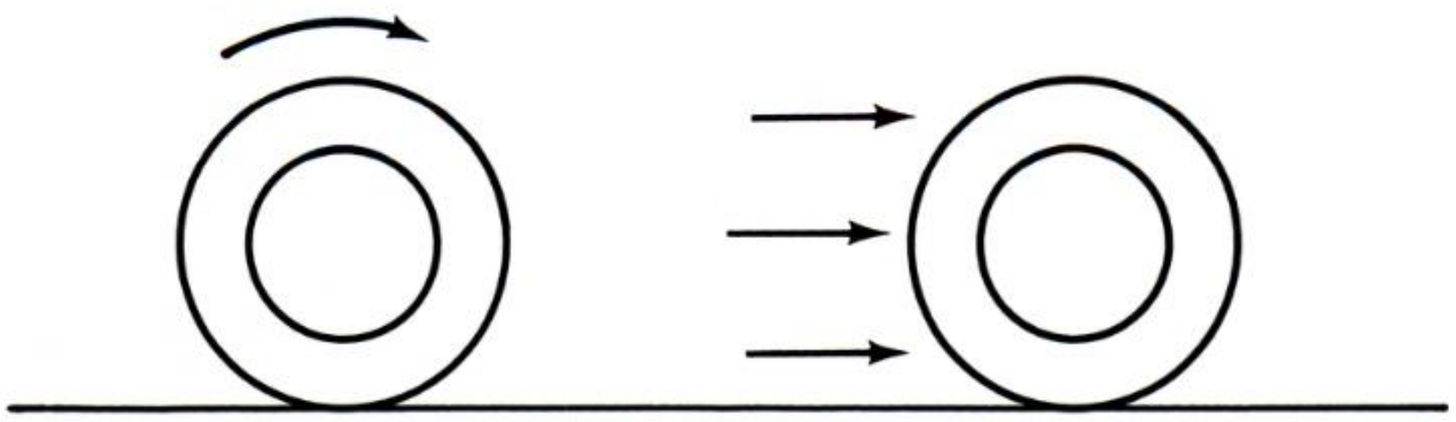
There is no way to deactivate the PSM, so a modern Porsche cannot be driven to extremes in this way. It *could* be deactivated at the factory or perhaps by your local dealer by totally reprogramming the PSM software, although for any reasonable use it is difficult to see why you would bother. Future versions will probably have a total deactivation option so the driver has full control again.

DRIVING ON BLACK ICE

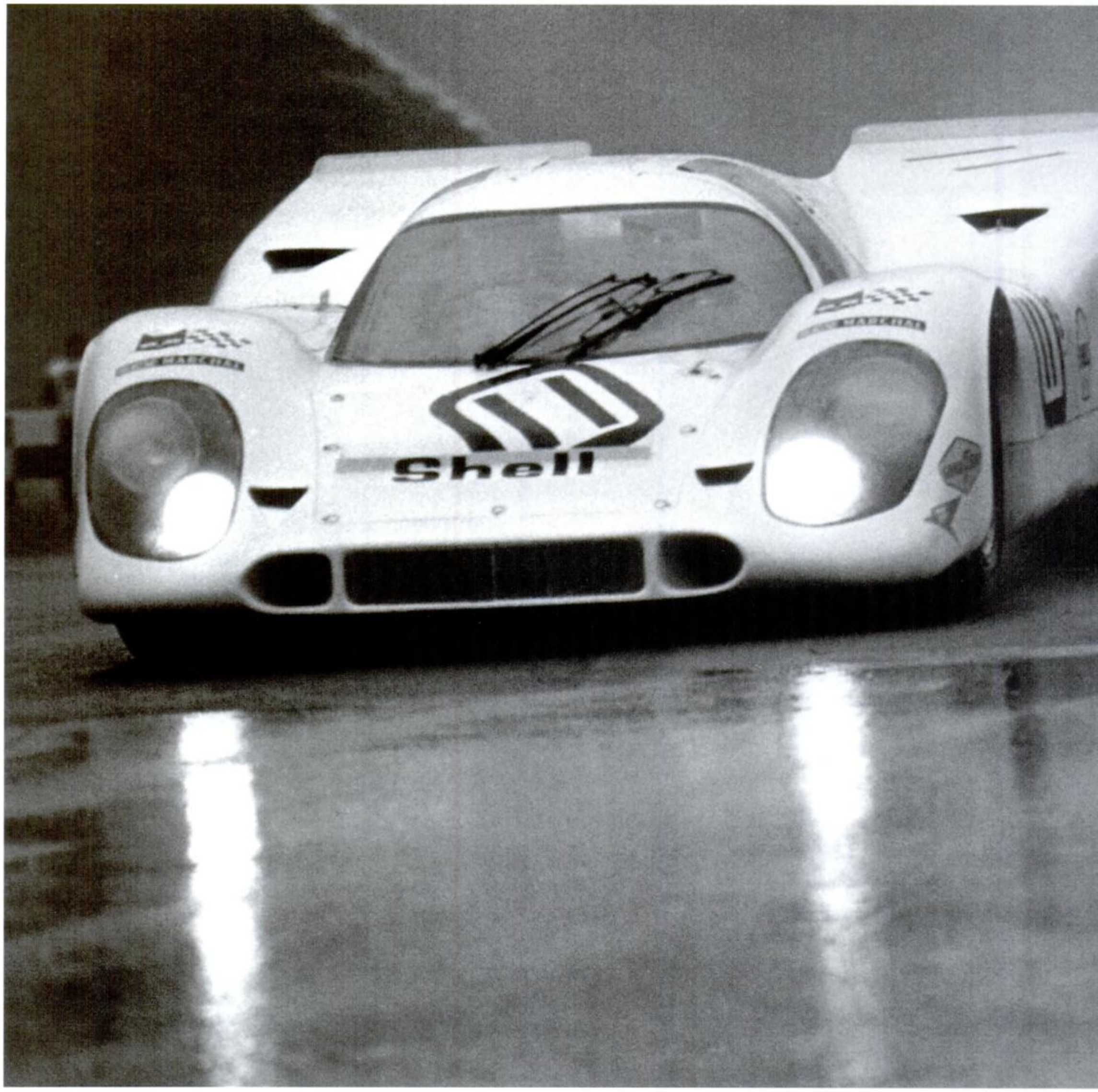
If the road is *really* slippery, just adding more power as the steering is turned may send the rear of the car out from under you and, again, you must be ready to apply instant correction the moment the car starts rotating.

Back in Chapter 9 I said that there is one and only one situation where "cadence braking" works. It is when you are confronted by sheet ice or black ice and you have virtually no grip at all. There is probably no driver alive who is sufficiently sensitive to be able to squeeze the brakes on without locking the wheels on sheet ice. Even ABS systems can get confused; because there is so little resistance the ABS "thinks" the car has stopped. If you just lock the brakes the car will eventually slow down, but as anyone who has ever experienced that heart-stopping moment knows, it seems to take forever.

By stabbing on and off the brakes as fast as possible you will stop a lot sooner than just sitting there with the wheels locked. As with everything involved with the dynamics of driving, there is a simple physical reason for this. Let's just look at what happens at one wheel. Each time you put your foot on the brake the wheel will go from a free-rolling state to a locked state where it is just sliding over the ice. Conversely, as you take your foot off the brake it will go from being locked to rolling freely.



Between the point where the wheel is rolling freely and the point where it is locked, there is an instant when it has both braking and grip.



Porsche 917, Brands Hatch, 1970

Although not easy to drive, the big, powerful 917 proved unbelievably fast in the treacherous conditions. Eric della Faille

Logic tells you that during each transition from rolling to locked and from locked to rolling there is a tiny moment when there is both braking and friction, so during that moment the car is slowing down. Since those moments are very tiny indeed you need to create as many of them as possible, so the faster you can pump your foot up and down on the brake pedal the quicker you will stop. Force is of no importance since you obviously do not need much force to lock the wheels on ice; the speed with which you move your foot *is* of importance.

This is another of those little exercises you can try in a deserted parking lot on Sunday morning. You don't have to be going fast; even just 10 miles per hour will do. Lock up the wheels at that speed and see how far you slide

before coming to a stop. Then do it again with the pumping action and see how much shorter the stopping distance is. You will actually feel a little jerk each time the wheels go through the locking, unlocking friction moment.

You have already seen that whatever the conditions, the car will always react to a direct input from the driver. This applies whether the input is voluntary or not. If you suddenly encounter sheet ice, the automatic reaction is to lift off the throttle pedal, which is a direct input from the driver. Even on ice, because of the dynamics going on within the car itself, there will be a weight transfer, which will almost certainly result in a spin. Instead of just lifting off the gas pedal it is preferable to lift off the gas pedal and *at the same time* declutch (that is, push the clutch pedal in) so the car is rolling absolutely freely. Now, keeping your feet away from the pedals, the only input the driver can make is with the steering, which must be done, of course, with extreme smoothness, but with which *it may* be possible to steer out of trouble.

Such a situation happened to me once in real life. I owned one of the first Audi 100s (known as the 5000 in the United States) in Belgium. Early one winter morning I turned off the freeway and was taking the long, sweeping exit ramp at about 90 miles per hour, when looking ahead I started to see puffs of dust, which I quickly discovered were being caused by cars spinning and hitting and bouncing off the guard rails. Although the freeway had been clear, the exit ramp ran over a bridge and was covered in black ice. Although I realized what was happening in front of me, I also knew that there was no way in the world I was going to be able to stop before I got there. By pushing the clutch in and immediately putting the gearbox in neutral I disconnected the engine and transmission from the wheels so that the car was simply freewheeling and I was able smoothly and delicately to steer my way through the carnage that was going on around me. As with the trip over the Col de la Couillole on my way to winning "the Monte," it was a few moments before my nerves and hands had calmed down enough for me to be able to relax again.

Another technique that helps in slowing down on slippery roads is using both brake and throttle pedal *simultaneously*. It will work to a limited extent with rear-wheel drive but really comes into its own with front-wheel drive and especially with four-wheel drive.

We already know that on packed snow or ice it is difficult to apply the brakes without locking up the wheels. However, it is logical that if you keep the power applied to the driven wheels it will be more difficult to lock them with the brakes.

With a front- or four-wheel-drive car, brake with the *left* foot but at the same time keep a little power applied with the *right* foot on the throttle. Keeping the power on will prevent the driven wheels from locking—and the harder you brake, the more power you must apply.

You can use the same technique with a rear-wheel-drive car, but only to a limited extent as the front wheels being non-driven will lock up comparatively early.

CHAPTER 12
ACCIDENT AVOIDANCE

The place: Outside Lyon, France
The time: A rainy afternoon in 1974
The occasion: Waiting in line at a red light

I was sitting in my Porsche waiting patiently for the traffic lights to change. As always when I am driving, my eyes were never still but roaming around ahead, to the side, and even though I was stationary, still frequently glancing in the rear view mirror. One of those rearward glances showed a car approaching from behind at such a speed that it seemed evident the driver had not seen the traffic sitting motionless in front of him. When he was about 100 yards away I decided that there was no way he was going to be able to stop and it was time to get out of the way. I had left about 4 feet between my car and the one in front and was able to squeeze past his rear bumper and onto the grass shoulder beside the road. At that moment the oncoming driver suddenly realized that everyone was stopped, slammed on the brakes, and slid at about 40 miles per hour into the rear of the stationary car I had just exposed.

Even while sitting still at a red light you can do some positive things to keep out of someone else's trouble. Had I been sitting there conducting blaring rock music with both hands, oblivious to all around me, it would have been my Porsche going away on the tow truck instead of the other two cars. Always try to have an alternative to just staying where you are on the road and becoming involved in an avoidable accident.

The things I am going to say now will most certainly upset some people but they are fundamentally true.

First: Accidents, with rare exceptions, don't just happen. They are caused.

Second: Speed in itself does not kill.

ACCIDENTS ARE CAUSED . . .

Accidents are usually caused by a mistake of some sort. Inattention, lack of anticipation, poor judgment, lack of awareness of what is going on around you—all are human faults for which you are responsible.

You can avoid accidents by looking for every little telltale sign that might indicate something unexpected is about to happen. That way, when it does it is no longer unexpected, but *anticipated*. Some examples of telltale signs might be: The ball bouncing into the road that is almost certainly going to be followed by its small owner, oblivious to the danger; the pair of tiny feet glimpsed underneath a parked car which might take off in any direction; the car approaching fast down a side road that may not be able to stop before it gets to the main road; the vehicle in front of you with the driver wandering along looking for house numbers or street names; the woman putting on her makeup or the man shaving with the aid of the inside mirror; the dog rushing across the road that will probably be followed by one or more of its species; and a new one since the first version of this book was written, the person paying more attention to yakking on the cell phone than to driving.

All of these situations are potential hazards and might create a situation that could lead to an accident. You cannot control those events, of course, but by being aware of them you can avoid the accident to which they may contribute.

Give the guy looking for street names a couple of extra lengths space so that if he does suddenly find what he is looking for and turns left just in front of you, you will have time to take avoiding action. The moment you see that ball bouncing into the road, slow down so that when its owner appears at full speed you have already virtually stopped. Not only will you not run over the child, but you will also protect him or her from vehicles behind you whose drivers were not so forward thinking as you. Practice again the running commentary we talked about in Chapter 3, analyzing all the potential accident situations you see.

CONTROLLING YOUR SPEED

Speed in itself does not kill, but the wrong speed at the wrong time very often does. I'm still alive despite having driven along the Mulsanne straight at Le Mans many, many times at nearly 250 miles per hour. Of course, had I made a mistake at that speed it is quite possible that I would not be here today.

In Germany, driving your Porsche for long distances at 120–150 miles per hour on the autobahn is perfectly normal. That is what Porsches and the autobahn were built for. Both the Porsche driver and the driver of the little Ford cruising along at a mere 70 miles per hour are used to the speed differential and *each respects the other*. Each also has a

responsibility to the other and each must exercise the anticipation we talked about in Chapter 3. When the Porsche driver sees the little car closing up behind a heavy truck on an upgrade, he *expects* him to pull out to overtake. When the Ford driver sees a Porsche coming up behind him in his mirror, he *expects* the Porsche to be going fast so he avoids darting out in front of it unexpectedly.

How often have you been overtaken in a 30 miles per hour zone by a car driven at 40–45 miles per hour, weaving in and out of traffic with little thought for other road user, only to come up behind the same car a few minutes later, out on the open highway still doing 40–45 miles per hour but now getting in everyone's way?

Everyone has different skill levels; everyone has different reaction times. Some people have more natural balance and feeling than others and can drive much faster on slippery surfaces. Some people have better eyesight and can drive quicker at night. The important thing is to learn and know *your own* limits under all conditions and just in case something does go wrong, *always wear your safety belt.*

Falling off the third rung of a step ladder can kill you, although if that happens your head will only be doing about 17 miles per hour when it hits the ground. Like everything else in driving, your speed, however high or low it may be, *must be controlled.*

Here is an example of a car that affords its driver unsurpassed visibility. Of course, the downside is its driver, and passenger, can easily fall out. Never pack your Porsche in such a way that something blocks your view, and keep your mirrors adjusted. And wear your seatbelt. Being aware of your surroundings increases your ability to anticipate unexpected events, and being buckled in increases your chances of surviving the one you'll inevitably miss

CHAPTER 13
COMPETITION DRIVING

The place: Somewhere in the French Alps
The time: 4:00 a.m. one morning in 1967
The occasion: The Tulip Rally

There was a terrible bang and the crunch of folding metal as the right front fender of my Porsche 911 hit the rough unyielding rock face and we ground to a halt with a punctured front tire.

Carrying number "1" on the car, David Stone and I had been the first to leave Noordwijk on the Dutch coast two days earlier at the start of the Dutch International Tulip Rally. The first special stage, which was also the only one held in the Netherlands, had been at the Zandvoort racetrack. From the Netherlands the rally headed south into the French Alps where most of the competitive driving would take place. We had set the fastest time at Zandvoort and on every special stage since and had already built up a substantial lead.

Now it seemed as though all that effort might have been for nothing. Being first on the road was a great advantage on all the special stages, as it meant there was never anyone in front of us who might cost us precious

Porsche 911, Tulip Rally, 1967

You can almost see the concentration in my eyes as I take the 911 off the start line of a special stage on the way to victory in the Tulip rally. One of three outright rally victories on the way to the European championship in my first year with Porsche. Foster & Skeffington

Porsche 911, Tulip Rally, 1967
Just seconds after the start we begin to climb with my specially designed "mountain" transmission. Vic Elford collection

seconds while we overtook them. Unfortunately it also meant that being the first car on the road we would be the first to encounter any unexpected hazards.

We had just encountered one. Coming out of a tunnel high in the mountains on what was a fairly straightforward road section (or liaison section) between special stages, I had found the road covered in sheet ice. Having just come from a dry hillclimb, the car was still on racing tires, which have virtually no grip at all on ice, and I had simply slid straight into the rock face. (We were going much too fast for cadence braking, or any other sort of braking for that matter, to have any effect in the distance available.)

At first glance the damage appeared light—a punctured front tire and bent front bumper and fender—and since it was on a liaison section we were not too pressed for time. We changed the wheel but found that the bumper was still rubbing hard on the tire. It was then that we discovered just how strongly Porsches were built; trying to pry the bumper away from the wheel with our hands was like trying to kill an elephant with a fly swatter.

Fortunately there was a convenient telephone pole right there, and we were able to attach one end of the tow rope to it and the other end to the bumper. After numerous attempts, jerking the car backward until the rope threatened to break and the phone pole quivered ominously above us, we managed to get the bumper away from the wheel.

All this had taken time, of course, and when we reached the next time control we were three minutes late. Somehow, David managed to check in at the control very discreetly without any of our competitors being aware of our time loss. Time lost on road sections, or liaison sections, was one minute for every minute or part thereof and total time on special stages was measured in seconds. This meant that I had a deficit of 180 seconds to make up over the next-fastest competitor on the special stages.

I talked earlier about my special relationship with Hermann Briem and Huschke von Hanstein and now all that mutual trust was coming into play. From my knowledge of the special stages I had calculated that I needed a maximum speed of only 100 miles per hour. By using equally spaced gears and a very low final drive ratio it was possible to build such a transmission but Hermann was worried that the low final drive ratio, being essentially one developed for short sprint races, would not survive 2,300 miles of road use and numerous wheel spinning hillclimb starts. Fortunately I had convinced him that by being gentle and smooth I would make it last. Now we were able to take advantage of the luxury of gears that were not available to other manufacturers and that even other Porsche drivers had not dared to try.

The first stage after the accident was a hillclimb up the Mont Salève just south of Geneva, and on a 6-minute climb we beat the next car, which incidentally was another Porsche, by half a minute. Around Geneva to the north side of the city, all this through liaison sections on roads in

McLaren F1, Nürburgring Grand Prix, 1969

Flying at the Nürburgring, just moments before crashing. Mario Andretti's lost wheel almost cost me my life. Vic Elford collection

France since the Swiss are not fond of motor sport on their roads, to the Col de la Faucille where we not only beat all our competitors but also beat the outright hill-climb record set only the year before by a Formula 2 car in the European Hill Climb Championship.

One particular corner on the way up will live forever in my memory. As I exited a long right-hander absolutely on the limit at about 75 miles per hour, there was a solitary gendarme standing at the side of the road in front of a low stone wall. He had nowhere to go but backward over the wall, and that was my last view of him as he disappeared down among the trees.

David and I continued this hectic pace throughout the next day and night, slowly getting back the three minutes we had lost. At one point we had a *downhill* stage in the Alsace mountains and even there we were able to make the fastest time, beating Timo Makinen's Mini Cooper S by one second.

The last real road stage was a hillclimb at yet another European Hill Climb Championship venue, La Roche-Samrée in Belgium. Traveling very fast with the last two corners taking us right to the limit of our 100 miles per hour top speed, we went through the first one with no problem but as I turned into the second one nothing happened; the car wanted to go straight on. I slowed, braked, and wound on more and more steering, but we were still heading for the trees. I finally got the car to respond a little, but not before taking out a number of the little concrete reflector marker posts on the outside of the corner, with a series of "bing-bing-bings" as we mowed them down.

Porsche 908/3, Targa Florio, 1970

Ferdinand Piëch and John Wyer had very different views about how the factory should run its racing program. Here Jo Siffert and I pose with them in front of the 908/3 entries for the Targa Florio in 1970. Porsche

Our momentum helped carry us to the finish line, and after having our time recorded—despite the problems we were still fastest—we surveyed the damage: Both right-side tires punctured and a lot of crumpled bodywork. Obviously the right front tire puncturing had been responsible for the loss of steering and the rear one had been punctured on the concrete markers.

Now we had another major problem; our next service point was after the next special stage, as we had not anticipated needing service here and we only had one spare wheel. While we pondered our dilemma, we changed one wheel and waited for the next Porsche 911 driver to arrive. When he did I explained our predicament and asked him to lend me his spare wheel, on the understanding that I would run behind him until we came to the next service point. If he needed the wheel back I would take it off and give it to him and my rally would be over.

I cannot for the life of me remember who that driver was. I know he wasn't an Englishman, but he was most certainly a gentleman and agreed. We both made it safely to next service where I gave him his wheel back, and then David and I continued setting fastest times everywhere, finally winning the rally by 46 seconds over Timo Makinen, which meant that we had actually been 3 minutes and 46 seconds faster than him on the special stages.

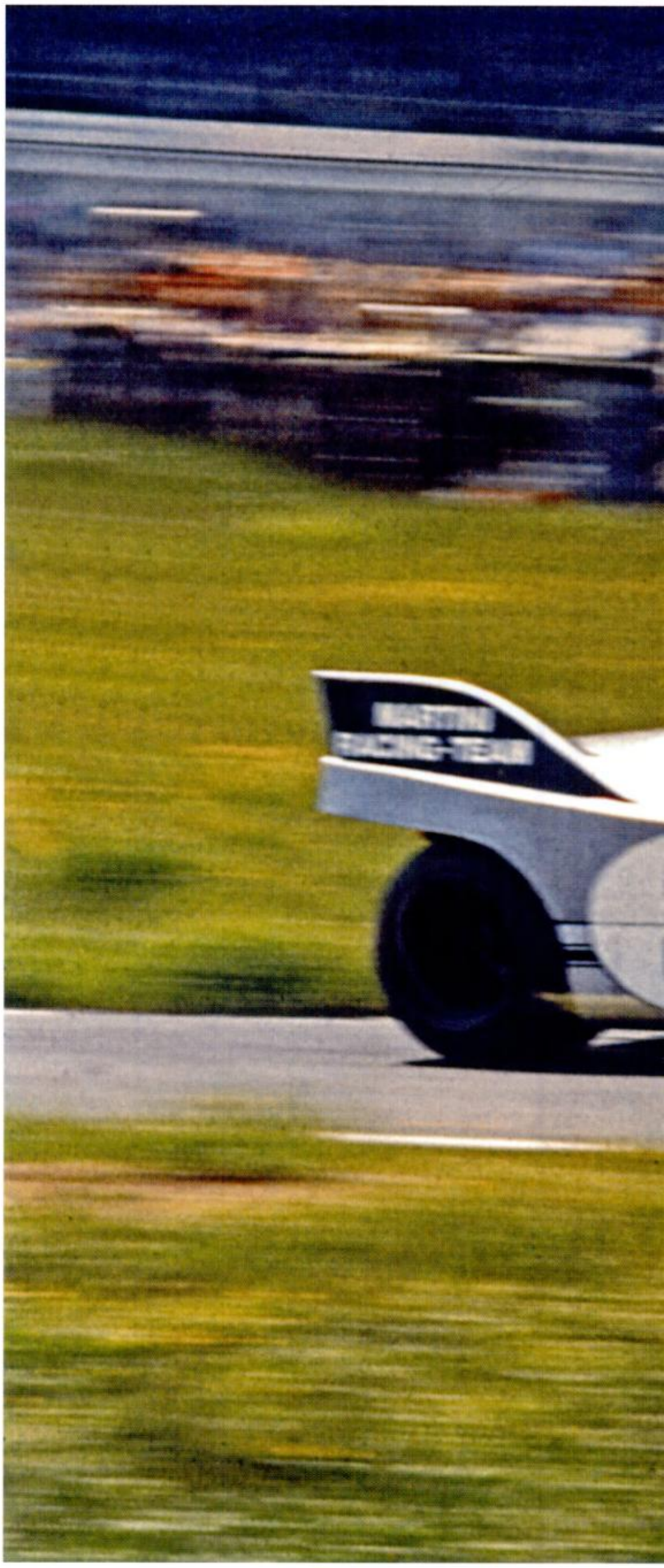
CONCENTRATION

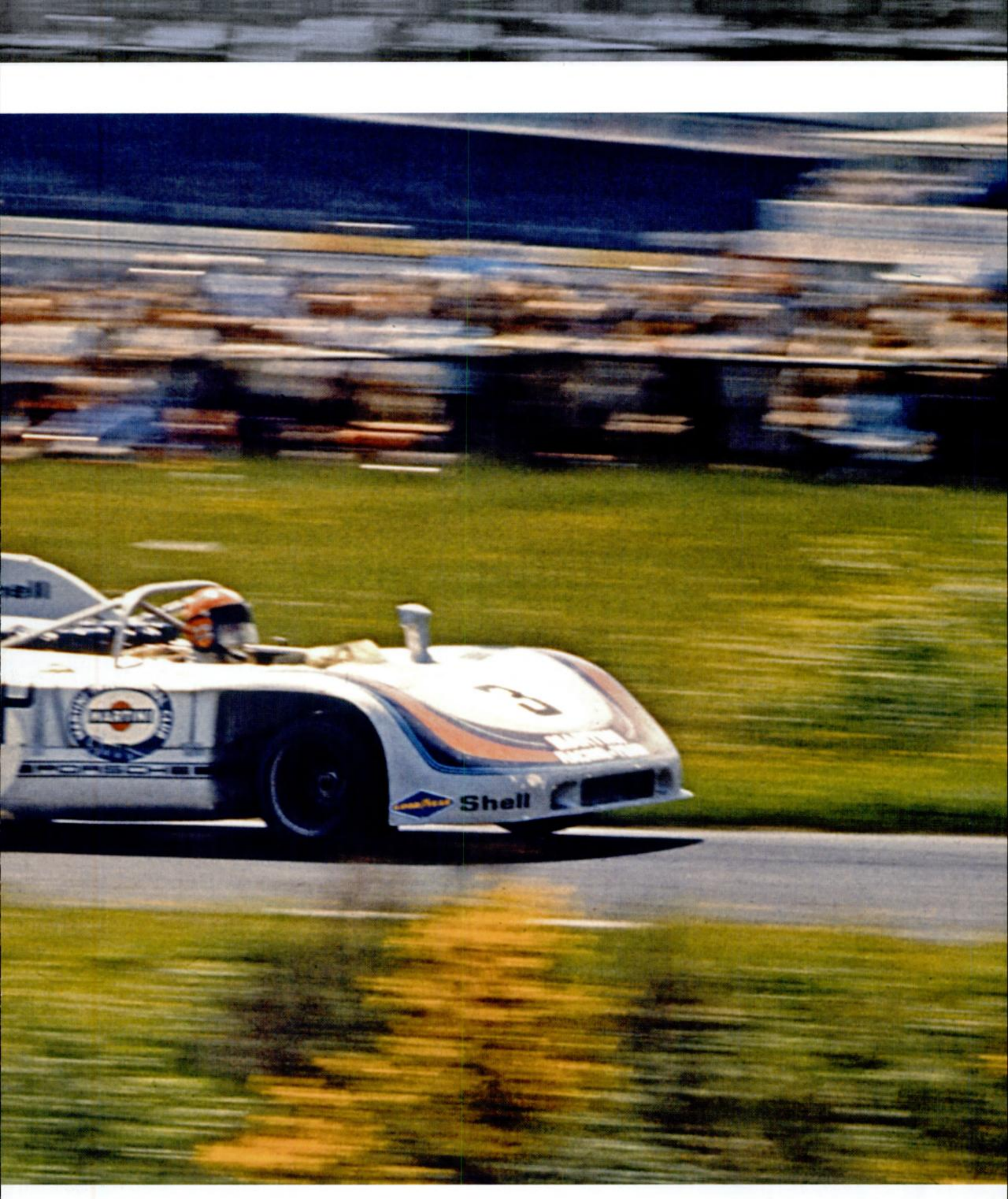
Competition driving is like any other form of competition. You must have the ability, the dedication, and the will to succeed, then allied to all that, the *concentration*.

Remember the Sebring 12 Hours I won with Gérard Larrousse, where he kept his concentration all the way to the end of the race, and then when it was no longer needed he relaxed and promptly spun on the cooling down lap?

Even funnier, at least for those watching, was the cool-down lap of Italian Vittorio Brambilla, who won a rain-shortened Austrian Grand Prix at Zeltweg. With the track only a few hours from Northern Italy, thousands of his compatriots had swarmed across the border to watch him, and he was so excited at winning in front of them that, as a result of enthusiastically waving to the crowd, he crashed heavily. It was a good five minutes after taking the checkered flag that he appeared at the pit entrance with the car looking like some sort of demented mechanical crab hauling itself along sideways with only two wheels touching the ground.

Once you have decided that a competition driving career is for you, be aware that to succeed, whether it be at an amateur level or with the intention of making it





Porsche 908/3, Nürburgring 1000 km, 1971

Gérard Larrousse and I drove our beautiful little 908/3 to our second victory for the Martini Racing team in 1971. Porsche

Porsche 908/3, Nürburgring 1000 km, 1971

Teamwork, even during a pit stop can be vitally important in long distance races. This pit stop resembles a well-rehearsed ballet.

through the ranks to Indy Cars or Formula 1, you have to be prepared to sacrifice virtually everything else to get there. Like any top-level sport, motor racing requires a great deal of single-mindedness to succeed.

Many years ago, when I was commuting regularly back and forth across the Atlantic to compete in Trans-Am and Can-Am, I cooperated in a psychological survey done by a scientific team from southern California to measure the ability of people to work under pressure. They tested many different groups—amateur and professional racing drivers, business people, and athletes from other sports—and came up with a startling discovery: People from every group eventually got to a point where their performance under increasing stress disintegrated, *except racing drivers, both amateurs and professionals, who continued to get better the more stress they were under.*

They also discovered something that anyone who is married to one of us could have told them for free: Racing

Porsche 908/3, Nürburgring 1000 km, 1971

A well-earned celebration at the victory podium.

Alfa Romeo 33TT3, Sebring, 1972

And here I'm beating Ronnie Peterson to the approach to the hairpin at Sebring. Vic Elford collection

drivers in general were self-centered, had little need for conformism, and were driven only by what *they* considered to be a measure of success. Winning, to a racing driver, means everything. There are occasions when a driver is content to finish second, but they are rare.

PHYSICAL PREPARATION

We have discussed learning to drive and some of the basics in preparing the car to be driven, so let us look for a moment at preparing *the driver* for competition.

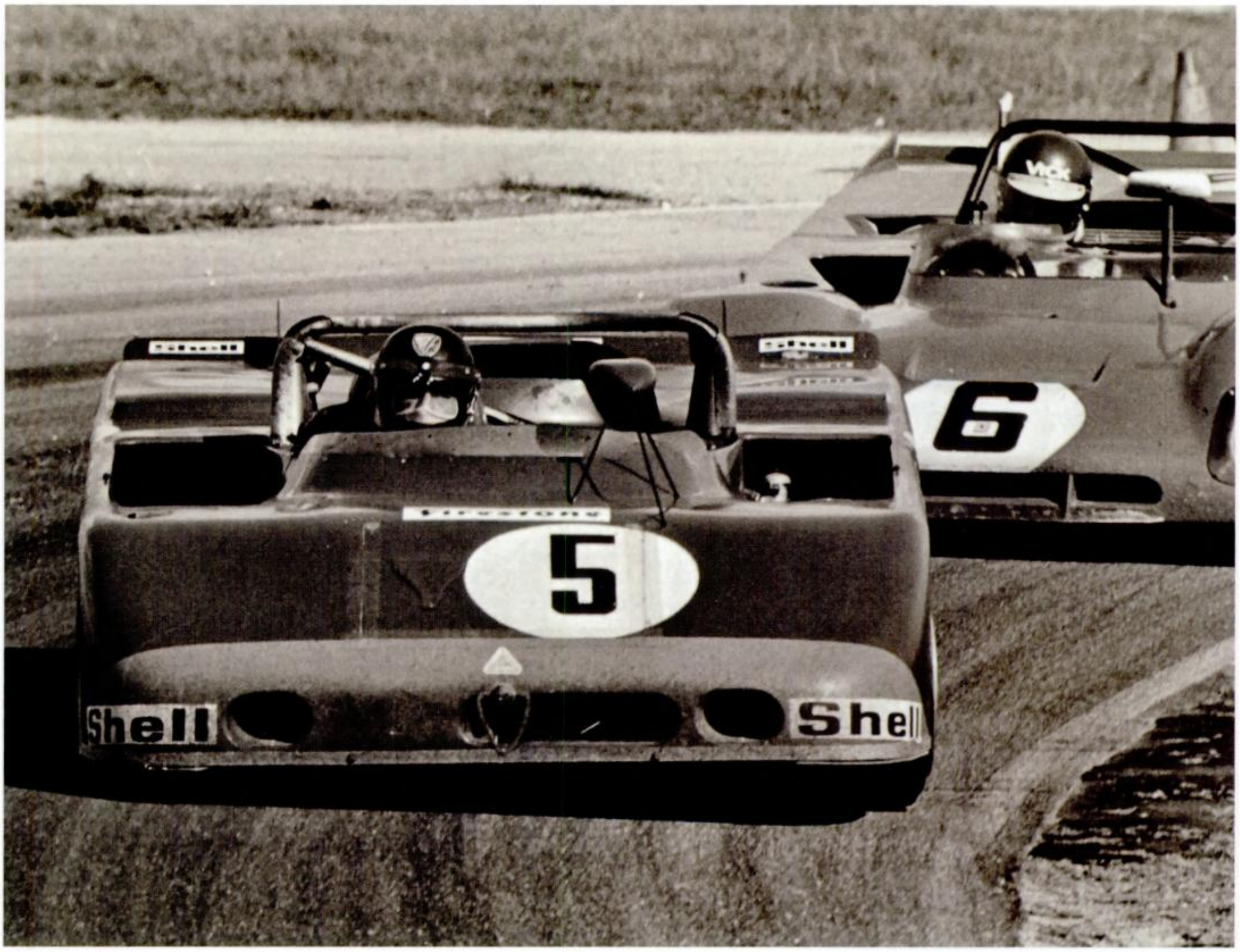
Jogging is a popular way for many people to stay in shape, although I must admit I tried it a few times and found it depressing and boring so I gave it up. I found that the best physical training for driving a racing car was driving a racing car. Developing your skills as a test driver, being able to understand what the car is doing and why, and then being able to transmit that information to your engineers will help you get plenty of seat time.

Most racing drivers have a natural aptitude for other sports, particularly those requiring balance and hand/eye coordination such as skiing, tennis, golf, swimming, and sailing. All of these form valid and enjoyable physical training programs. The same is true in reverse, incidentally; a few years ago I had the pleasure of teaching Martina Navratilova at a Porsche Owners Driving School, and I doubt that I have ever seen anyone else with such ability to concentrate. Whatever the exercise, it never took her more than two tries get it perfect. Years ago, just after his

triple-gold-medal Winter Olympics, I met Jean-Claude Killy, and a few months later, driving in the Targa Florio, his first-ever motor race, he won the GT Category. In my case I used to scuba dive and sail, both of which are excellent for concentration, alertness, and self-control. There is, however, one part of your body that you will need to work on in the gym, and that is the neck muscles. They will need considerable development in order to be able to withstand the g forces generated by modern race cars. A good modern family car is probably capable of cornering at about 0.75 g, your Porsche can reach about 1.0 g, and before the advent of ground effects, race cars could develop around 1.3 g, maybe 1.5 g. With the evolution of ground effects, Indy cars now reach over 3.0 g and a Formula 1 car can reach a staggering 4.5 g. In other words, a Formula 1 car can create five or six times the centrifugal force in a corner than the car you drive on the road. When you are cornering with that kind of force acting on you, it is the equivalent of having a bowling ball strapped to your head.

Virtually all top-level racing now requires drivers to use a HANS device. Quite simply, HANS stands for Head And Neck Support and is a harness-type collar made of Kevlar and carbon fiber that fits over the driver's shoulders; it is held in place by the seat belts, which also hold the driver in place. The helmet is attached to it by two small straps, thus limiting the head movement in the event of a violent crash.

Whether you are about to take part in the Indy 500 or an SCCA club race, the Monte Carlo rally or a Porsche



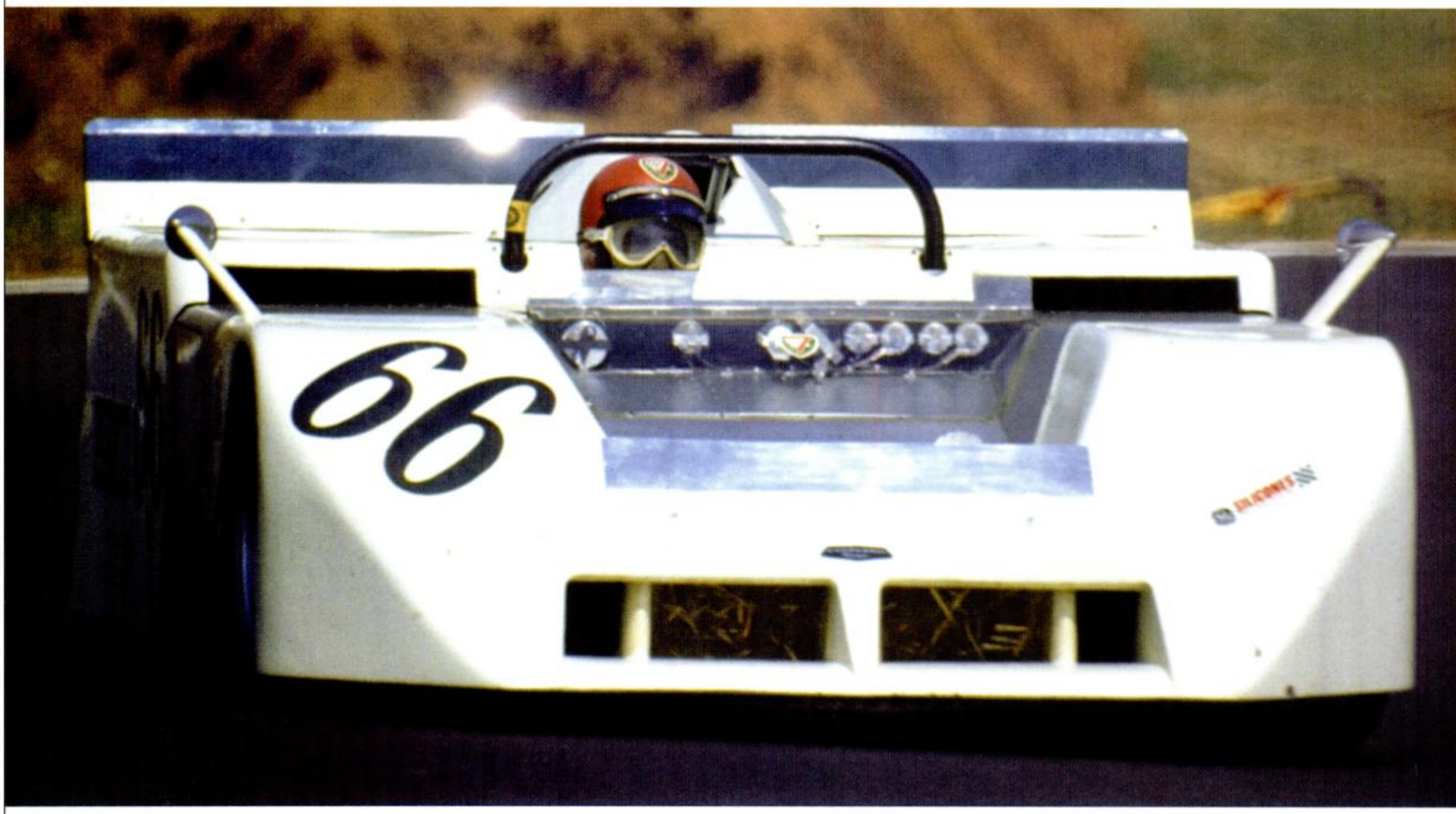
Alfa Romeo 33TT3, Daytona, 1972

At the end of 1971, Porsche suffered from the outlawing of the 917, and while the 908/3 was unbeatable at the Nürburgring and Targa Florio, it lacked the outright top speed to take on the Alfas and Ferraris on the faster tracks. And so, after more than five years with my friends from Stuttgart, I moved to Alfa Romeo. Here I am in front of Ronnie Peterson's Ferrari 312. Vic Elford collection

Chaparral 2J, Can-Am, 1970

After Jackie Stewart debuted the Chaparral 2J "sucker car" at Watkins Glen, Jim Hall asked me to drive it for the rest of the year. As with Ferdinand Piëch, I formed a great affinity with Jim, and we worked well together as a team.

Peter C. Borsari



Chaparral 2J, Can-Am, 1970

A great close-up of the 2J in action at my first race with it at Road Atlanta. Vic Elford collection

Porsche 908, Targa Florio, 1969

Almost a family photograph of the Porsche team at the Targa Florio in 1969. From left to right behind my car, number 279, are Umberto Maglioli, Richard Attwood, Brian Redman, Dr. Ferry Porsche, Hans Herrmann, Udo Schultz, Hans-Dieter Dechent, Rolf Stommelen, me, Rudi Lins, Gérard Larrousse, and an unknown gatecrasher on the end. Gerhardt Mitter is seated in his car. Porsche

CHAPTER 14
PUTTING IT ALL TOGETHER

The place: San Francisco
The time: January 1991
The occasion: Lunch one Saturday

Porsche Cars North America had just received the first Porsche 911 Turbo of the 1991 model year. I was ready to leave Reno for a week of meetings, starting at Willow Springs racetrack, continuing on to San Diego, and then terminating in San José and San Francisco.

Brian Bowler, then president of Porsche Cars North America, asked me if I would mind taking the Turbo for my trip, as I was the only one in the company who could really evaluate it from a performance point of view.

Would I mind?

So, the week's business over, I was sitting in Basta Pasta, one of my favorite San Francisco Italian restaurants, with my wife, Anita, who had done the trip with me, and our two 6-foot-tall teenagers. We had just picked them up from the airport, together with all their baggage, from a month in Europe. Listening to the anecdotes of their vacation, enjoying the marvelous spaghetti, and occasionally gazing out the window, it was a while before it dawned on me that rain was falling in sheets over the city.

Rain. If it's raining in San Francisco in January, it must be snowing in the Sierras. A quick trip to the pay phone and the California Highway Patrol confirmed that Interstate 80 over the Donner Pass was alternately open and closed, sometimes with chain controls, and definitely with major delays. On the other hand, the pass to the south of Lake Tahoe, Route 50, was still open with no restrictions.

The bill paid, everyone and their bags squeezed into the 911 Turbo and we were soon on our way. A stop at Sacramento for another quick phone call confirmed that Route 50 was still open and we started to climb. It started to snow and we eventually encountered the dreaded chain control, which was now stopping all traffic. I wasn't worried about the driving part; in fact, I was looking forward to it, but I was worried about conning my way past the chain control, which, not without reason I must admit, often assumes that everyone behind the wheel in winter is a moron.

The state trooper peered in the window from beneath his yellow oilskins.

"Is this a front-wheel-drive car?"

"No," I lied, "this is the new Turbo Four, brand-new four-wheel-drive car from Porsche, and it has all-weather tires."

"OK, man, go, go," he replied, waving us on our way.

So we went.

The 911 Turbo at that time had a rather peculiar limited-slip differential that allowed a maximum of 20 percent slip on acceleration but locked up 100 percent on deceleration. The theory, admirable for the conditions for which it was designed, is that 100 percent lockup on deceleration will give added stability.

But it doesn't work on snow. This meant that going up we had no problem. The car was sideways most of the time, but the rear wheels were locked together, giving traction, which I was able to control by the amount of correction applied, or steering into the skid.

Going down was something else altogether. The cadence braking that we talked about earlier is fine in a straight line on a flat surface, but now we had a narrow road with a lot of camber and no real straights. Just lifting off the throttle pedal had the effect of locking up the rear differential and the wheels would then immediately start sliding down the camber, putting the car sideways. The only thing to do in these circumstances is to push the clutch in so the car is freewheeling, steer it back straight again, stab the brake pedal a few times to slow down, and then blip the throttle and *get it exactly right* in order to let the clutch out with perfect engine/road speed coordination so the car regains balance. Then the moment the car is unbalanced again by a bend or the camber of the road the whole thing starts all over again . . . and again . . . and again. . . .

I was enjoying the challenge so much and my concentration was so intense that it was not until we reached home that I realized that one of the kids had not uttered a word the whole way and the other was white from fear. Anita, on the other hand, had found the trip as exhilarating as her days as a rally co-driver years before.

Putting it all together means remembering all the little things you have learned from this book and all your other sources over the years and being able to pull out the one that counts . . . when it counts.

In the case above, it meant making maximum use of the limited-slip differential to keep traction on the way up, then on the way down disconnecting the drivetrain to get steering control and using cadence braking to slow down.

Above all it means keeping cool and analyzing what is happening from one moment to the next so you always anticipate what will happen and never have to react hurriedly to something unexpected.

I hope this book has interested, entertained, and above all instructed you. Before you drive again, read it a second time and really retain the things that matter to you in whatever type of driving you do.

Then drive well. Drive safely . . . and buckle up.

RALLY PACE NOTES

The first ever rally pace notes were the brainchild of what was then the BMC (British Motor Corporation) team back in 1961. Budgets were not what they are now and even a manufacturer could not afford to send its entire team for a couple of weeks reconnaissance before an international rally.

BMC had entered no fewer than six cars for the Acropolis Rally in Greece; three Austin-Healey 3000s and three Minis. One crew was sent to go over the entire route, making navigation notes so that the rest of us would not get lost. At the same time they also devised a system that would at least give us an indication of which way the road went when we were driving flat out against the clock on the unknown special stages. This was particularly important in Greece as the rally was in May and with the speed sections almost exclusively on gravel roads we would be constantly blinded by dust from the cars in front.

That first set of pace notes looked something like this:

- 400yds House Right
- 200yds Left to Tree then Right
- 500yds Slight Left
- ½ mile Tree and House Hairpin Right
- 50yds Left
- 100yds Bad Right

In those days, "Slight" meant simply that the corner was less severe than it appeared to the driver, "Right" (or "Left") meant that it was more or less as it appeared, and "Bad Right" meant that it was sharper than it appeared. Pretty elementary, to say the least, but it was a start.

The notes were read by the co-driver/navigator so that the driver knew what was coming. They obviously helped from a safety point of view, because at least we knew if the road went right or left, but they did not really help us to go much quicker. Besides which, the navigator had to shout to be heard so he or she was likely to be hoarse or even speechless by the end of the rally.

Pace notes stayed fairly rudimentary for about two years until David and I started thinking about how we could actually use them to go faster. Over the next few years we developed and refined the system. Until 1968, when I quit rallying to concentrate on circuit racing, a typical section of my pace notes for the Monte Carlo rally might have looked something like this:

• 100 SR—SL • KR—L + R • KL into BR—FL + FR • 50 SR into L —Fast KR • Flat R—FL over Crest • Flat over Crest bearing R • 100 Flat R—FL • L into BR—HL— SR + over Crest • Long L tightens—R opens •
SL—SR—SR into OHL—Fast KR opens to SL •

Translation:
Straight 100 Slight Right then Slight Left Straight Kay Right then Left and Right Straight Kay Left into Bad Right then Fast Left and Fast Right Straight 50 Slight Right into Left then Fast Kay Right Straight Flat Right then Fast Left over Crest Straight Flat over Crest bearing Right [not actually turning right, just aiming toward where the right side of the road would be after the crest] Straight 100 Flat Right then Fast Left Straight Left into Bad Right then Hairpin Left then Slight Right and over Crest Straight Long Left tightens then Right

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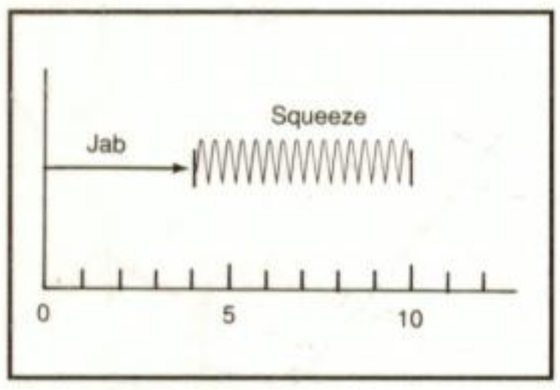
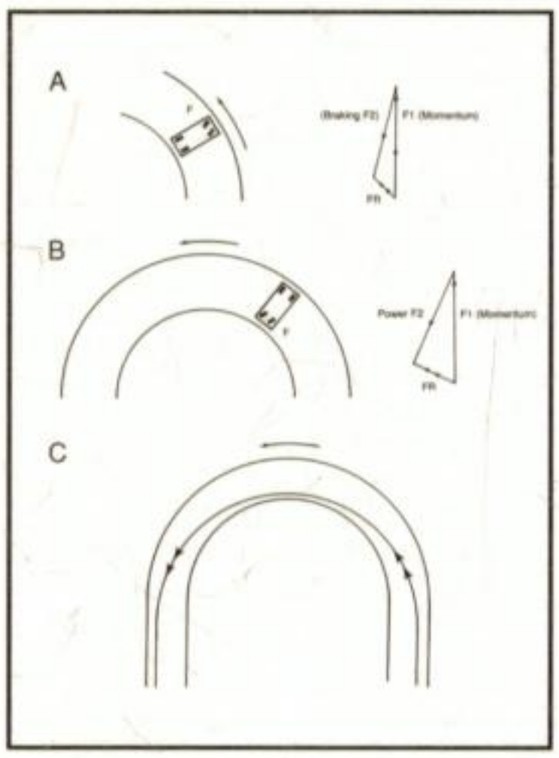
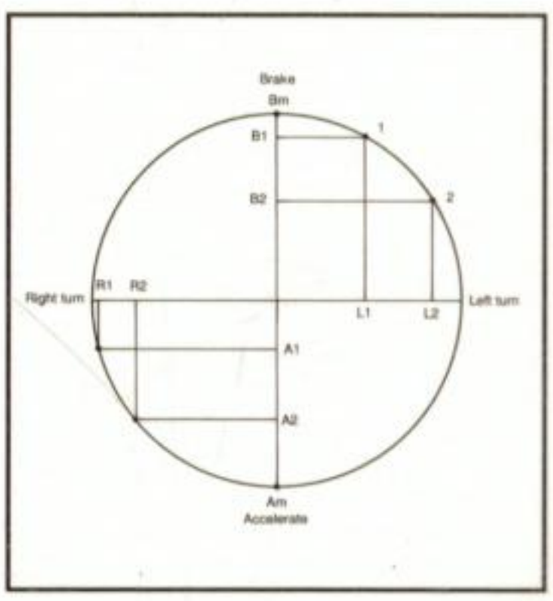
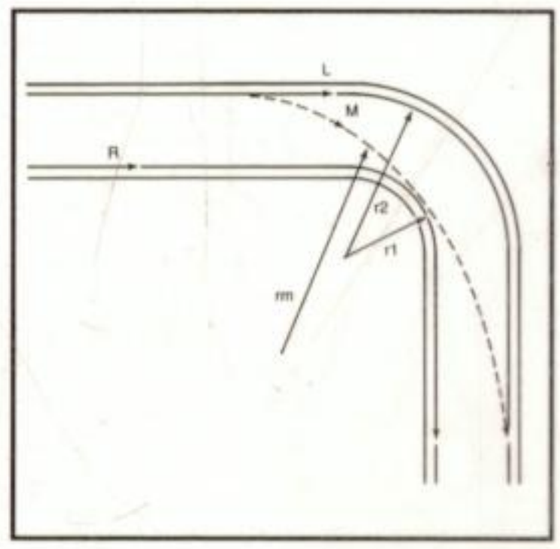
Vic Elford was the first to drive a Porsche to victory in the Monte Carlo Rally, and he was the first to lap Le Mans at over 150 miles per hour—in a Porsche, of course. Who better, then, to write the *Porsche High-Performance Driving Handbook*? Inside, Quick Vic shares his insight into the latest Porsche technologies, like ride control systems, new tire compounds, and the Tiptronic S transmission. Whether driving the new-generation 911 or the whole-cloth inventions of the Boxster, Cayenne, Cayman S, or Carrera GT, these new systems and more have transformed the experience–and challenge–of driving a Porsche. Using modern images and historical photos, Elford immerses the reader in both the history and the evolving technology that he knows like no one else does.









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