BYRNE'S

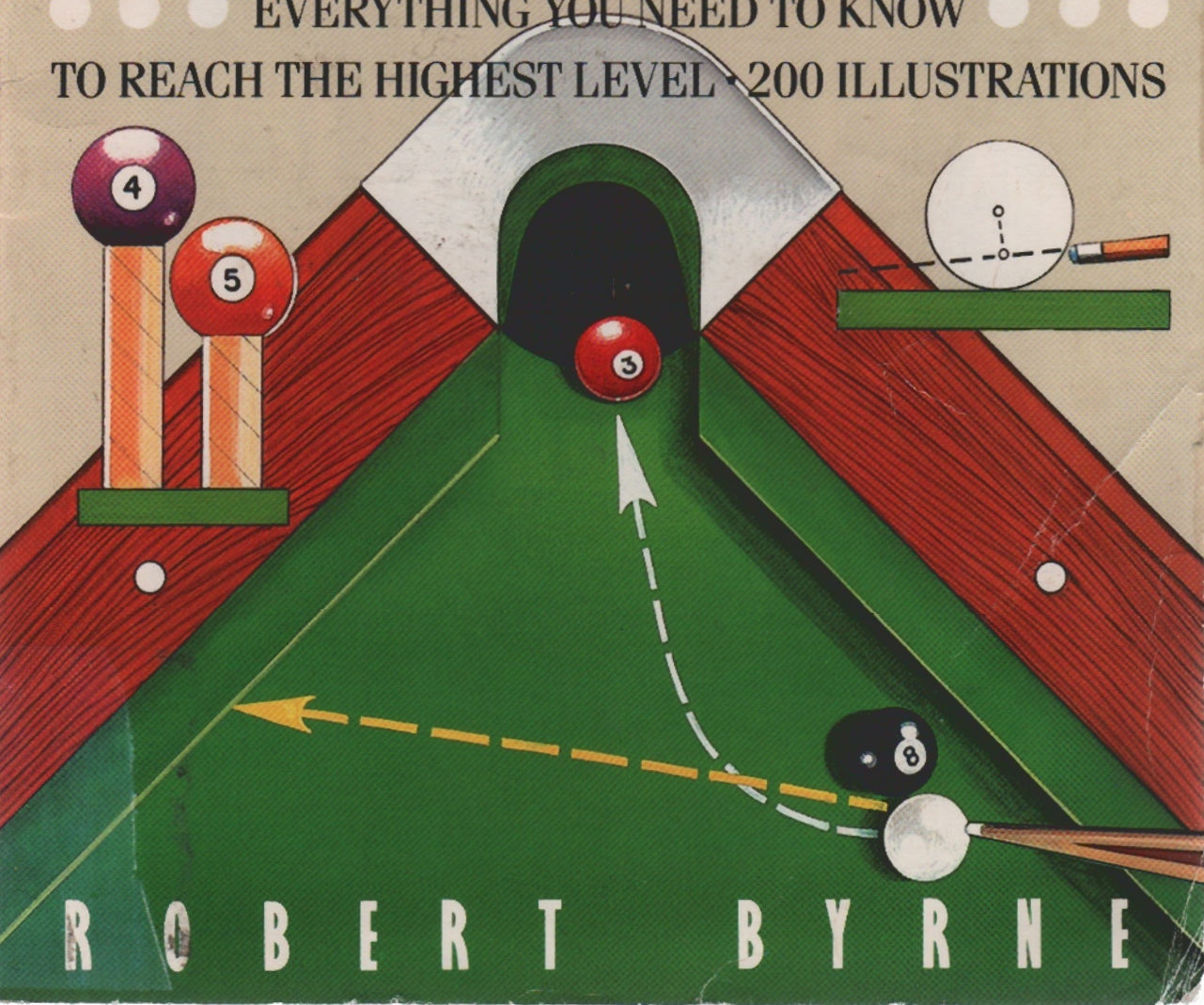# ADVANCED TECHNIQUE IN

POOL AND BILLIARDS

EVERYTHING YOU NEED TO KNOW
TO REACH THE HIGHEST LEVEL · 200 ILLUSTRATIONS

ROBERT BYRNE

Byrne's

ADVANCED TECHNIQUE

in

POOL

and

BILLIARDS

Robert Byrne

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Introduction

I'VE ALWAYS ENVIED—BY WHICH I MEAN HATED—NEWS-paper writers who could throw a bunch of columns together and become instant book authors. Such a deal! No need to slave for a year in the kitchen to come up with an original soufflé; just pop some leftovers in the microwave.

Now here I am myself serving up a predigested meal, namely, a selection of my articles and features from *Billiards Digest* magazine dating back to its inception in 1978.

I'm not red-faced about it at all. In fact, I'm pleased as punch, as Hubert Humphrey used to say, and I feel morally superior to the average recycler. For one thing, the articles were planned from the beginning to be chapters in a book. In the magazine I was able to write about the game in more technical detail than I could in a general book of instruction like *Byrne's Standard Book of Pool and Billiards*, which also first appeared in 1978. In that book, which was designed as a how-to-play manual aimed partly at beginners, there was no room for personality profiles, background features, or explorations of physics.

For another thing, relatively few people saw the articles when they were published, and students of the game today would have a hard time collecting them. In its early years, *Billiards Digest* had fewer than 10,000 subscribers and was not sold at newsstands. Compare 10,000 magazine subscribers to the 30 million people surveys show now play at least an occasional game of pool or billiards. There are a lot of people ready for something that goes beyond chalking the tip and drawing the ball.

More editing, updating, and rearranging was needed than I first thought to turn my journalism into a book. A lot was left

behind that was ephemeral, argumentative, fuzzy, or repetitious. Articles on the same topic were combined into single chapters. Photographs that appeared with the features (Part Three) were replaced with pencil renderings by artist Cynthia Nelms. Diagrams were renumbered from 1 to 183 and keyed to the text. The goal was to create an essentially new work, one that didn't overlap my other books in any significant way and didn't have the creaky joints of the typical anthology.

Among the repetitions that were pared down were references to Robert Jewett, Ph.D., former national intercollegiate pool champion and now a research scientist with Hewlett-Packard. Most of what I know about the physics of the game I learned—and continue to learn—from him. The misconceptions he has swept from my mind over the years would fill a book as large as this. Thank you, Bob.

While the book is aimed mainly at experienced players, there is plenty here for neophytes as well. Understanding the science and the subtleties won't hurt you even if you can't yet apply the knowledge to your game. At the very least, knowing how the laws of nature apply to pool and billiard balls will help you avoid false theories, phony "systems," and teachers who talk nonsense.

Byrne's Advanced Technique isn't only about advanced technique, despite the title. It's also about why the game is so fascinating, why its tournaments are so entertaining, and why its characters are so colorful. Parts of the book even your grandmother might like.

There are dangers involved, though, in letting her (grann) read it unless she can handle a cue fairly well. The chapters massé shots and jump shots, to take two examples, could lead disaster, embarrassment, and loss of funds. Then, too, players who rely on instinct rather than analysis (maybe including grann) might be thrown off by learning about the physics of the game, at least initially. But it's hard to get anywhere unless you take few chances, which goes for readers as well as writers. Tell the old girl all you know, I say, and turn her loose.

My career as a billiard journalist started in 1963 when Newby, a billiard room owner in Philadelphia, started mailing (publishing seems too grand a term) a small newspaper on game. Newby was a sweetheart of a man, but he had no b.

ground in writing or editing and was—how shall I put this?—indifferent to the fine points of the English language. His early issues were fountains of typographical errors, misspellings, and syntactical muddles. I used to look at them in awe, wondering if a bomb had gone off in the printing plant.

Once I sent him an account of a California tournament along with a handwritten cover note that read: "Dear Earl, Here's something you and your readers may be interested in." When the paper came in the mail a month or so later, I leafed through the chaos until I found my article and saw with dismay that the first sentence was: "Dear Earl, Here's something you and your readers may be interested in."

But for years nobody else could see that the industry needed a publication or had the energy and nerve to start one. He didn't let his lack of technical qualifications stop him. (A lesson for us all.) He provided a way for players, tournament promoters, manufacturers, dealers, wholesalers, and just plain fans to communicate with each other and find out what was going on. I salute him. He would be amazed to see how many billiard publications there are now; almost every tavern league has at least a newsletter.

In about 1970 I switched my allegiance to *The National Bowlers Journal and Billiard Review* because—*mirabile dictu!*—the editor paid for freelance contributions. Writers have to eat just like people who work for a living.

In 1978 *Bowlers Journal* spun off the handsome, professionally edited *Billiards Digest*, from whose pages this book is drawn. For the first time in history, pool fans could open a magazine and see photos of players, equipment, and rooms in full color. The first issue of *BD* had 64 pages; a dozen years later it was almost twice as big. (For a subscription call 1-312-266-7171.) The magazine's growth reflects the growth in the game over the same period.

Pool is in boom times, make no mistake about it. New rooms, especially of the upscale variety, are opening everywhere, and tournaments of all kinds are growing in terms of entrants, spectators, and prize funds. A Gallup survey shows that there are as many pool players as joggers, a fact that surprises people who have never had to swerve to avoid a pool player. The advertising industry suddenly loves pool. Pool is in. Pool is chic.

Television networks, though, with the partial exception of ESPN, have yet to notice how the recreational landscape has changed. When they do, there is no telling what dizzying heights the game will attain.

Robert Byrne
Mill Valley, Calif.

POOL
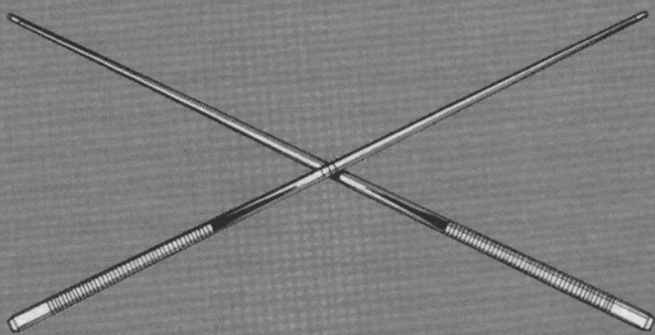
The Fundamentals—Facts and Fantasies

What is the poor student of the game supposed to do when the experts contradict themselves and each other, not just on advanced strategy but on fundamentals? One would think that after 200 years there would be agreement on how to stand and how to hold and use a cue, but such is not the case. Players can't even agree on what type and size of cue to use.

If you are trying to improve your game, remember these facts: Not all good players are good teachers; some good players are wrong on how they get the results they do; what works for any given good player may not work for you; and just because a statement is made by a good player or authority doesn't necessarily mean it is true.

In other words, take even what *I* say with a grain of salt. You have to develop your own style of play, which means finding out what works best for you. The point is so obvious it seems unnecessary to state it. Watch 50 top players in a tournament and you will see a wide variety of postures, grips, and strokes, yet teachers and writers continue to say that the student should stand and hold the cue in a certain way and use a certain kind of stroke. Nonsense!

The stance. Forget all that stuff about facing the shot with your hand at your hip, taking a half-step forward, turning 45 degrees, etc. Stand any way you want to, provided you feel comfortable and one eye is over the cue. If you have to be told to put one eye over the cue, you are a hopeless case and should stick to bowling. Some good players bend slightly at the knees, some keep the legs straight and spread their feet wide apart; some balance their weight evenly, some put more on the forward foot; some put quite a bit of weight on the bridge hand, some hardly any; some turn almost sideways, some face the shot more squarely. What should you do? Whatever feels right. There is no *correct* way to stand.

Notice, though, that all the snooker professionals, who play a game where accuracy of hit is all-important, lean down so far that their chins are on the cue. The three-cushion champions, on the other hand, who are more concerned with carom and rebound angles, stand up straighter. That observation leads me to think that pool players who need a precise hit should crouch low and aim the cue like a rifle, the way the snooker players do. Missing shots you normally make? Are you in a slump? Try leaning down more. Because of laziness or fatigue, players sometimes don't bend over as much as they should.

The bridge. All you have to do is provide a support for the cue that enables it to move back and forth without wobbling from side to side. It is up to you to find a comfortable way to hold your fingers. Only when you are shooting hard or using a lot of sidespin is it necessary to form a "looped" bridge. On most shots an open or V bridge is sufficient and even an advantage

because the entire shaft is visible for aiming. Harry Sims has a snug, solid, looped bridge, but his fingers spring open at the moment of impact—that would have to be considered a flaw and it is something you wouldn't teach a student—but it didn't stop him from twice winning the national billiard championship.

The grip. Should there be a space between the cue and your fingers? Should you hold it with just two fingers or all five? Should the wrist be loose or locked? People write and phone to ask me such questions. Hold the cue any way that feels right to you and ignore all other advice, including mine. Florida's Carlos Hallon, the brilliant three-cushion player, holds his cue at the tips of his thumb and forefinger, the way Queen Victoria held a teacup, yet he can slam the balls with sledgehammer force if he has to. California's Jim McFarlane, a terror when he was known as Whitey the Beer Salesman, always holds the cue at the extreme rear, which doesn't mean he can't take your money. A sprinkling of great pool and billiard players, Al Gilbert among them, use a slip stroke, in which the hand takes a new grip just before the trigger is pulled. Some players have a flexible or even a "whippy" wrist, while others keep it rigid. A guy in Kentucky wrote to ask if I had ever experimented with "the reverse slip stroke," in which the cue is more or less thrown into the cueball. The answer is no.

What all this suggests to me is that the grip isn't as important as it has been made out to be. All kinds of grips can be made to work.

The stroke. A lot of mythology surrounds the stroke. Some players believe that uncanny, mystical effects are possible with one kind of stroke or another. A loose wrist, it has been claimed, will make the cueball do one thing, while a locked wrist on the same shot will make it do another. Not true. A long follow-through does one thing, a check stroke another. False. Use a tight grip here, a loose grip there, stroke with the wrist here, with the shoulder there, twist the wrist here, swerve the cue there. Spare me!

Here are the facts, and I wouldn't lie to you on something so important. In the physics formulas that describe the motion of balls and the collisions between them, there are no coefficients or factors for wrists, grips, or strokes. They aren't needed. The cueball moves down the table with a certain speed, spin, and direction, which can be applied to it with almost any kind of stroke or grip. The cueball doesn't care what you are thinking about when you hit it, or whether or not your wrist is tight or relaxed—all it "knows" is where the tip hits it and how hard. Whether or not you twist the cue or check your stroke or lock your wrist or follow through makes no difference to the cueball at all.

Consider the follow-through. The contact between the tip and the cueball is almost instantaneous. Once the cueball leaves the tip, it doesn't care what you do with the cue. When the instant of contact has passed, you no longer have any control over the cueball. The only reason for teaching

students to follow straight through the cueball is because it helps them *deliver* the cue into the ball properly. Once they know how to hit the ball it no longer matters if they follow through or not.

But there is no particular reason why you *shouldn't* follow through, unless there are balls to be avoided. Once the cue is moving forward it is a waste of energy to bring it to a sudden stop.

You can make quick warm-up strokes or slow; you can pause at the rear of the final backswing or not. As in the other fundamentals, you have a wide range of acceptable styles to choose from. Find what is right for you and don't let a teacher try to make you his clone.

What really counts. While good fundamentals and basic technique are undeniably important, other factors are even more important in reaching top levels. What does it take to become a champion? Here are just a few things you must have: steady nerves; good eyesight; good hand-eye coordination; enough intelligence to learn how best to analyze an array of balls; a good memory so that you can learn from your mistakes; a knack for knowing when to attack and when to defend (which means being able to estimate percentages on every shot); a relentless lust for competition; so much desire to improve that you wake up in the morning thinking of shots and moves; a will to win so strong that a defeat gnaws at you for hours or days; the ability to concentrate while aiming (instead of just going through the motions of aiming); the discipline to practice with intensity; a willingness to put everything else in life second—especially when you are still a teenager; and an imagination that enables you to come up with creative solutions to problems you've never seen before.

Once you reach the top level, you can relax a little and turn some of your attention to trivialities like family and career. Getting there, though, takes a terrific investment of time and attention. It takes far more than changing cues or finding a new way to hold your wrist.

Some of the ingredients, like eyes, nerves, coordination, intelligence, and imagination, are part of the package you were born with and can't be improved with teaching or practice. Sorry.

My aim regarding fundamentals is to encourage you to develop your own style without slavishly aping a teacher. A student complains: "I can't believe you think the stroke is unimportant." Please! A good stroke is absolutely essential, that much is clear even to me. What isn't clear is what constitutes a good stroke. Should you adopt the pump-handle, teeter-totter style of Efren Reyes? The free-flowing classic style of Ralph Greenleaf? The slip-stroke of Ray Kilgore or Al Gilbert? The solid compactness of Raymond Ceulemans? The slow, deliberate approach of Bud Harris? The precious sidearm of the young Willie Hoppe?

With such a smorgasbord of styles to choose from, it is impossible to say which is best for any particular player. All that is necessary for top-flight

play is the ability to hit the cueball at precisely the right spot, in precisely the right direction, with precisely the right speed. How you do it is up to you. I would like to be able to say that one thing all good strokes have in common is an absence of wobbling or veering during the warm-ups and final delivery, but there are even exceptions to that. I knew one superb hustler who worked on making his stroke crooked. Some hustlers, to make themselves look lucky rather than good, always address the cueball in the center, applying the necessary English only at the moment of contact, which requires veering on the approach. (That dodge may have been used by Jack Carr, thought to be the discoverer of sidespin, in England in the early years of the last century. See *Roberts on Billiards,* by John Roberts, 1869, page 68.)

How, an anguished reader asks, does Mike Massey jump his cueball entirely over a ball and still draw back the length of the table? What is his mechanical secret? The secret is called talent. He has a gift for hitting the cueball off center with both precision and explosive power, along with the knowledge of what is required on the shot and the hand-eye coordination to achieve it. Things like these are sometimes lumped together under the heading "touch." There are a thousand mechanical secrets that a player can learn, but touch, talent, and genius are built-in features.

Let's explode some other myths. Practically every top player will tell you that if you spin a ball in place like a top and then knock it slowly down the table with another ball, it will curve toward the direction of the spin— that is, right English will make a ball curve to the right, right? Wrong! A massé effect is needed to make a ball curve. Try it. If you don't have the digital dexterity to spin a ball in place with your fingers, shoot a stop shot with heavy English. When you roll another ball into the spinning ball, it will take off at an odd angle because of throw, then it will roll in a straight line (on clean, unpitted cloth). Knowing this has great practical use. If you are using a perfectly level cue, and you are applying middle-ball sidespin to the cueball, you don't have to allow for curve. Only when you are shooting slightly down on the cueball will it curve.

Bob Jewett has a trick way of making a cueball curve to the left even though it has right-hand spin. It is a proposition bet that may be unknown even to Willie Jopling, a collector of them. Put a cube of chalk mouth-side-up on the rail and rest the cueball on it. Drop to one knee and shoot into the cueball from below, angling the cue at an upward angle of 30 or 40 degrees. If you hit the ball right of center it will take a left curve as it goes down the table.

Some players apparently think that some sort of English or other can cause an object ball to go all the way into a pocket and jump back out onto the table. No way. When that happens it is because of stupid pocket design. One would think that after hundreds of years of experience the industry could make pockets that would retain balls no matter how hard they are

hit, but such is not the case. Of course, even with a perfect pocket, it will always be possible to send a ball into it several inches off the table so that it strikes the upper rim and bounces back, but I'm not complaining about that. If you still think English has something to do with it, place a cueball in front of a pocket that sometimes spits back balls, and shoot the cueball straight in with various kinds of spin. The spin will have little or no effect on the ratio of rejection. The effect will definitely be zero if an object ball is used, because only a very small fraction of spin can be transferred from ball to ball.

Can a ball be made to hug the rail? Not an object ball, unless there is a groove in the cloth or the table isn't level. An object ball will *stay* on the rail, of course, if hit accurately . . . and maybe it will appear to hug the rail. A cueball can be made to hug the rail by elevating the butt of the cue and imparting massé action, but that kind of spin can't be transferred to an object ball.

Can more English be put on a cueball with a small tip or a large one? In the range of sizes that is practical, from 11 mm. to 13 mm., it doesn't make any difference. I think it is a little easier to hit the cueball exactly where you want to with the smaller size, but a tiny tip usually means a shaft that is too flimsy and a tip that will wear out too fast. (If anybody cares, my own tip is 12 mm. My cue weighs 18.75 ounces and has shafts with the stiff European taper. In my opinion, almost all American pool cues have shafts that are too flexible.)

Is a loose wrist the key to lively draw action? No. What you need is a well-chalked cue and a very low hit.

Transferring Spin from Ball to Ball

Can English on the cueball help an object ball into a pocket, or keep it out? No. A spinning ball rolling so slowly that it just barely touches one side of a pocket may drop or stay up depending on the direction of the spin, but you can't control speed that accurately under game conditions, and you can't deliberately put enough spin on an object ball to matter. It is possible to make a cueball scratch in the side when approaching from a shadow angle by using slow speed and a lot of spin, but I can't think of a practical application outside of proposition bets. Forget trying to assist the object ball into the pocket by transferring spin to it from the cueball—you will only make it more difficult to get an accurate hit.

Consider shot A in Diagram 1. There is nothing you can do in terms of English on the cueball that will "help" the object ball into the corner pocket
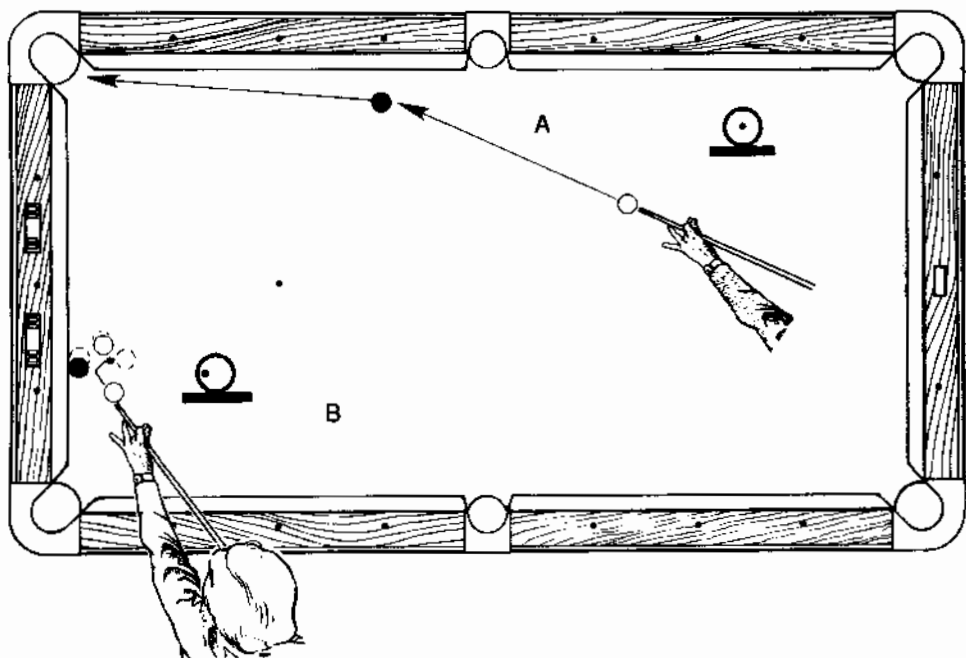
Diagram 1. Transfer of spin

If this is game ball and there is no need to play position, the best course is a center-ball hit on the cueball, a level cue, and as accurate a hit as possible on the object ball. Any use of spin on the cueball makes the shot tougher.

It is true that left English will put a little right English on the object ball, but with soft or medium speed the transferred spin lasts only a few inches; by the time the object ball reaches the corner pocket it will be rolling naturally. (Try it and see—the object ball will not be spinning when it reaches the corner no matter what you put on the cueball. Even with great speed—ridiculous for this shot—the ball will not be turning enough to see or matter. Banks, though, are different.) Further, the left English will make the object ball "throw" slightly off line to the right, making it harder to determine the correct aiming point. If your cue isn't exactly level, left English will make the cueball curve to the left on its way to the ball, and if you use any speed you have "squirt" to contend with as well. (Squirt is what I call the way the cueball diverges in the direction opposite the English.)

We have all seen spinning object balls go into pockets because the spin carries them in off-the-jaw, but that is always after the ball has hit other balls. The only way to get heavy spin on an object ball is to carom it off other balls. You can't get meaningful "into-the-pocket" spin on an object ball by putting the opposite spin on the cueball, and to try to do it at the expense of accuracy is crazy.

English, or "side," as the English put it, makes it harder to pocket the

object ball. Ask any English snooker player. Snooker is played on a 6-by-12 table with narrow pockets and demands such extreme accuracy that very little sidespin is used. It is a game of follow, draw, and dead ball strokes. Terry Griffiths, 1979 World Snooker champion, states in his book *Complete Snooker,* that he hits the cueball somewhere on its vertical axis 99 percent of the time! The lesson for American pool players is clear: Avoid sidespin whenever possible.

Maybe their unfamiliarity with sidespin is what makes so many snooker professionals deny that any spin at all can be transferred to the object ball. Current world champion Steve Davis has written that the idea that spin can be transferred is "rubbish." John Spencer, another top snooker pro, says in his book *Spencer on Pool,* that he is asked at least once a week whether or not cueball spin has any effect on the object ball. "My opinion," he writes, "is that you can impart side to an object ball only unintentionally and not in a way that you can gain any advantage from it."

It is amazing to me that in a country where English billiards (a combination of pool and carom billiards) is still popular there should be any doubt about whether or not spin can be transferred. Of course it can, and it is easy to prove.

In shot B of Diagram 1, a rail nurse position common in straight billiards as well as English billiards, the correct shot is a soft kissback off the red ball (Note the short bridge.) Left sidespin on the cueball will cause the red ball to move toward the white ball, keeping the two object balls close together for another easy shot. Kissing back off the red without cueball spin, or with right spin, will freeze the red ball in position or make it move to the left *away* from the white ball. This is simple and indisputable proof that spin can be transferred.

Another easy proof is to put an object ball on the head spot and drive it across the foot spot into the exact center of the end rail using firm speed and heavy sidespin on the cueball, as in Diagram 2. (This is not easy to do because the object ball will be thrown off line by the cueball spin, which requires compensation.) If you shoot hard enough and with enough cueball spin, the object ball will rebound at somewhat of an angle because of the slight turn ("spin" seems too strong a word) it will have picked up from the cueball. Influencing the rebound of an object ball in this way is very important in making off-angle banks in pool and in making "gather" shots in straight billiards and balkline. (In snooker, the margin of error is so small that players normally play safe rather than trying to influence banks with spin.)

There is a way to demonstrate transfer of spin directly. A slick surface, like glass or plastic, is best. Set up a cueball and two object balls in a straight line, as shown at the top of Diagram 3. Using heavy sidespin and a hard stroke, drive the first object ball so squarely into the second one that it stops dead, which is harder than it looks. When this is done correctly, the first
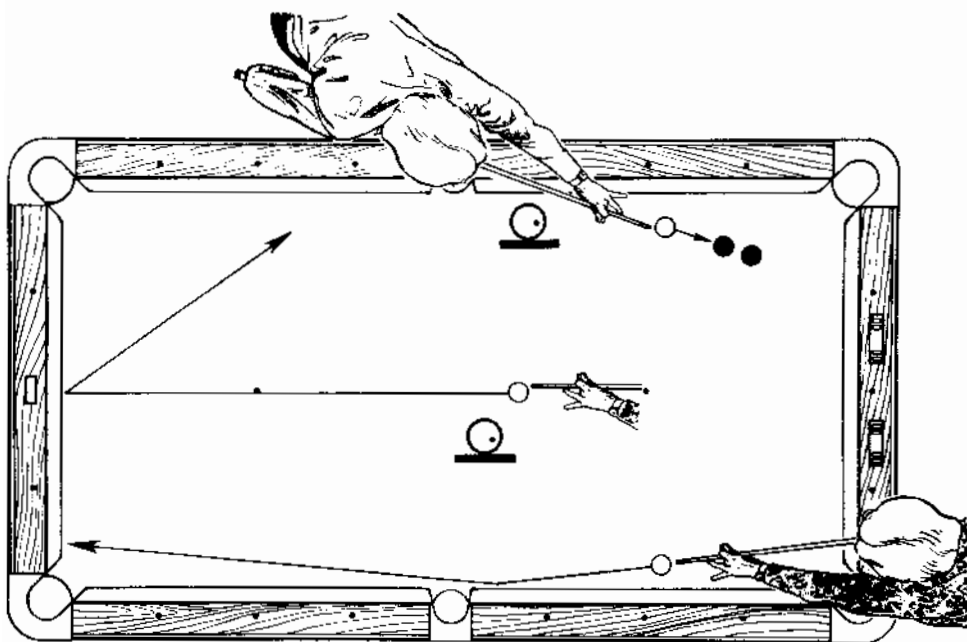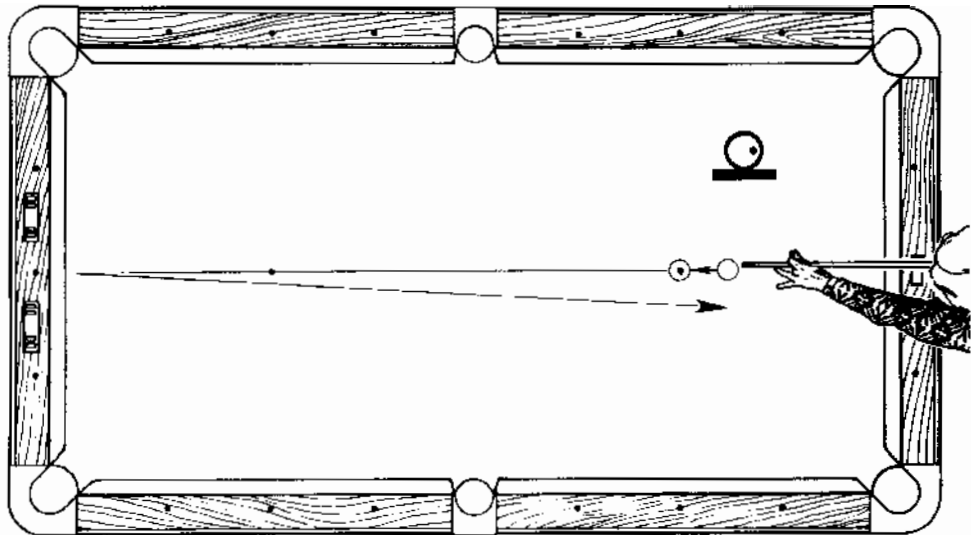
Diagrams 2 and 3: Transfer of spin

object ball can sometimes be seen rotating several times before coming to rest.

The amount of sidespin that can be transmitted from one ball to another is quite small, about two percent, and can be ignored when considering a second object ball. In the above example, you can add a third object ball to stop the second one—you will never see the second one turning after the collisions.

The phenomenon of English transfer is especially important on bank shots, and the closer to a right angle the bank is, the more pronounced is the effect. If you shoot a cueball straight into a rail, sidespin affects the rebound angle tremendously. The middle of Diagram 3 shows what can be done with maximum right spin. (Hit the cueball slightly below center and softly for the greatest effect.) At the bottom of the diagram, the cueball approaches the rail at a small angle; here the rebound angle will be almost identical no matter which side of the cueball is struck.

It follows that transfer of English will be of most importance on a shot that involves an almost perpendicular approach to a rail. Such a shot is given in Diagram 4. At the top, the cueball is about six inches from the object ball. Assume that the paths to the obvious pockets are blocked by other balls, or assume that the game is one-pocket and you must make the ball in the upper right-hand corner. The shot can be played as a bank. Use heavy left English and enough right English will be imparted to the object ball to affect its rebound as shown. In fact, in a position like this you can easily transfer too much English.

At the bottom of Diagram 4 is the shot as it is usually presented. Here enough sidespin is put on the object ball simply by the way the cueball rubs across its face. It is essential not to use any left-hand English on the cueball at this angle because it would cause the cueball to roll across the face of the object ball and would give the object ball no sidespin.

It has been alleged by at least one expert that the position at the bottom of Diagram 4 should be approached with an elevated cue so that the cueball leaves the cloth and gives the object ball a downward blow. This, it was claimed, will impart a massé effect to the object ball and make it curve

Diagram 4. Transfer of spin
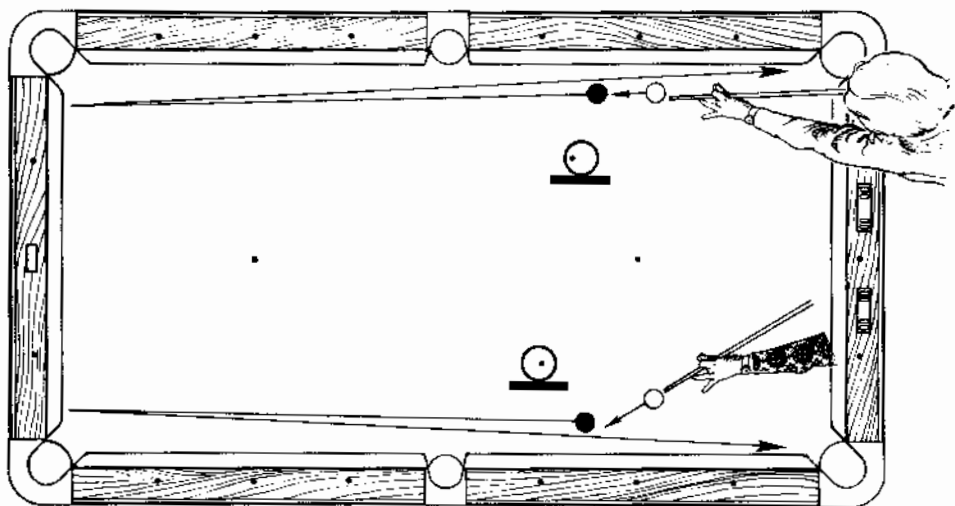
slightly to the left. I deny that an object ball can be made to curve in any significant or practical manner by means of a jumping cueball. The friction between the balls isn't great enough for the massé effect to take place. Even trying to make the *cueball* curve is almost impossible without a well-chalked tip—think how much less friction there is between two balls.

Which is not to say that interference can't be avoided by getting the object ball airborne. Imagine a straight-in shot similar to the one at the top of Diagram 4, and imagine that there is a ball a foot away from the object ball that just barely blocks the path to the pocket. A player might consider elevating his cue to make the cueball hit the first ball slightly from above with the hope that the object ball would then jump over the edge of the interfering ball. A well-known exhibition shot is to make the cueball jump over a cue placed on the table and strike an object ball that in turn jumps over a cue before going into the pocket. Not terribly difficult. (See page 126 of *Byrne's Treasury of Trick Shots in Pool and Billiards*.)

Which brings us to Diagram 5 and the trick shot that for some reason is one of the best known in the world. Yet it's not easy to make all four balls. The ball that's hard to make is the one that has to bank the length of the table. If you've read this far you know that you have to give it a little right spin, either by using heavy left on the cueball or by placing the cueball at the start so that it crosses the ball from left to right. Aim directly between the two middle balls so that the end ball is given enough speed to reach the opposite side pocket. There's a final point to consider: If the balls are dirty, it may be unnecessary to do anything with the cueball; the ball to be banked may pick up enough sidespin as it leaves the end ball.

Diagram 5. Transfer of spin
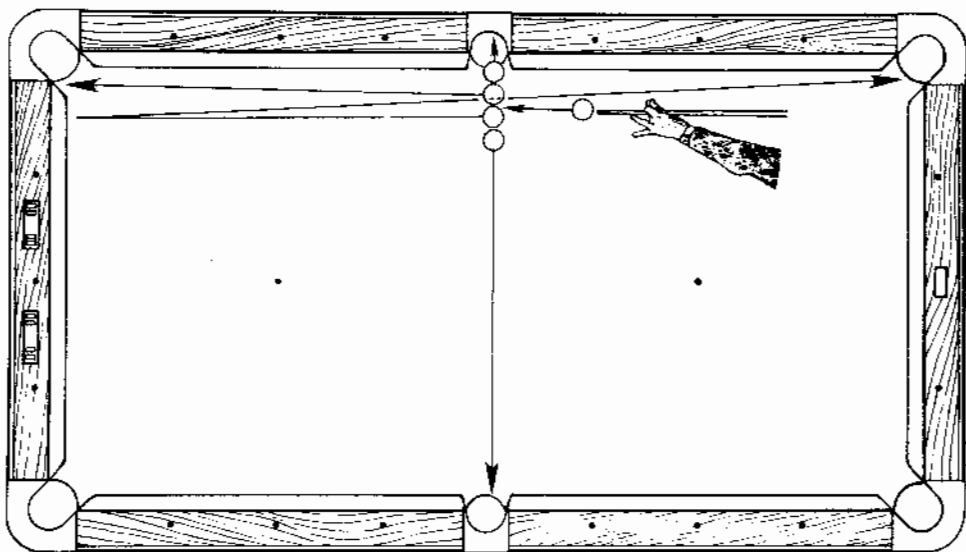
Four Sidespin Falsehoods

Consider the following four falsehoods:

1. After hitting an object ball on a cut shot, a cueball with sidespin wil move forward more slowly than one without sidespin.
2. Sidespin affects the direction the cueball takes off the object ball.
3. A cueball with sidespin divides a cluster better than one without spin
4. Sidespin on a cueball increases when the cueball hits an object ball.

I'll take up the points in order.

1. On a cut shot, what determines the cueball's speed after contact depend on the cueball's initial linear speed, the amount of the cut, and the amoun of topspin or backspin. Sidespin has nothing to do with it. Sidespin be comes significant when the cueball touches a rail—then it influences bot the speed and the rebound angle off the rail.

2. Sidespin has no significant effect on the direction the cueball takes on an object ball on a cut shot. At impact, the cueball path changes to th right-angle (or tangent) line, which is 90 degrees from the path taken h the object ball. Sidespin has no effect, but topspin and backspin do. the cueball has topspin, then it will bend forward from the right ang along a parabolic curve; with backspin it will curve in the opposite c rection. The curves are shown on pages 54, 56, 70, and 71 in *Byrn Standard Book of Pool and Billiards* and can be seen being traced . slow motion in Volume II of *Byrne's Standard Video of Pool*.

3. Urging players to use sidespin when sending the cueball into a pack cluster is poor advice. The cueball won't wade in like Hulk Hogan a: throw balls in all directions because it is spinning; the speed of the obje balls leaving the cluster depends entirely on the linear speed of the cueb. when it hits the cluster and the point of contact.

   Topspin, though, is necessary if you need to make the cueball burr through the cluster.

   There are other reasons for not advocating sidespin on primary secondary break shots. Sidespin raises the problems of squirt (deflectior curve, and object-ball throw as well as increasing the chance of a misc If sidespin *did* help in dividing a pack, then nine-ball players would u it on the break.

   Splitting clusters often decides the game, and because with a lar. pack considerable force must be used, accuracy goes down. Don't a. to the chance of missing by using sidespin, which doesn't help in a event.

   Some bowlers think that "a working ball," by which they mear ball that has sidespin, throws the pins around more energetically, ! they are wrong. A bowling ball curves only while it is sliding on the la

once it starts to roll it travels in a straight line. It is the changed angle of attack on the pins that makes the difference. (See *Sports Science, Physical Laws and Optimum Performance,* by Peter J. Brancazio, Simon and Schuster, 1984, pages 99 and 100.)

4. It's okay to say the sun comes up and the sun goes down provided you know that in fact the sun stays put while the earth moves. It's not accurate to say that cueball spin increases when the cueball hits an object ball, though that's how it looks. What *really* happens is that the impact between the balls reduces the linear speed of the cueball while the sidespin remains the same. When you use heavy sidespin and hit an object ball full, the spin you see is merely what the cue tip put on the cueball in the first place, not something mysterious that arose because of the impact.

When a cueball hits an object ball full in the face, for all practical purposes it stops dead and all of the linear speed is transferred to the object ball. What the cueball does next depends on whether or not it has topspin or backspin. It if slid into the object ball, it stays put (the stop shot). If it had topspin, even the topspin imparted by the natural forward roll, then it will follow forward as the spin grabs the cloth. Backspin makes the cueball back up. The slight hesitation before the follow and draw take effect can be seen if you watch carefully.

On the left side of Diagram 6, the idea is to get good position of the 2-ball for a break in a game of straight pool. Follow will send the cueball along a path to point A, depending on the force of the hit. Adding some right English will change the angle off the first rail, sending the ball to B, or thereabouts, not so far down the table. (Note how the cueball starts out
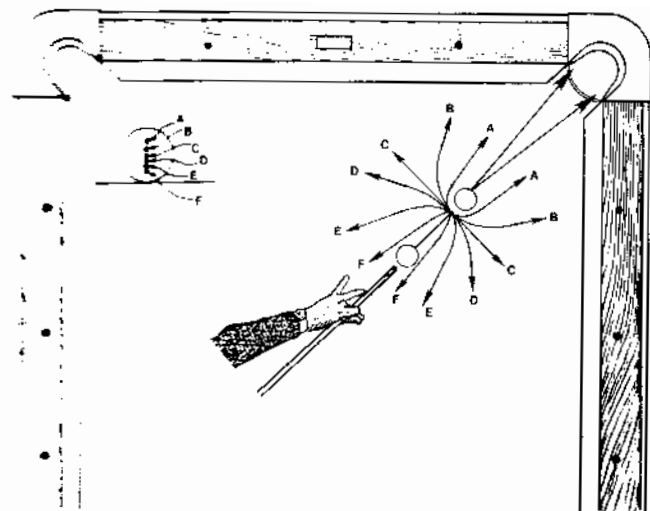
Diagram 6. Effects of sidespin
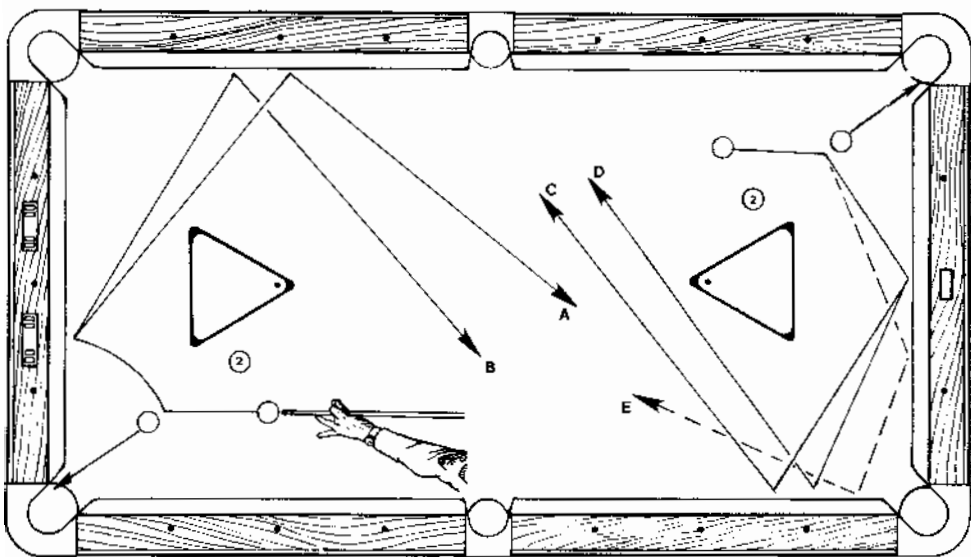
Diagram 7. Effects of sidespin

along the right-angle line off the object ball, then bends forward.)

On the right side of the diagram is the same position. Using slide instead of follow keeps the cueball on the right-angle line off the object ball, sending it along the diagrammed path to point C, or nearby. Adding sidespin changes the rebound off the first rail as shown by the path that ends at D. On a fuller hit, which would take more of the speed of the cueball, the cueball may still be spinning strongly when it hits the second rail, sending it to the vicinity of E. Spin off the second (and third) rail is action familiar to every three-cushion player and can be achieved only with hits fuller than half-ball (approximately).

Diagram 7 shows what is possible with varying amounts of topspin and backspin. By sending the object ball into one part of the pocket or another and by varying the hit on the vertical axis (sidespin is immaterial), it is possible to make the cueball move away in any direction. Some of the angles are hard to achieve consistently. At the left is a player's-eye view of the cueball showing point of tip contact.

The Best Ways to Practice

Students of the game who are trying to improve usually spend too much time pocketing balls and not enough time on position. Controlling the cueball is the key to success, yet there are few practice drills that zero in on position play alone.

Despite the obvious value of working on drills, most players dislike them because of the dullness and repetition. Practicing by yourself, in fact, can do more harm than good. Lacking the motivation to try your best on

every shot, you can easily get careless and end up merely reinforcing the flaws in your game. Competition is the key. Ever notice that almost every top player learned his skills at a public room rather than at home or in a club?

In *Byrne's Standard Book* there are ten position practice shots presented in the form of a game in an effort to avoid boredom. Following are a few more that will challenge both beginners and professionals.

In all of the shots, making the object ball is easy; the challenge is to control the cueball with as much precision as possible. Practice against a friend or an enemy. He gets three tries, you get three tries, and whoever comes the closest to the goal wins. Put some money on it so you'll stay alert.

At the top of Diagram 8 the object ball is at A and the cueball is at B. The first test is to shoot a stop shot, allowing the cueball to drift no more than the width of a piece of chalk, with the cueball at B, C, D, and E. A useful thing to learn here is that a stop shot can be done either with a firm stroke and a middle ball hit or with a soft stroke and a very low hit. Of course the farther you are from the object ball the more speed is needed.

Next, with the object ball at A and the cueball at B, draw the cueball to B, to C, to D, and to E. Leaving the object ball at A, start with the cueball at C and try drawing it to points B, C, D, and E. If you are an advanced player, you can try starting with the cueball at D and E. Getting draw action with the object ball at A and cueball at E takes very good technique.

If you are competing against someone, use a coin to mark the final position of the cueball.

At the bottom of Diagram 8 is a series of shots designed to enhance
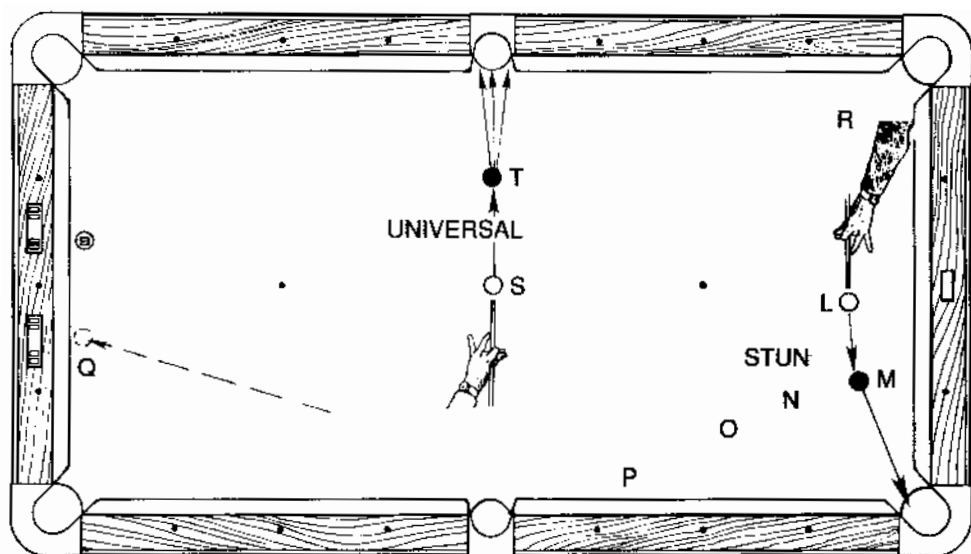
Diagram 8. Practice methods
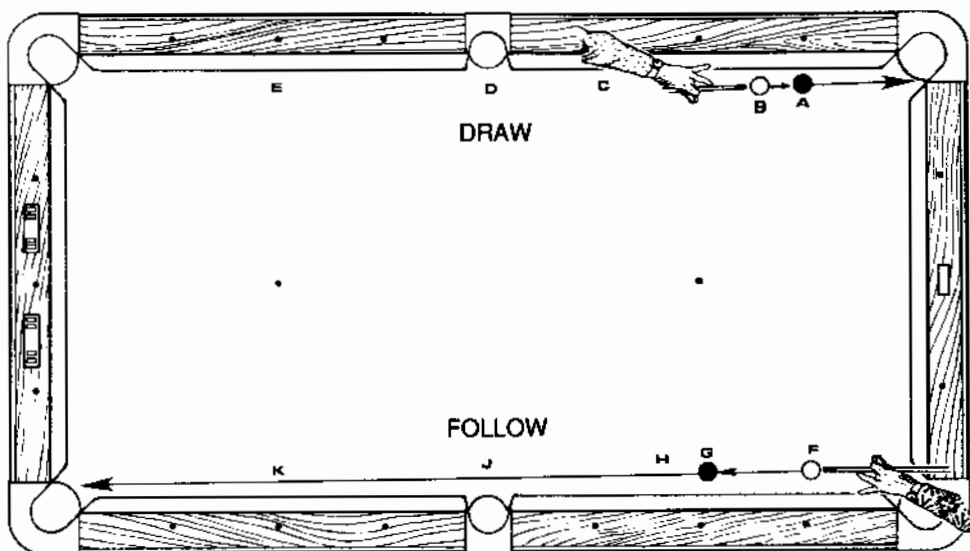
Diagram 9. Practice methods

your judgment of follow. The cueball is always placed at F to start. With the object ball at G, make it in the corner and try to leave the cueball at H, J, and K. It is possible to leave the cueball at H by shooting very softly, but you should also be able to do it using a lot of speed, hitting the cueball just slightly above center. With the object ball at J, follow to K.

It is easier to judge the length of the cueball's roll on follow shots than draw shots, a good thing to remember in nine ball when you have ball in hand.

It is absolutely essential to have command of the so-called stun shot, also called the dead-ball draw. It takes a certain touch. The idea is to make the cueball slide into the object ball with neither topspin or backspin; the result is that the cueball will then drift along the tangent line from the collision point. Again, it can be accomplished either with a firm stroke and a middle ball hit, or a softer stroke and a low hit. (When the shot is straight in, the cueball will stop dead, as in a stop shot.)

Study Diagram 9. With the cueball at L and the object ball at M, you should be able to pocket the object ball and make the cueball die at N or O or P, and you should be able to do it with fairly good precision. From the same starting position, you can use a harder stroke and a little right English to make the cueball end up at the other end of the table at Q for an easy shot at the 9-ball. Pretty easy when you get used to it, but can you leave the cueball at N, O, P, and Q when the cueball is farther away, at R? Success on this drill requires a good feel for the relationship between speed and distance.

In the middle of Diagram 9 is what I call the Universal Position Shot. The cueball is in the exact center of the table and the object ball is one

diamond away from the side pocket. From that position, through the use of varying speeds, spins, and hits (you can cheat the pocket as shown), it is possible to make the ball and send the cueball *to any point on the table*. Try it with a friend. Put a coin anywhere on the table and see how close you can come to it with the cueball in three chances. Then he has his turn. Mark the cueball stopping points with a damp finger.

I'd like to see a competition with shots like these among the top players, perhaps as a special feature at a tournament. It would sort out the shotmakers from the position players and it would demonstrate why it is that the pros get so many easy shots.

How to Teach Position Play

We all know players—maybe members of a local bar league team, maybe somebody who shows up at the billiard room only occasionally—who haven't yet realized that thinking ahead is often just as important as pocketing the ball. Some are fairly good shotmakers and have been playing socially for years, yet rarely put together a decent run. How can you get them to pay more attention to cueball control? The examples in this section will help because they lead to immediate results. (I assume you know a pastime player who is willing to learn and listen; not all are.)

Place the 4, 5, and 8 as shown in Diagram 10. Position the cueball exactly between the 4 and 5. There are thousands upon thousands of social players who have trouble ending a game of eight ball from this position.

Diagram 10. Position play
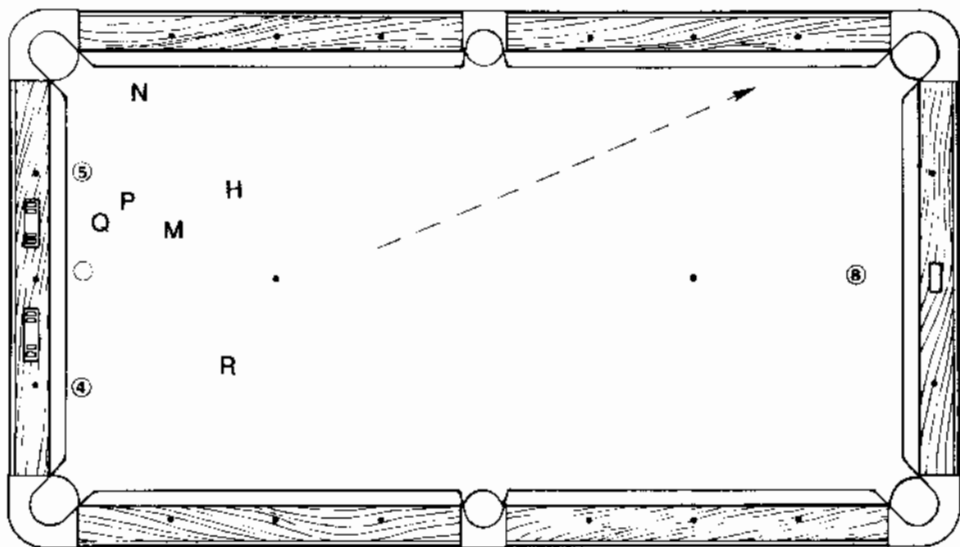
Before doing any teaching, see how many times your student can do it in, say, five tries.

The key, of course, is getting an angle on the second ball, which depends on the ability to put a little follow or draw on the cueball, skills you might have to teach some students. If the 5 is a little farther from the rail than the cueball, or if the pockets are "easy," draw the cueball to M, from which point it is easy to cut in the 4 and send the cueball along the dashed line to position on the 8. Once the student can do it, block the pattern with a ball at P. Now what? Follow to N and out to H.

A good method of teaching the value of advance planning is to set up several balls and hand the cueball to the student for placement, which is advocated by Jerry Briesath of Madison, Wis., perhaps the premier teacher in the country. In Diagram 10, a good spot for the cueball is Q, from where it is easy to pocket the 5 and bring the cueball to M for the desired angle on the 4. An additional point you can make with this diagram, if you think your student is ready for it, is that it would be better to shoot the 4 first and end up at R rather than H because the 5 is easier to reach for a right-handed player.

In Diagram 11, the challenge is to make the 6 and 7 and get the cueball to the other end of the table for the 8 (not shown). A stop-shot on the 7 is a blunder because then the 6 is straight in. A stop-shot on the 6 is good because the 7 can be cut in and the cueball sent off point W on the rail and down the table. Once the student understands, block the path with a ball at S. Now a way out is to shoot the 7 and follow to point T, which provides an angle on the 6. And if a ball at U interferes? Shoot the 7 first and draw the cueball to V. The use of draw to avoid a straight-in shot, it depresses me to report, is a novel concept to many.

Diagram 12 shows a 7-ball near the side and the 8 at the left end. After placing the balls, hand the student the cueball and ask where he would put it to run out a game of eight ball. Is the problem too simple? No. Try it on players not accustomed to thinking ahead and you'll see. Probably the safest plan in Diagram 12 is to place the cueball at K and send the cueball on the indicated path. If that path is blocked, the cueball can be put at H and sent to M with follow. And if that can't be done because of the opponent's balls, the cueball can be put at P and sent three or four rails to the area around M (part of the path is shown by dashed lines). Prediction: the first time your student tries the latter path, he will hit the 7 too full.

The position in Diagram 13 arose in a professional tournament at the Jointed Cue in Sacramento. A very fine player had ball in hand. The 4 was near the corner pocket and the 5 was at the other end of the table (out of the diagram). Perhaps because of tournament pressure (it's easy to think clearly in the bleachers), he failed to think of putting the cueball on the lip of the pocket and playing the 4 in the other corner pocket. The position

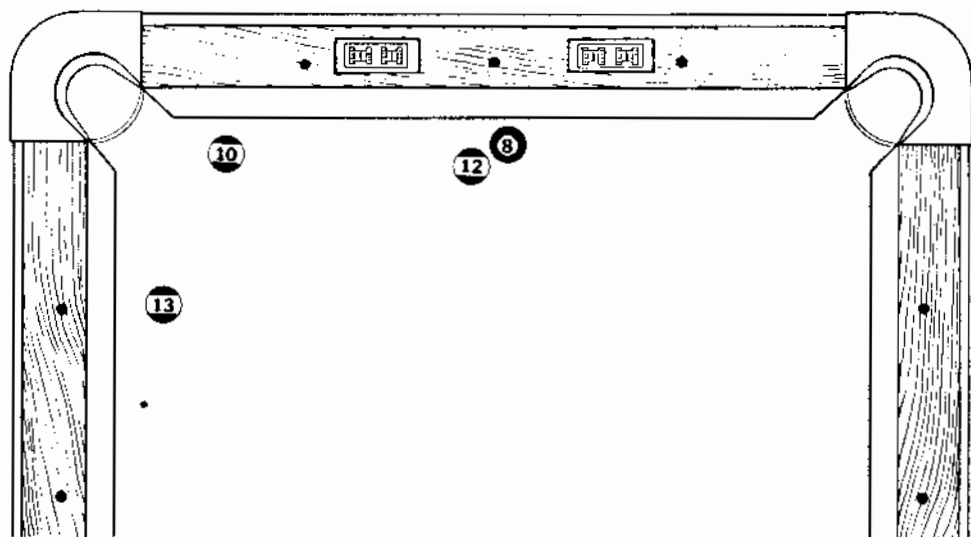Diagrams 11, 12, and 13: Position play
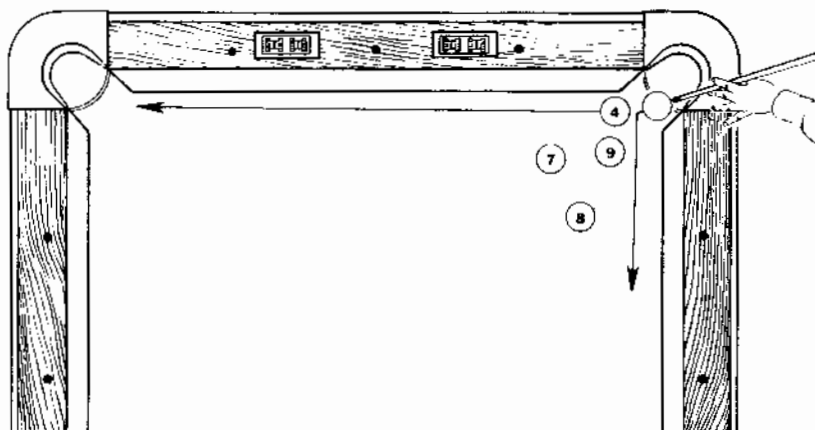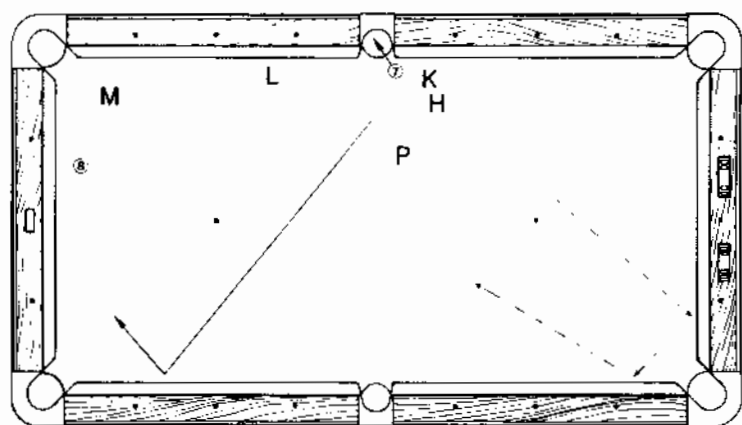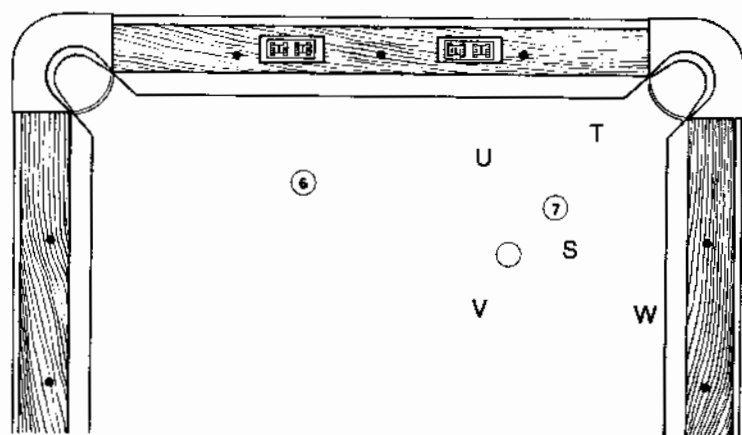
Diagram 14. Position play

can be used as a challenge with fairly good players. Jump shots can be blocked with extra balls.

Then there is the common problem of breaking up clusters. Diagram 14 is a position of heavenly simplicity. If your student had cueball in hand in a game of eight ball, would he know where to put it? (Ball in hand is typical of nine ball, but the kind of student I am thinking of tends to respond better to eight-ball examples.) The correct answer is to put the cueball on the dot shown near 13. From there the 13 can be pocketed and the 12 and 8 lightly spread. The 10 makes it easy to get position on the 12.

The point of the examples given here—and others you can make up yourself—is that pool requires thinking as much as hand-eye coordination. A little foresight often results in a series of simple shots.

How to Aim Carom Shots

To call yourself a player, you have to be able to stop the cueball dead on straight-in shots of any length. It's not easy at a distance of, say, five feet. Very often, a cueball that drifts even an inch after contact with the object ball will stop a run. If you can't stop the cueball absolutely dead, especially on short shots, practice until you can, for the technique is essential in top-class play. You can't completely kill the cueball on cuts, but you can make some great caroms with the same "stop action."

Stop action results if the cueball is sliding when it hits the object ball: no backspin and no topspin. You have to be able to make the cueball slide

into the object ball over a wide range of speeds if you want to stop it dead on straight-in shots. A very low hit and soft speed will do it, as will hard speed and a hit just slightly below center. Why you have to be able to do it all ways becomes apparent when the shot isn't straight in. The position player has to be able to judge the distance the cueball will travel after the hit, which is a function of speed, and the carom player has to be able to judge the cueball's direction, which depends on the degree of cut.

If the cueball is sliding when it reaches the object ball on a cut shots, then it will travel along the "tangent line," which is the line at right angles to the line formed by the balls at the instant of contact. Another way to think of it is this: On a cut shot, if the cueball is sliding at contact, the two diverging ball paths form a right angle. (The angle is slightly less than 90 degrees because of "throw," and because balls are never perfectly elastic, but I'll ignore that to simplify the explanation.)

Some readers may wonder what happens when the cueball has topspin or backspin on cut shots. In those cases the cueball starts out along the right-angle line, then bends forward or backward. Here we'll stick to straight cueball paths, which result from zero spin.

Take the position in Diagram 15. To hit the 4-ball and make the 9 with the cueball requires finding the tangent line, driving the 1 ball at right angles to it, and hitting the cueball so that it's sliding when it contacts the 4. One way to find the tangent line is to rest the tip of your cue on the cloth at
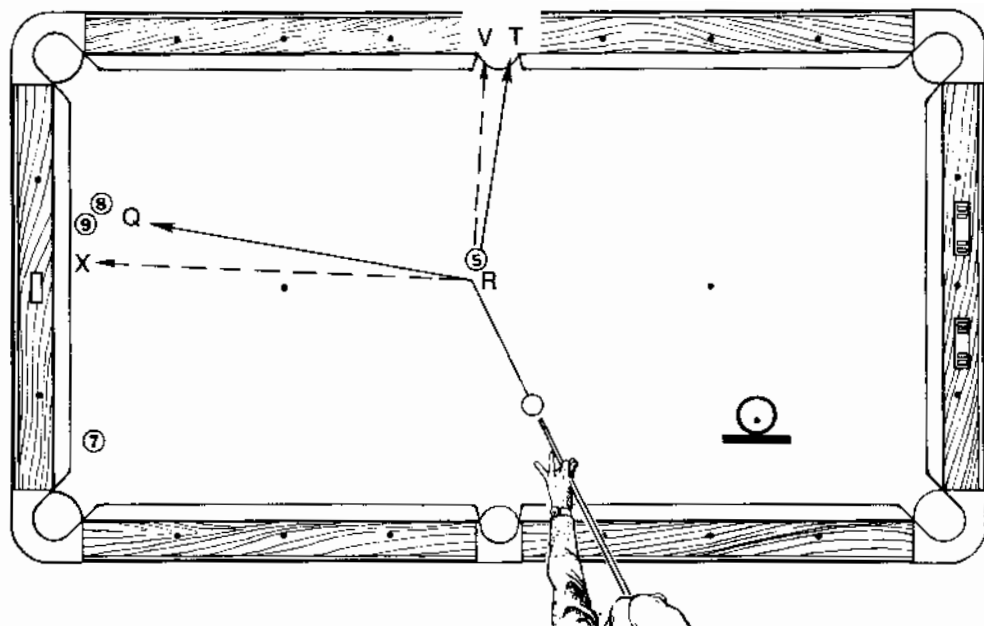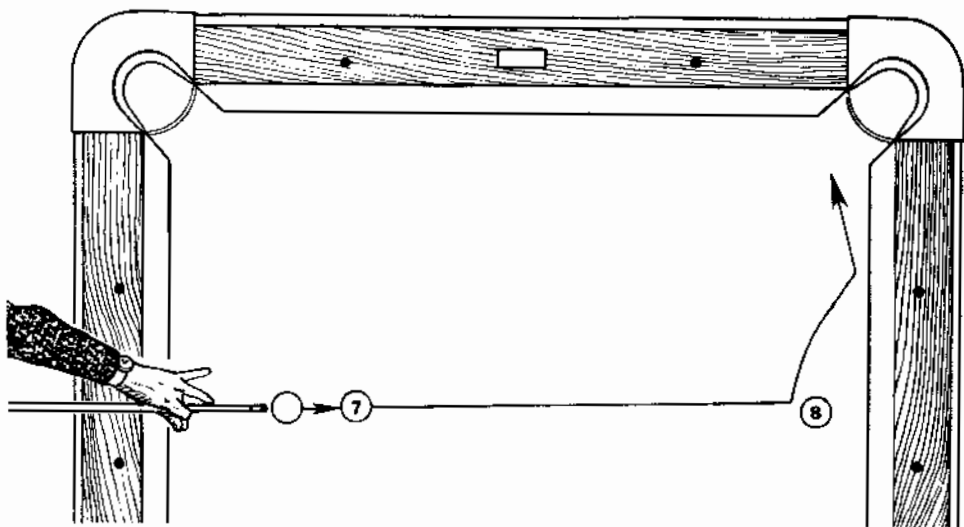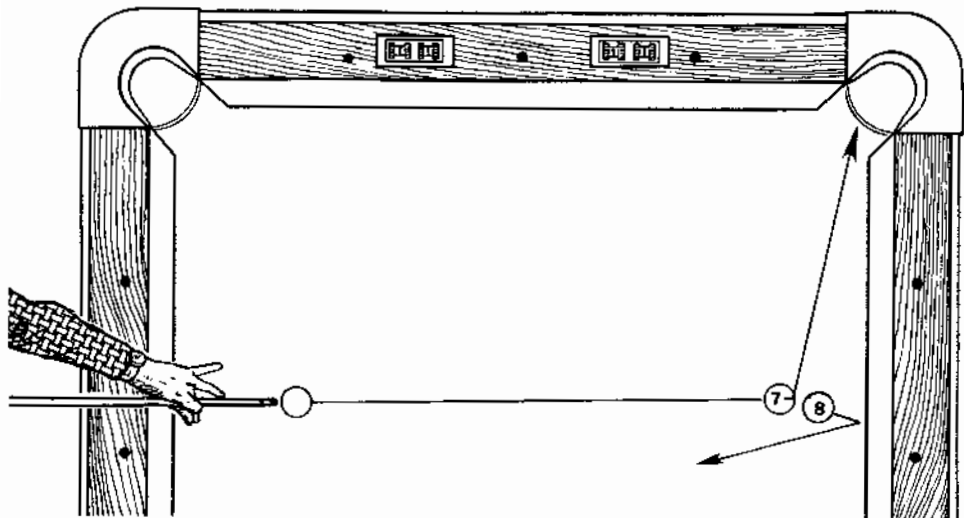
Diagram 15. Carom shots
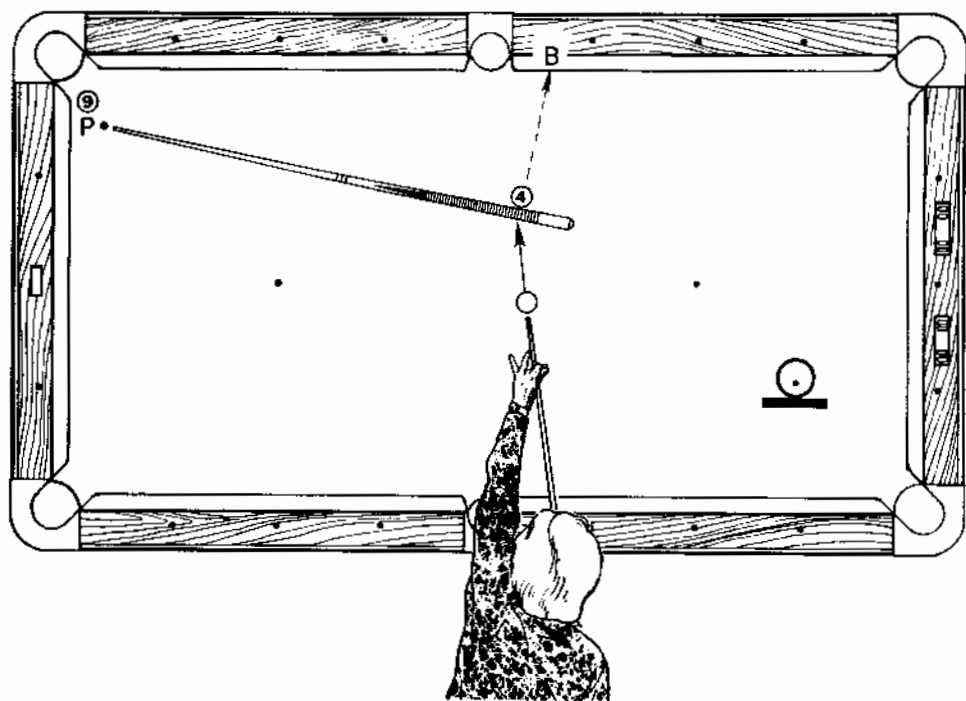
Diagram 16. Carom shots

point P, which is a point over which the cueball must pass to cut the 9 in, and pivot the butt toward the 4 until it almost touches it. The center of the cue is now the tangent line. Next, project a line through the 4 at right angles to the cue, and mentally locate point B, where the line crosses the rail. If you can drive the 4 into point B with stop action (slide) on the cueball, the carom will be successful.

In Diagram 16 the game is also nine ball. The task is to cut the 5 into the side and break up a cluster on the end rail. If the cluster is at point Q, as shown, then drive the object ball into the right side of the pocket with slide on the cueball, because QRT is a right angle. If the cluster is at X, use the left side of the pocket because XRV is a right angle. The calculation is fairly simple and is within the reach of pastime players. Master players can hit a cluster anywhere on the end rail by using various amounts of follow and draw and judging the resulting curved cueball paths.

In Diagram 17 there is a carom even weak players can make. Hit the 7-ball head on at a reasonable speed and it will carom off the 8 into the corner. In Diagram 18 the geometry is the same but several feet of distance have been added between the 7 and the 8. If you drive the 7 into the same spot on the 8, you must shoot very hard. Why? So the 7 will still be sliding when it hits the 8. If the 7 has time to pick up natural forward roll on its way to the 8, its path leaving the 8 will be curved because of the topspin and may look as drawn, which is a miss.

Note that I have changed my shirt for each diagram. That's not necessary unless you sweat a lot.

Diagrams 17 and 18: Carom shots

The Throw Effect on Cut Shots

For years I wondered why balls "throw" off the line indicated by contact points only when they are frozen or nearly so. I also wondered why beginners tend to hit object balls too thick more often than too thin. Could it be that throw is involved whenever balls collide, even on simple cut shots? Every top player I mentioned the possibility to looked at me as if I didn't have both oars in the water.

In 1981 I tested my suspicions in a systematic way. The results were startling. I think they destroy some widely held myths about the proper way to aim a cut shot. They also show that top players tend to use outside English on cut shots not for reasons of affectation but because they have learned

unconsciously that they must nullify the throw effect if they want to hit the theoretical contact point and still make the shot.

My inspiration came from browsing through the excellent book *How I Play Snooker*, by England's great Joe Davis, first published in London in 1949. Davis goes into tremendous detail on such fundamentals as grip, stance, and stroke. In a section called Finding the Angle he dismisses what he calls "one of the most popular tips in the game," that of aiming the cueball at the center of an imaginary ball frozen to the object ball at the point opposite the pocket. I sat up straight when I read these words because I suggested that very thing in *Byrne's Standard Book* for beginners who can't get the hang of cut shots. Davis writes: "It is a very plausible theory, but it happens to be untrue. It might stand you in good stead when the object ball has only a foot or fifteen inches to travel to the pocket; if any more it will let you down. I have tested the theory very thoroughly, placing a ball in the (combination) position, carefully lining the cueball on it, and sending it there with all the care and skill I possess. Further, I have induced others to try. In my experiments I have found that sighting on this principle is always too thick . . . and you can take it that I have made my tests as nearly foolproof as is humanly possible."

He drops the subject soon after and doesn't relate it to the phenomenon of throw with frozen balls, but he gave me the incentive to get to a table and run some tests of my own. I felt I was onto something important. I wanted to see if a cut shot threw as much as a frozen two-ball combination at the same angle, as I suspected, and Davis had given me a simple way of finding out.

The subject here discussed is of vital importance to three-cushion players as well as pool players. A misunderstanding of what direction an object ball will travel after an impact leads to kiss-outs. For pool players, it means balls failing to go into pockets.

Look at Diagram 19, shot number 1. This was my first experiment.

Freeze the 1 and 2 so that the combination line (the line of centers) is directed through the center of the corner pocket. Place the cueball as shown. The 1-ball represents the imaginary ball; that is, where the cueball will be at the moment of contact if the 2 is to be cut to the corner pocket, according to the theory I am trying to debunk. Aim the cueball at the dead center of the 1, use no English, and when you feel your stroke and aim are grooved, ask a friend to remove the 1. Pull the trigger and you will find that the 2 hits the rail around the point marked A. The 2 was thrown by a cueball with no English. Set the combination up again and shoot it as diagrammed without removing the 1-ball. Again the 2 will hit the rail at A. The throw is the same in each case.

Excited, I called the man who serves as my technical consultant in matters like this, Bob Jewett. When I described on the phone what I had
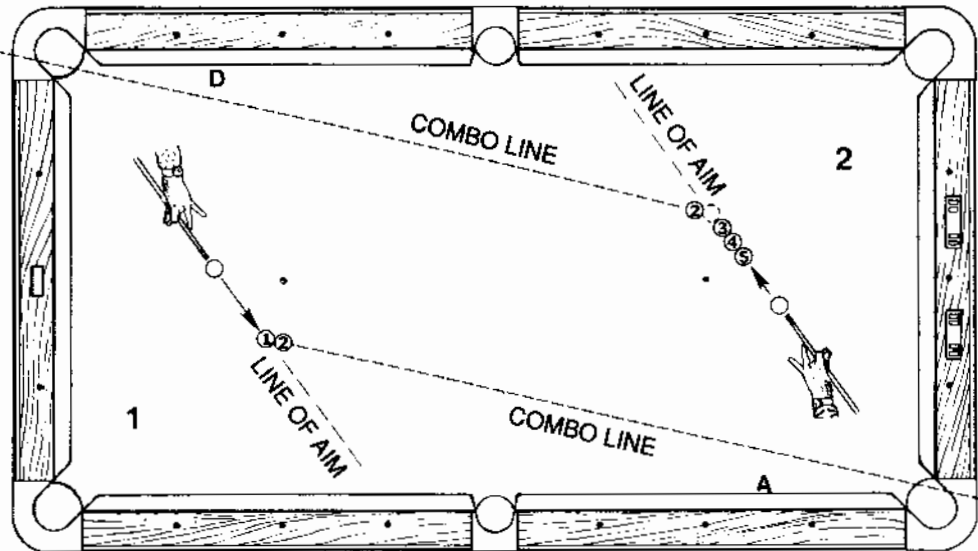
Diagram 19. Throw shots

done, he thought for a moment, then suggested that maybe I had unconsciously influenced the results by altering the hit on the object ball. He said a better test would be to use a three-ball combination, which would remove all doubt.

Back at the table, I set up shot 2 in Diagram 19. You can do it, too. Use the side of a wooden triangle to form a straight line of four frozen balls. Freeze the 2-ball to the end of the line so that it is aimed directly into the corner pocket. Now remove the ball it was frozen to, shown in the diagram by a dashed circle. As you can see, if you drive the cueball into the 5, the 3 pops out of the other end and must occupy the precise space the imaginary ball was in. The 3 must contact precisely the point on the 2 opposite the corner pocket. Shoot and you'll see that the 2 will hit point D.

Using the same experimental setup, I thought of a further confirming experiment. Look at Diagram 20, shot number 3. The 1, 3, 4, and 5 are frozen together in a straight line. The 1 and 2 are aimed at a point on the end rail so that if the cueball is driven into the 5 the 2 will be pocketed. Try the combination a few times to find out where the 2 must be aimed to be made. (The point will vary with the stickiness of the balls.) Once you have found it, set the arrangement up again and carefully remove the 1-ball. Shoot the 5-4-3 combination into the 2 and you will find that it will throw into the pocket just as if the 1 was still there.

Friction between the balls is sufficient to carry the object ball slightly off line as well as to impart a slight spin to it. Throw is insignificant on full hits because the object ball is not given a sideways "rub." It is insignificant on very thin hits because the passing ball is not in contact with the object ball long enough for the friction to act; also the balls are not pressed together
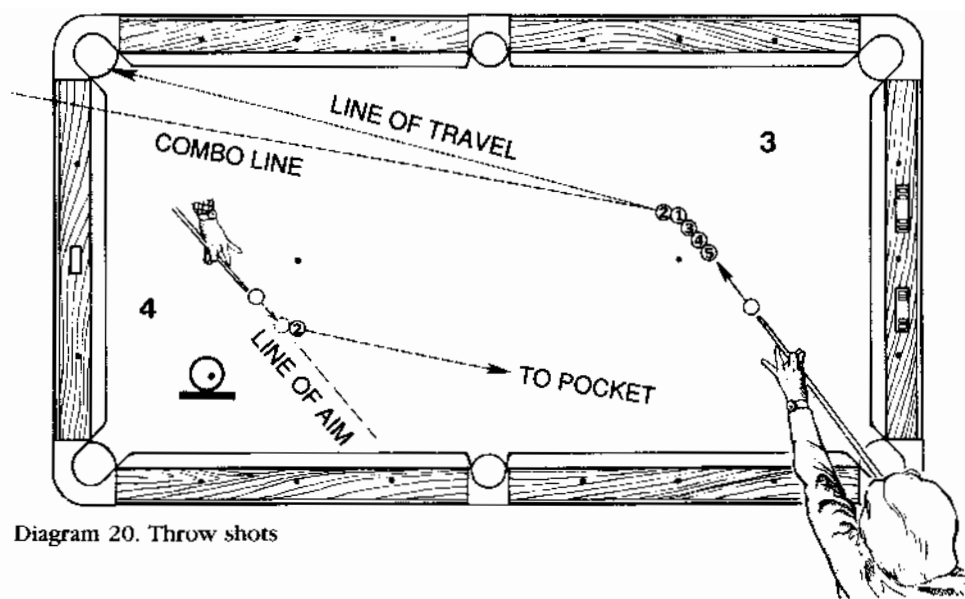
Diagram 20. Throw shots

hard enough for solid contact to be made. This reasoning can be tested.

Set up shot 4 in Diagram 20, which is the same as shot 1. Aim a two-ball frozen combination at the corner pocket. Aim directly through the center of the first ball, and when you are ready to shoot have a friend remove the first ball. This time, though, use right English so that when the cueball hits the 2-ball there will be no "rubbing" action. (The amount of English, of course, to eliminate rubbing entirely depends on speed and the angle of cut; just use judgment.) This time when you pull the trigger you will either make the 2 or come awfully close to it. The outside English has nullified the throw. Now we know why you so often see top players using outside English to "cinch" a shot when position is not critical. (In shot 4, I have placed the cueball quite close to the object ball so that allowing for the curve of the cueball induced by the spin is not an important factor.)

There is a final test. Set up shot 5 as given in Diagram 21. To make the arrangement, first put the cueball on the spot. Set the combination lines so they cross the edges of the pockets to reduce the margin of error. Now back the cueball off three inches. If you shoot between the balls trying to hit them simultaneously, neither one will go because they both will be thrown. The amount of throw will be the same as if you had a third ball on the spot, where the cueball was, and shot into it. Now set the balls up once more. Shoot between them again trying for a simultaneous hit, but this time use side spin. With left English the 1 will go in and the 2 will not. With right English the 2 will go in and the 1 will not.

What further proof is needed that the vast majority of pool players haven't been approaching cut shots correctly?
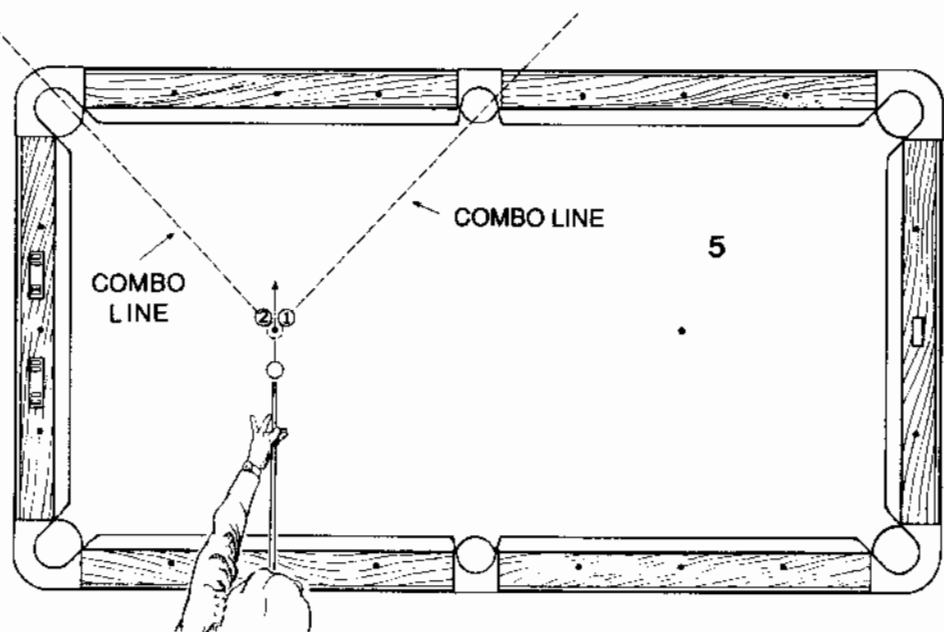
Diagram 21. Throw shots

The Secret of Making Rail Shots

It is surprising how little top players have to know about the physics of the game they play so well. Some carry around notions that are just plain wrong, such as that the cueball on a draw shot goes a short distance through the object ball before backing up (that happens only with a heavy cueball or one that has left the cloth) or that on a follow shot the cueball bounces backward off the object ball before going forward (that happens only when the cueball is lighter than the object ball or when the object ball is supported, as it is on the break shot). Many players use "systems" for certain shots, systems that turn out to be false when analyzed closely. Not too many top players will admit that they play almost entirely by instinct or judgment. One player who would was the late Luther Lassiter. Once when he was in Sacramento, Calif., for a tournament, I asked him if he could find time to give me a few lessons. He replied: "I don't give lessons because I don't know what I'm doing."

I will show you now how to make a shot that is incorrectly described in every instruction book that mentions it. The shot is pocketing a ball that is frozen to the rail. The student is routinely told to hit the ball and the rail at the same time. Such advice may be good enough for beginners, who shouldn't be burdened with too many fine points at the start, but the truth is that when no English or inside English is used the rail must be hit first.

Let's eliminate shots where the frozen ball is only a foot or two from the corner pocket, or where the pockets are easy, or the object ball is encouraged to stay on the rail by a groove in the cloth or by a table that isn't level. The margin of error is so great in those cases that little is proved

by experimentation. Consider instead a shot where great accuracy is required, like the upper shot in Diagram 23, which calls for cutting a ball along the rail past the side pocket. If the pockets are tight, the cloth is new, and the table is level, how many times can you make that shot in ten attempts? If you aim to hit the rail and ball at the same time, you will be lucky to make it two or three times in ten. If you hit the rail slightly first, you can quickly learn to make it eight or nine times in ten, as I did.

First, a review of the previous chapter. At the top of Diagram 22, the 1-ball and the 2-ball are frozen and aimed at the pocket at A. If you shoot a cue-ball directly at the center of the 1-ball, as shown, the 2-ball will be thrown forward and will hit the rail near T. That is common knowledge. Now try this: Aim at the precise center of the 1-ball with no English, and just before pulling the trigger ask a friend to remove the 1-ball. If you shoot without changing your aim, the cueball at the moment of contact will occupy the same space as the 1-ball did and the contact point will be exactly opposite the target, just as the instruction books and teachers advise. Yet the 2-ball will hit the rail at T, just as it did when it was part of the combination. If you use outside English (right, in this case) the 2-ball will not throw because the surface of the cueball will not rub against the surface of the 2-ball.

At the bottom of Diagram 22 is a familiar challenge or "bar bet" shot. If the 3-ball combination is struck as shown, the 5-ball will not stay on the rail—it will rebound along the line marked R. The 5-ball will stay on the rail only if the contact point between 4 and 5 is moistened (secretly if you are trying to rob somebody). The point to be made here is that the 4-ball is touching the 5-ball and the rail at the same time, which is exactly where the conventional wisdom suggests the cueball should be if you were simply cutting a single 5-ball up the rail. Yet the 5-ball diverges from the rail. The reason is that it is thrown into the rail and rebounds from it.

Set up the same 3-4-5 combination, but this time don't freeze the 4 and 5. Leave about a one-fourth-inch gap between them. Now hit the 3-ball and the 5 stays on the rail! This demonstration proves the thesis, which is that to run a ball down a rail the rail should be hit first. (In the three-ball combination, the size of the gap depends on how hard you hit it.)

Look again at the cut shot at the top of Diagram 23. To make it consistently, first aim to hit the rail and the ball simultaneously, then change the aim slightly to favor the rail. Don't shoot too hard. No English is needed, but inside English (left, in this case) enables you to hit the rail farther from the object ball than would be the case without English. I'm talking fractions of inches here—hit the rail just *slightly* first.

Why does it work? The explanation is in Diagram 24. Because the object ball throws on simple cut shots, you must slightly overcut them (unless you use outside English). There are two ways that can happen if you hit the rail first. At the left the cueball is shown at the moment of contact with the
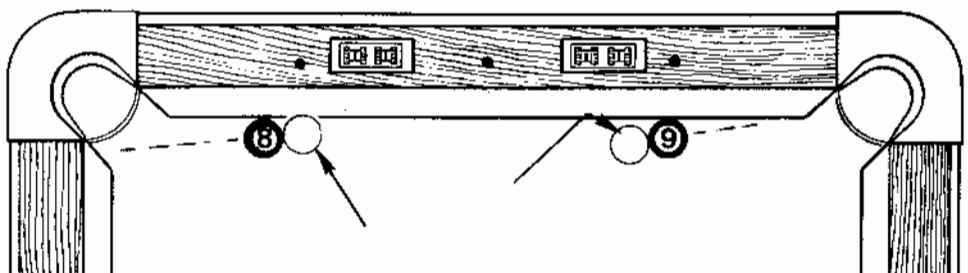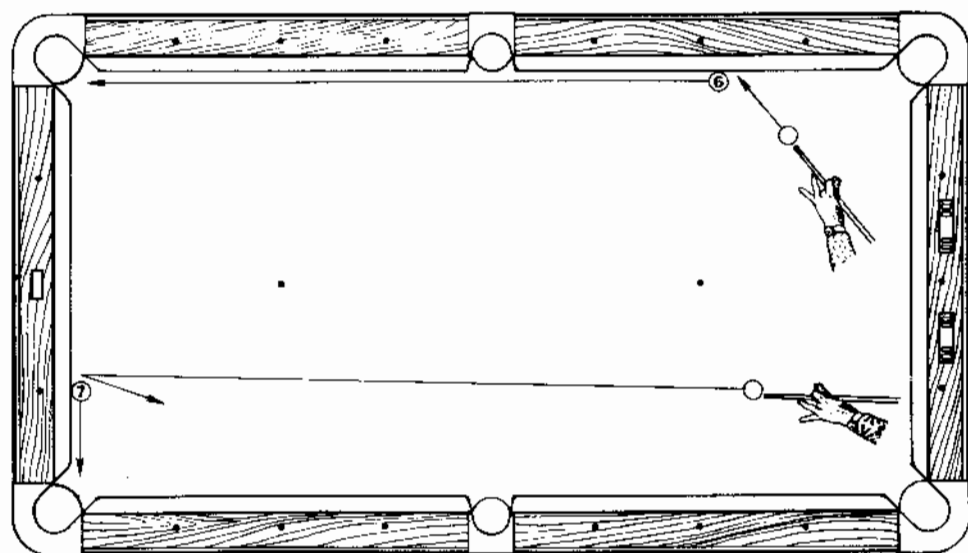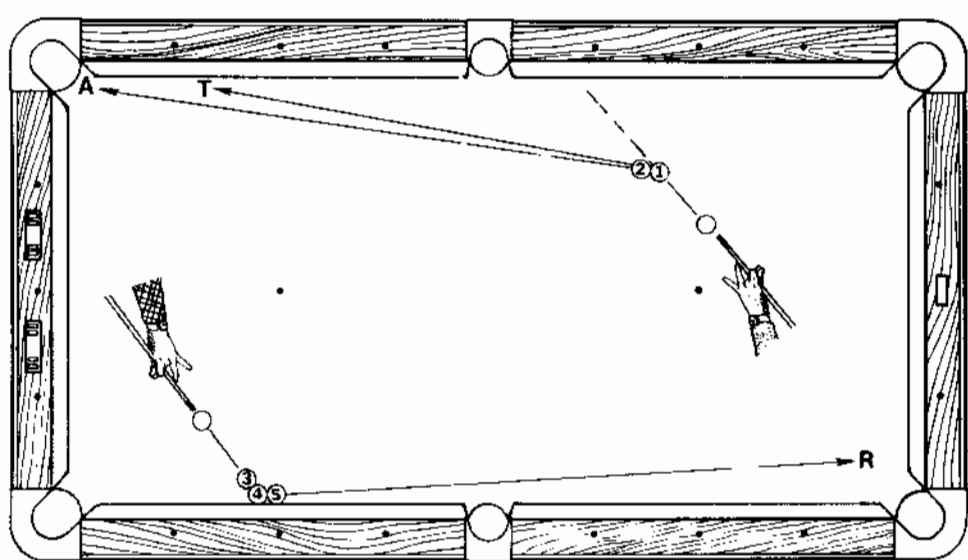
Diagrams 22, 23, and 24: Rail shots

8-ball. The line of centers (dashed line) diverges from the rail, but since the cueball is sinking into the rubber, depressing it more and more, the 8-ball will be thrown into a path parallel to the rail. At the right, the cueball is shown contacting the 9-ball, but after it has depressed the rubber and is rebounding away. This time the line of centers converges with the rail, but since the cueball is leaving the rail the throw effect will act in proper direction and the 9-ball will travel parallel to the rail.

A related shot is the familiar right-angle cut shown at the bottom of Diagram 23. Several books reveal that the secret is to hit the rail first with plenty of English, but none gives the correct reason. When the cueball hits the 7-ball it is emerging from the rubber—the hit is slightly thinner than the geometry it calls for, which is just what you want on a cut shot.

A final note. When the balls are dirty or greasy or covered with chalk, the throw effect is much greater than it is when the balls are clean. The only way to avoid having to guess at how much to allow for throw on cut shots and combinations is to brush the table, wash your hands, and clean the balls before starting play.

When to Cut and When to Throw

It's possible to cut a ball to the left with a level cue and make the cueball go to the left as well, as impossible as it seems. Before explaining how, I want to make sure you understand the underlying geometry and physics.

If you ignore friction between the balls, picking the correct contact point on an object ball is a simple matter: it's the point farthest from the target. Let's say the target is a pocket. Imagine a line from the pocket to the center of the ball and extend it through the ball until it emerges on the other side—that's the contact point. If the cueball hits it, then the object ball will travel along the imagined line to the pocket.

Unfortunately, friction must always be considered, and the effect it will have in throwing the object ball off line can never be calculated precisely. Sticky balls throw more than clean ones. Once a good player is used to the balls, though, he can estimate the amount of friction and throw within a fairly narrow range, often unconsciously.

Ball-to-ball friction complicates the game, but it also increases the player's options when controlling the cueball.

The most basic application of throw on a cut shot is shown at the left of Diagram 25. A beginner might decide that the black ball can't be cut in because of the interfering ball; the point on the black ball farthest from the target is masked by the other ball. A more experienced player knows that
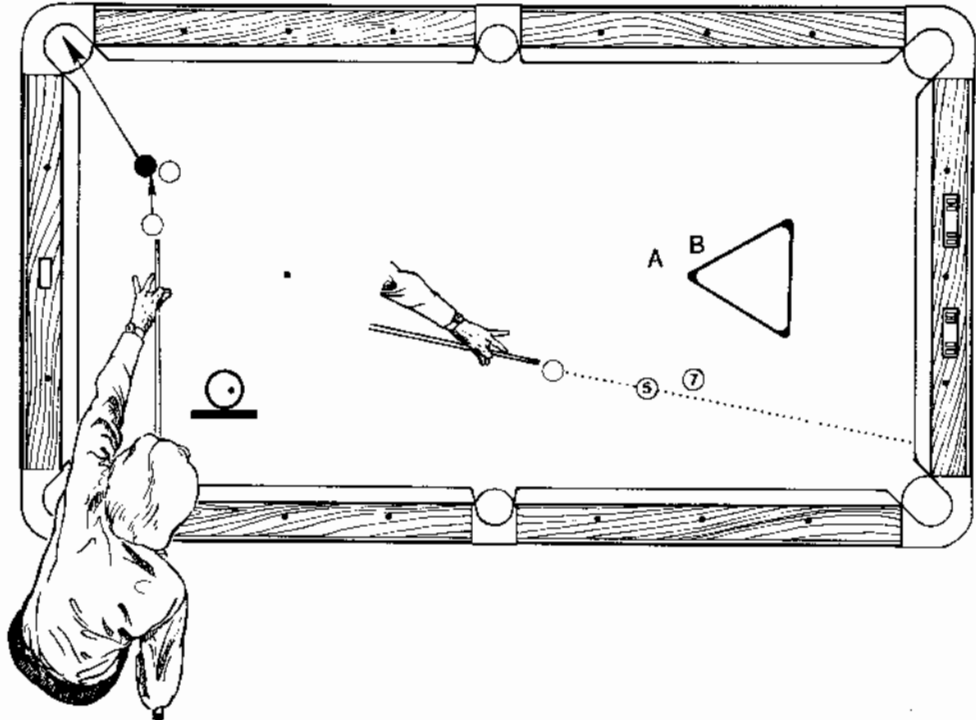
Diagram 25. Throw and cut shots

the ball can be made easily with right spin on the cueball, which throws the object ball to the left.

An advanced application of throw is reducing or increasing the cueball's sideways drift on a cut shot. Consider the shot at the right of Diagram 25. The game is straight pool. The problem is to make the 5-ball and still have an angle on the 7-ball so it can be used to break the pack. It is much better in a case like this to shoot almost straight at the object ball and throw it to the right with left sidespin; if done properly the cueball will move only a little to the left after hitting the object ball.

Or the player may want to maximize the sideways travel of the cueball. In the same position, using right spin on the cueball and a slightly below center hit, the player can overcut the object ball, counting on the sidespin to throw it back on line, and get the cueball to move to the vicinity of A for an angle on a break ball at B.

Now for the solution to the problem posed at the start, cutting a ball to the left and sending the cueball to the left as well.

At the top of Diagram 26, the cueball and the 3-ball are exactly one ball width from the rail. If the balls are only half an inch apart, you may be surprised to know that the 3-ball can be sent along the rail into the corner pocket while at the same time sending the cueball either into the same rail or all the way across the width of the table.

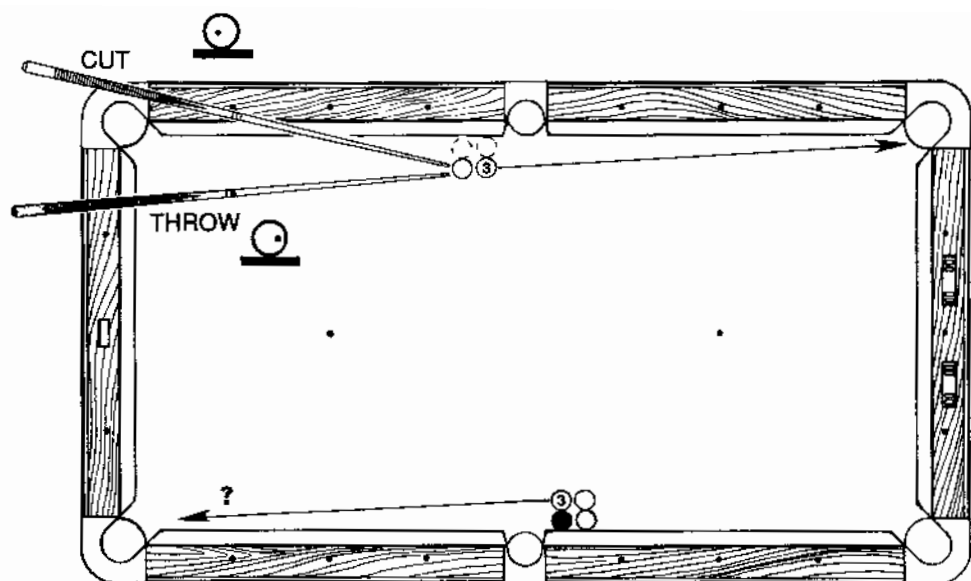To make the cueball drift to the left, use heavy right English and angle

Diagram 26. Throw and cut shots

the cue as if you were cutting the 3-ball *away* from the rail—the English will throw it back to the left and the cueball will go to the left as well. (Something similar, with the cueball frozen to the object ball, is given on page 88 of *Byrne's Standard Book.*) When correctly aimed, the butt of the cue crosses the end rail about six or eight inches from the corner. It is vital to keep the cue as level as possible, for a massé effect would work against you.

To send the cueball all the way across the width of the table, aim the shot as a cut with no English or overcut it with left English.

Many players don't realize that they have so much freedom of cueball action on this shot.

The farther the two balls are apart, the less freedom there is. If the two balls are a full ball width apart, you can still throw the ball into the pocket and make the cueball drift left, but only slightly. When the distance to the first ball is two ball widths, you can stop the cueball dead, but you can't get it to go left. At greater distances, the cueball will drift to the right.

When the distance between the balls is several feet, accuracy becomes a problem. It is still possible to minimize cueball drift by using sidespin, but it becomes harder to make the shot. Many players use *slight* outside English on fairly long cut shots to minimize the throw effect, but to do it effectively they have to be able to allow for squirt (deflection of the cueball off the aiming line toward the side opposite the English) and curve. Each player must determine his own length-of-shot limits depending on his skill, tolerance for risk, and the shot's margin of error.

The position at the bottom of Diagram 26 is given as an item of curiosity, though gamblers might use it as a proposition bet. The cueball and the

3-ball are frozen to balls that are in turn frozen to the rail. The space between them is the width of a cube of chalk. Shooting crisply (no slow rolling), can the 3-ball be made into the corner pocket without moving the black ball? If the black ball even trembles, that counts as "moving," and the shooter loses the bet.

It turns out that if you try to cut the 3-ball in, the black ball will at least quiver. If you shoot straight at the 3 and throw it to the left with right English, the black ball is untouched. The balls compress enough so that the 3-ball is clear of the black ball before it is thrown.

Twenty Keys to a Killer Break

Want to be a consistent winner at eight ball and nine ball? Then you've got to have a crushing break. Players who can splatter the balls all over the table without losing control of the cueball have a big advantage; very often they can run out the game without giving their opponents a chance.

You don't have to be a big brute to break the balls effectively. More important than bulging muscles is proper technique. After watching top pros in action for years, studying videotapes, and interviewing players known for their explosive breaks, I've developed a list of tips. If your break doesn't improve after putting these ideas in action, maybe you should try darts, where accuracy is all and power doesn't count.

1. **Form a looped bridge.** An open or "V" bridge is okay for most pool shots, but when you intend to thrust the cue forward with maximum speed, you'd better circle the cue with your forefinger—it's the only way to make sure the cue will stay on line.
2. **Lengthen your bridge.** Plant your bridge hand on the table a couple of inches farther away from the cueball than you would for a soft shot, say eight or ten inches instead of six or eight. You need extra room for a longer backswing.
3. **Change your grip.** Move your grip hand three or four inches closer to the back end of the cue and grip it firmly to make sure it won't slip. Some players feel that a tight grip using all four fingers adds part of the weight of your arm to the weight of the cue, but the point is arguable.
4. **Forget your wrist.** Whether or not your wrist is locked or loose is unimportant.
5. **Adjust your stance.** If you usually shoot with your chin within a few inches from the cue (which is best for accuracy), stand up a little straighter on the break shot.
6. **Control your stroke.** Take a few vigorous warm-up strokes to prepare yourself for unleashing maximum power and to refine your aim. The

final back swing should be long and slow, like drawing an arrow back in a bow.

7. **Time it.** A good break depends in part on proper timing. The cue should reach its greatest speed at the moment of contact with the cueball. Easier said than done.

8. **Explode.** When you decide to pull the trigger, think of a bomb going off. Try to explode the cue into the cueball.

9. **Follow *straight* through.** The cue tip should hit the cloth a foot or two in front of the cueball. If you consistently follow straight through, then you will consistently send the cue into the cueball accurately.

10. **Freeze.** Lunging on the break adds little or nothing to the speed of the cueball and interferes with accuracy. Better to keep your body still and your head down.

11. **Use the right cue.** A heavy cue isn't necessarily better for breaking because it's harder to control and can't be brought forward as fast as a lighter cue. A powerfully built man can perhaps get more cueball speed with a cue weighing 22 or 23 ounces, but 20 or 21 is the limit for most players. Many pros are now breaking with cues as light as 18 ounces, an ounce or two *lighter* than their regular cues.

12. **Don't elevate.** Keep the cue as level as possible; otherwise the cueball will jump too far off the cloth. Because the butt of the cue is bound to be elevated slightly on the break shot, a really powerful stroke will force the cueball to jump. A jumping cueball is hard to control and often lands on the floor.

13. **Use a hard tip.** The harder the tip the better on the break, for the same reason that hammers are made of steel rather than rubber: the energy absorbed at impact is immediately returned.

14. **Use a stiff cue.** All cues vibrate when struck, but stiff cues vibrate less than flexible or spindly ones. With less energy lost to vibration, more is left to transfer to the cueball.

15. **Avoid sidespin.** Make sure the cue tip hits the cueball exactly in the center or a little below. Sidespin makes the cueball deflect from the aiming line, which makes a direct hit on the pack impossible. Concentrate hard on avoiding sidespin.

16. **Kill the cueball.** Ideally, the cueball should move only a foot or two after hitting the pack. When that happens, almost all of its energy has been imparted to the balls. Strive mightily for a dead-square hit on the apex ball.

17. **Don't scratch.** Scratching is the worst thing that can happen on the break. Avoid it by getting as square a hit as possible on the pack. Don't let the cueball run around the table looking for a pocket.

18. **Relocate the cueball.** Many pros are now breaking from the side of the table rather than the center. The theory is that there is less chance

of scratching in one of the side pockets, there is more chance of making the apex ball in the side, and there is a better chance, in nine ball, of getting the 9 moving.

19. **Practice.** Few players practice the break shot, maybe because they don't like to rack balls. A shot so important, though, deserves to be worked on. Even a small improvement will pay big dividends.
20. **Keep smiling.** Nobody's perfect, so don't let failure get you down. The best players in the world make a ball on the break in nine ball only three times in five, and they make the 9-ball only one time in 35.

Of all the elements that go into a good break shot, one towers over the others in importance: an accurate hit on the pack. Try above all else to hit the apex ball as squarely as possible. Even if you are so delicate and petite that your break shot wouldn't break an egg, the balls will spread well if hit squarely.

Searching for the Perfect Break Cue

The opening break is by far the most important shot in eight ball and nine ball, yet there is no general agreement on how it should be done. Should the cueball be placed in the center, a few inches from the center, two feet from the center, or so close to the side that you must bridge from the rail? At major tournaments you can find all of the above. You can also find a variety of grips, strokes, and stances.

Over the last couple of years, the cueball position on the break has been migrating toward the side of the table in nine-ball tournaments. Breaking from the side, players claim, tends to cut the chance of scratching, seems to get the 9-ball moving more, and increases the chances of pocketing the 1-ball. No studies have been done to support the claims.

Even the question of what cue to use on the break has never been settled. Should it be long, short, thin, fat, light, or heavy? Should you even use a different cue on the break? Nick Varner (who weighs only 115 pounds and yet has a powerful break) breaks with the same 19-ounce cue he plays with on the grounds that he doesn't want something unfamiliar in his hands for such a crucial shot. The disadvantage, he admits, is that his tip flattens and wears out too fast.

Not too long ago, most players thought that a heavy cue was best for the break; now the consensus is swinging in the opposite direction. Mike Sigel, to cite a conspicuous example, plays with a 20 and breaks with an 18.

What weight is best for the break? The goal is the greatest possible speed on the cueball and the squarest possible hit on the pack; the problem is that the harder you hit the cueball the less control you have over it.

I once tried to solve part of the problem with the help of field research and the laws of nature. Forgetting accuracy, what weight cue gives the maximum cueball speed? That was the question put to science. A cue weighing 1 ounce would crumple against the cueball; a cue weighing 100 pounds couldn't be brought forward fast enough. Somewhere in between was the ideal weight, and a band of courageous researchers tried to find it.

Experiments that were comical if not conclusive were conducted in my garage and driveway on April 18, 1989. While no members of the Nobel Prize committee were present, there was no shortage of frightening heavyweights. Assisting with cues of various weights, clipboards, calculators, and tape measures were Mike Shamos, who is a member of the physics faculty at Carnegie-Mellon in Pittsburgh; Bob Jewett, who is a research scientist for Hewlett-Packard; Tony Annigoni, who once beat Jim Rempe to win a nineball tournament in Sacramento, Calif.; and Lee Simon, who owns a store called Billiards Unlimited and is an expert on cues and tables. Several neighbors and passersby refused to identify themselves and threatened to call the police.

Here was the situation: Simon was setting up a pool table (a black-and-brass Gandy) in my garage. Before the rails were attached there was an opportunity to try an experiment suggested by Robert Callahan, a science professor at Morehead State University in Kentucky. In the absence of electronic equipment, a cueball's speed can be calculated by shooting it off the end of the table and measuring how far it flies before hitting the floor . . . or, in my case, the driveway.

I remembered most of the applicable ballistics equations from engineering school, but to make sure I had them right I consulted with Dr. George Onoda of IBM's Watson Research Center in Yorktown Heights, N.Y. It was Onoda who studied videotapes and oscilloscopes to calculate that the cueball averages about 24 mph when top pros break in nine ball. His results appeared in the April 1989 *Billiards Digest*.

The main equation for the Callahan test is simple: $S = 1.76D$ (approximately), where S is the speed of the cueball in miles per hour and D is the horizontal distance in feet measured from the end of the table to the spot the cueball hits the ground. This assumes that the table is 29 inches high. A cueball traveling 24 mph when it leaves the end of the table will land 13.5 feet away.

After the driveway was covered with blankets, we took turns shooting the cueball off the table as hard as we could, using six cues ranging in weight from 9.5 ounces to 25.9 ounces. Sixty-seven shots were taken and measured. Jewett recorded the results and later plotted them on graph paper. No cueballs were lost and no windows were broken. An average of 1.374 cans of beer was consumed per researcher.

The results were suggestive but not conclusive, partly because of the

inconsistency of the shooters (distances varied as much as 20 percent from shot to shot) and because we didn't have a cue for each step of the way in the sensitive range, which is from about 18 to 21 ounces.

Simon had the three best shots, reaching 23.72 mph with a 20-ounce cue, 23.29 mph with a 19.5 ouncer, and a surprising 22.85 mph with a 17.9 ouncer. Nobody topped 20 mph with the 25.9-ounce graphite "break" cue.

Two cueballs were used, a pool ball weighing 5.9 ounces and an ivory billiard ball weighing 7.35 ounces. The sixth and seventh greatest speeds (22.42 mph and 22.28 mph) were achieved by Simon using the 19.5-ounce cue and hitting the 7.35-ounce ball, which argues strongly in favor of the trend toward lighter break cues. The trials also argued against using a very heavy cue.

When Professor Callahan ran the same sort of test in Kentucky, he managed, in one glorious case when everything went right, to give the cueball a speed of 30 mph with a 20-ounce cue even though he weighs only 145 pounds. How did he do it? By practicing karate for 15 years. Throwing his body forward and twisting his torso so that everything reached top speed at the moment of impact added considerably to the speed of his cue. Accuracy, though, went out the window.

If you could bring a heavy cue forward as fast as a light one, you could break harder because the speed of the cueball depends both on the weight and speed of the cue. The formula is not complicated. To find out how fast the cueball will go after being hit by a cue, double the weight of the cue, multiply it by the speed of the cue, and divide the result by the sum of the weight of the cue and the ball.

As an example, say the cue weighs three times the ball (18 ounces to 6 ounces). In that case, the cueball will leave the tip at a speed 1.5 times the speed of the cue. If the cue weighs four times the ball (24 to 6), then the cueball will be given a speed 1.6 times the speed of the cue.

In other words, by adding 33 percent to the weight of the cue you are chasing only a 6.6 percent gain in cueball speed. And because you can't swing a heavy cue as fast, the potential gain is even less. When you also consider the importance of precision and control, which are easier to achieve with a light cue, then it seems to me there is no longer any argument. Light cues are best. Mike Sigel is right.

There is corroboration in the 1984 book *Sports Science*, by Peter J. Brancazio, professor of physics at Brooklyn College. While he doesn't discuss the break shot in pool, he minutely examines something similar, the collisions between baseballs and bats. On the subject of transfer of energy, he writes on page 230: ". . . it is more effective for the batter to put his effort into swinging a lighter bat at higher speed—or, in other words, that bat speed is a more important consideration than weight." And a light baseball bat, like a light cue, can be swung more accurately than a heavy one.

When the tests were over, the laboratory was destroyed by a mysterious explosion.

What weight bat or cue is best for you, of course, depends on the size of your wingspan, the strength of your arms, and whether or not you have a black belt in karate.

Want to do some research of your own? Then do what I'm going to do next time: Use a radar gun.

Note: In addition to the gentlemen named above, I wish to thank Pat Fleming and David Howard for educational discussions on the break shot.

The Truth about Bank Shots

More baloney has been written about bank shots in pool than almost anything else in life. Most books that discuss the subject state or assume that the angle of incidence equals the angle of reflection, which is true if you are dealing with light rays bouncing off mirrors but not pool balls bouncing off cushions.

The point is easily proven on a billiard table. Freeze the ball in a corner and shoot it without English in the midpoint of the opposite long rail. It will not bank into the other corner as the equal-angle predicts. It will go "long" and will hit the short rail at least a half-diamond from the corner. The reason is the natural roll on the ball, which causes its path to bend forward after leaving the first rail. If you hit the ball hard enough so that it slides rather

than rolls into the rail, the rebound angle more closely matches the angle of approach.

The same thing is true on a pool table when you try to bank an object ball. If you hit it so hard that the object ball doesn't have time to begin rolling naturally before it hits the rail, it will come short. That bank shots are shortened by increased speed is widely known, but the reason has never before appeared in print.

Also rarely, if ever, written about is the tremendous effect English has on bank shots. The English can be imparted to the object ball either by cutting it or by spinning the cueball. An understanding of the principle will greatly shorten the time it will take you to become a good banker.

As you now know, on simple cut shots the object ball gets "thrown" just like a two-ball frozen combination—unless outside English is used, which eliminates the friction when the cueball hits the object ball. In other words, when using center ball or inside English on a cut shot, you must slightly overcut the ball. The same factor must be considered on bank shots along with an additional crucial variable: transferred English.

Because of speed, spin, and throw, the various geometric and mirror-image banking systems aren't worth much.

Consider the top position in Diagram 27, which is familiar to most players because it is the starting point in many trick shots. Struck as shown, the striped ball will go into corner pocket Y and the black ball will bank into side pocket Z. In setting it up, the two frozen balls must be directed straight across the table as indicated by the dashed line; the reason is that the striped ball in rubbing across the face of the black ball will throw it slightly to the right and will also give it a little right English. Unfortunately, most players who know how to set up the trick shot don't apply the principle to shots that come up in their games.

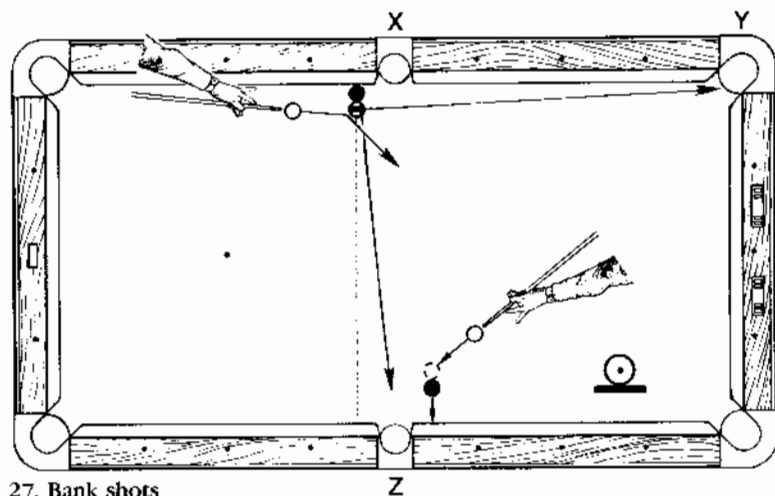At the bottom of the diagram, the goal is to bank the black ball into

Diagram 27. Bank shots

side pocket X. The dashed ball shows where the cueball will be if it contacts the object ball directly opposite the cushion. In theory, that should drive the object ball straight into the rail as indicated (provided there is no English on the cueball). In practice, however, the black ball gets thrown forward and hits the rail a little closer to the side pocket than the arrow suggests, and in addition is given a slight sidespin by the passing cueball. The result is that it banks in the side. Most good players make such easy banks consistently on instinct and experience, not because they have a clear understanding of what happens.

In Diagram 28 the object is to bank the black ball into the side pocket from three different cueball positions. If a center ball hit is used on the cueball, it may surprise you to know that a different contact point is required on the rail for each of the three starting points. While experimenting with
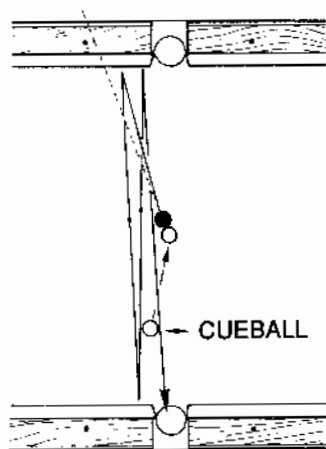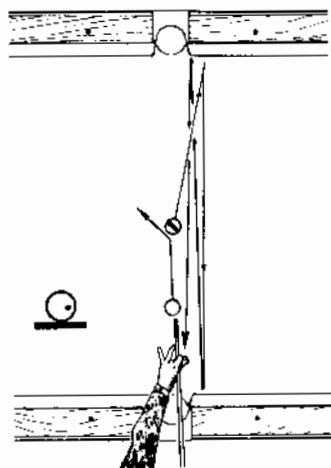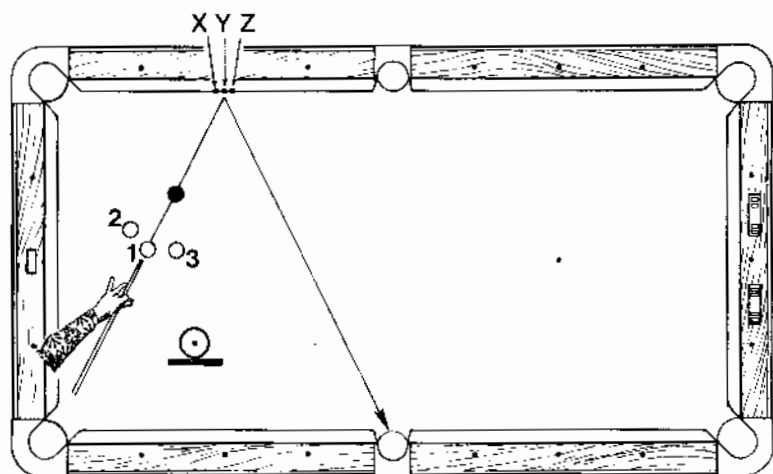
Diagrams 28 and 29: Bank shots

this, mark the cueball and object ball positions on the cloth with chalk so the balls can quickly and accurately be respotted.

After marking the object ball location, find position 1 for the cueball so that a straight-ahead hit at soft speed will result in a successful bank. Have a friend mark the contact point on the rail (shown here as Y). Now mark cueball positions 2 and 3, roughly six inches on either side of position 1. You will find that to bank the black ball from position 2 you will have to drive it into the rail a little to the left of Y, at a point I have marked X, because the black ball will pick up a little running English from the cueball. From starting point 3 the contact point on the rail is on the other side of Y, at the point marked Z, because a small amount of reverse (holdup) English is on the object ball. These statements hold true only if you use no English. With "running" English (right from position 2 and left from position 3), friction at the instant of contact can be eliminated, along with throw and transfer English, and point Y becomes correct.

Further understanding of banks can be gained by trying the shot from position 1 with English on the cueball. With heavy right English, you must drive the object ball into point Z. With heavy left English you must hit point X. With lesser amounts of English, of course, the effect is reduced.

The two shots in Diagram 29, which could come up in any game, illustrate the points in an entertaining way. Both are in *Byrne's Treasury of Trick Shots*. In the shot at the left, the striped ball is in the exact center of the table. Nevertheless, it can be triple-banked in the side by using extreme right English on the cueball.

At the right in Diagram 29 is a surprising shot that makes intermediate players gasp. The black ball is on the center spot and the white ball is frozen against it so that the two are lined up as indicated by the dashed line. Strike the white ball full and the black ball can be made to triple bank in the side in a beautiful demonstration of throw and transfer English.

Students serious about mastering bank shots should also take a look at the holdup double bank on page 146 of my trick shot book and at the three examples on page 99 of *Byrne's Standard Book*.

Facts about Follow, Skidding, and Banks

In my videotape on how to play pool, I state categorically that when you want the cueball to follow the object ball, it is useless to hit the cueball higher than 70 percent of its diameter, but I don't take the time to explain why. I'll take the time now, for the point is important.

In his great book on the physics of billiards, published early in the last century, Gustave Coriolus showed that when the cueball is struck 70 percent

of its diameter above the bottom (a hair less than halfway from the center to the top), it starts out immediately with natural roll; that is, the ball and the cloth are in solid contact without sliding of any kind. The question is, will a higher hit give the cueball extra topspin? Yes, but it is almost impossible to demonstrate it under game conditions.

My technical adviser, Bob Jewett of Hewlett-Packard, came up with a simple test to get to the bottom of the matter. The results amazed me.

Place an object ball in the center of the table, as in Diagram 30, and the cueball near the head rail, at point R. Hit the cueball in the center (no topspin), and bank the object ball to point P, or thereabouts. At that speed, the cueball will be rolling naturally by the time it reaches the object ball, and the natural forward roll will cause it to follow to roughly point F. On the table I used for the test, the cueball rolls about a third as far as the object ball. Mark on the table, or write down, or remember where the two balls come to rest.

Return the object ball to the center of the table and put the cueball an inch or two away from it, on the point marked T. Bank the object ball the same distance, but this time put as much topspin on the cueball as you can. Will the cueball follow farther than it did when it was only rolling naturally? The surprising answer is no! Provided the two shots are hit with the same speed (as shown by the distance the object ball is driven), the follow on the cueball is the same. You might occasionally be able to put *slightly* more follow on the cueball with high topspin, but the difference in the length of the follow will be too slight to matter in practical terms.

Think of the money you could make with this information if you were unscrupulous! Bet a top player that you can put just as much follow on the cueball by hitting the center as he can by hitting it high, and watch him

Diagram 30. Follow, skidding, and banks
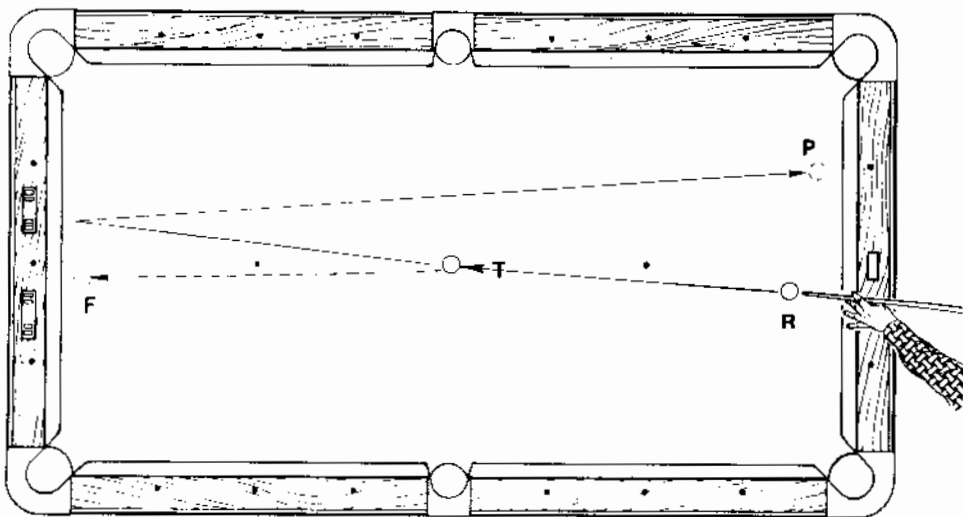
reach for his wallet! Just make sure you start with the cueball far enough away from the object ball so that it has time to begin rolling naturally before contact. Your hapless dupe can put the cueball anywhere he wants and can hit the cueball as high as he wants and he won't be able to make the cueball follow any farther than you did. (Either throw out shots where the object ball doesn't bank to the right place or keep track of every shot by dividing the length of the drive by the length of the follow. The ratio will remain close to constant.)

The practical implications of this experiment are (1), that hitting the cueball more than halfway between the center and the edge on a follow shot (and perhaps on draw and sidespin shots as well) is useless and merely increases the chance of a miscue and (2), that if the cueball is rolling naturally or has been struck halfway from the center to the top, the length of the follow depends only on how hard the cueball is hit.

At another point in the videotape I state flatly that the various systems for calculating bank shots don't work well because they are based on the assumption that the angle of the approach to the rail equals the angle of departure. Again, I don't take the time to fully explain why.

Follow, or topspin, or natural forward roll are the culprits that make banking a guessing game rather than a geometry problem. If a ball has forward roll on it, it will bend "forward" on leaving the rail, thus making the apparent angle of departure less than the angle of approach.

The effect of topspin off the rail is demonstrated dramatically in the billiard trick shot I call Bulldog Brink Bends the Ball (page 273 in *Byrne's Treasury of Trick Shots*). The same idea can be applied to pool. In Diagram 31, it looks impossible to bank the cueball and make the ball near the diagonally opposite pocket because of the interfering balls. However! Hit

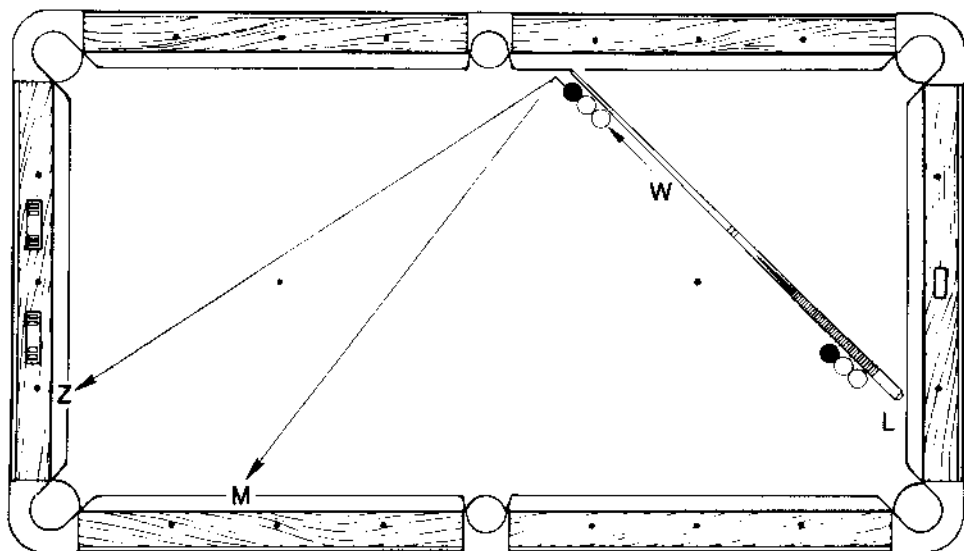Diagram 31. Follow, skidding, and banks
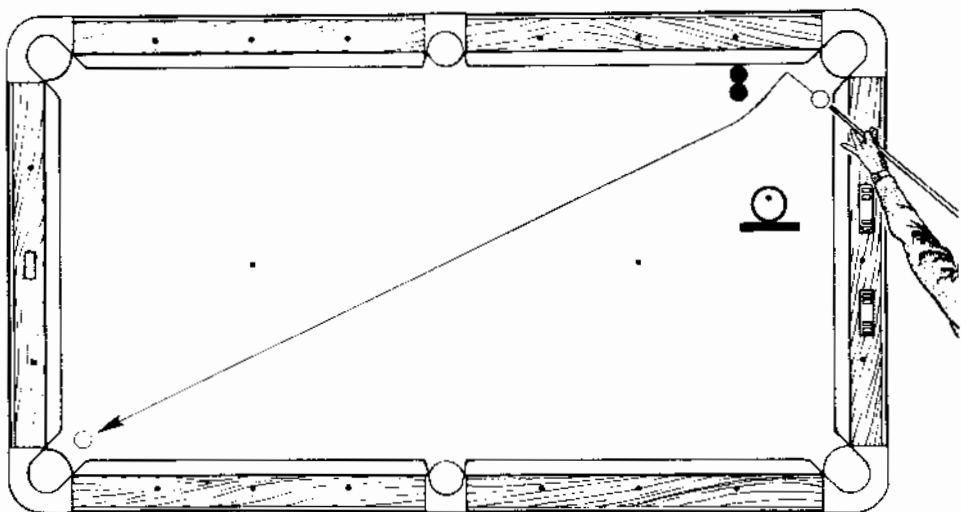
Diagram 32. Follow, skidding, and banks

the cueball three-fourths of the way up, giving it natural forward roll, and it will bend around the blocking balls. Don't shoot hard.

To show the tremendous influence slide and follow have on bank shots, Bob Jewett suggested an idea that I have used in Diagram 32. Set up two three-ball combinations along the same line (put a cue on the table and use it as a guide in aligning the balls), one close to the rail, one four feet away. Put the cueball at W, hit the upper combination with medium speed, and watch where the black ball banks. It will hit the opposite rail at about point M.

Now remove those three balls, place the cueball at L, and hit the second combination at the same speed. This time the black ball (the front ball) will bank to the other side of the corner pocket, at point Z! The reason for the tremendous difference in the angle is that in the first case the banked ball was sliding into the rail, while in the second case the banked ball had time to acquire a natural forward roll. This demonstration would make another good bar bet, for few players, even the best ones, would be able to predict the results with much accuracy.

And now the solution to another mystery, why an object ball sometimes "skids." Once every 100 shots or so, when you are trying a cut shot, the cueball seems to "grab" the object ball and throw it forward. The object ball slides after the hit instead of rolling, and sometimes even hops a little. Irving Crane has said that when this happens the object ball acts like a sliding ashtray instead of a ball.

I've written before about the weird effects that are possible if you chalk the contact points between balls (pages 152–153 in my trick shot book). Chalk greatly increases the friction between the balls, making them behave

for an instant like cog wheels. If you chalk your cue and strike a cueball, you implant a nice big chalk mark on it, and if by chance that chalk mark is oriented in such a way that it strikes the object ball at the moment of contact, skid occurs. On a cut shot, the object ball gets thrown forward; on a straight-in shot, if the cueball is rolling, the chalk spot strikes the object ball a downward blow, making it hop and slide.

Steve Davis, the world's best snooker player, lost the world title in 1985 when he blew an easy cut on the final 7-ball. Skid was probably the reason. As ridiculous as it sounds, Davis, and you, too, if you are ever faced with a cut shot for all the money, would have been better off *removing* all chalk from his tip. Attention, hustlers! Spitting on your opponent's tip might cost you the game!

The Importance of the Half-ball Hit

Very few players have clear in their minds three important facts: 1) To make a naturally rolling cueball deflect at a given angle off an object ball, there are almost always two places the object ball can be struck; 2) In terms of the angle the cueball is deflected when hitting an object ball, the half-ball hit is most resistant to error; 3) The half-ball hit causes the naturally rolling cueball to deflect the maximum amount.

Diagram 33 illustrates what is meant by the term *half-ball hit*. Note that the center of the cueball is directed at the edge of the object ball. It's a useful concept in three cushion because it provides the shooter with something specific to aim at in many situations. The player familiar with the deflection angle in a half-ball hit can often eliminate one variable (the amount of object ball to hit) and concentrate on speed and spin. The great Jay Bozeman once told me that when he was jousting for the world three-cushion crown with Willie Hoppe and Welker Cochran in the 1930s and 40s he went for the half-ball hit whenever possible.

The importance of the half-ball hit derives from its resistance to error.

Diagram 33. The half-ball hit
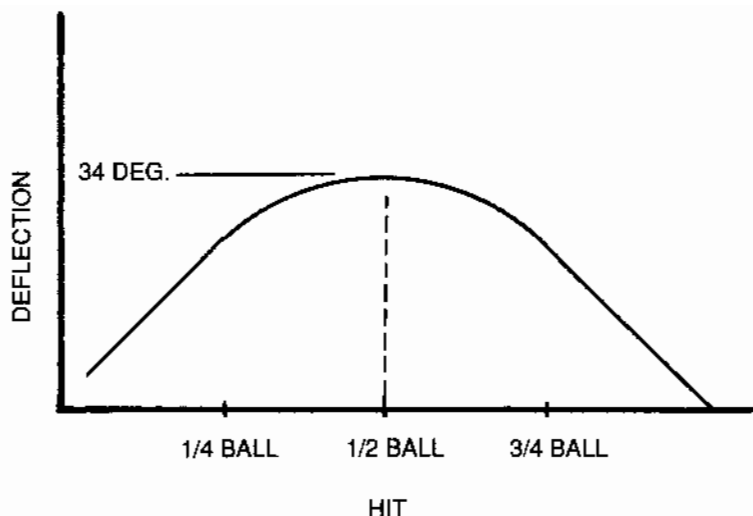

CUEBALL

OBJECT BALL

LINE OF AIM
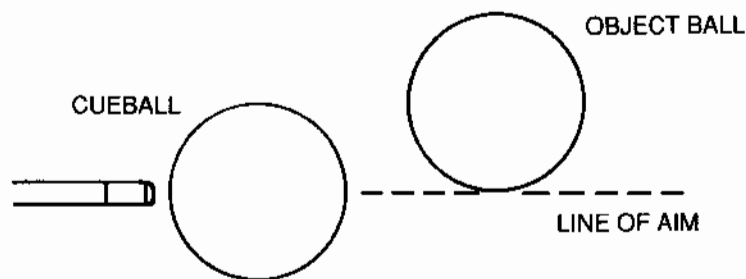
Diagram 34. The half-ball hit

That is, you can hit the object ball slightly fuller or slightly thinner than half and the deflection of the cueball's path will still be about the same. For the balls and cloth used today, the deflection angle, for practical purposes, is 34 degrees.

The resistance-to-error effect can be seen in the simple graph in Diagram 34. The curve represents the amount of deflection of the cueball's path for various hits. At the left end the curve is at zero because the cueball's path hardly changes at all for a very fine grazing hit. The curve climbs as you move along the horizontal scale because the thicker the object ball is hit the more the cueball is deflected. The maximum, 34 degrees, is reached when the hit is half a ball. From there, for fuller hits, the curve declines because the cueball *follows through* the object ball. The curve reaches zero again at the right end, which represents a full-in-the-face hit, when the cueball follows straight through the object ball without going right or left.

Two practical conclusions can be drawn from the graph. One is the resistance to error of the half-ball hit. Note that the half-ball hit occurs at the flat part of the curve—a little to the right or left doesn't make much difference in the height of the curve or, in other words, in the amount of the deflection. The second point is that to get a given rebound angle off the ball, the ball can be hit in two different places. The cueball is deflected the same amount for a one-quarter-ball hit as for a three-quarter-ball hit (about 27.5 degrees in practice). This last point is made use of frequently by three-cushion players trying to miss a kiss or play position—they estimate the path the cueball must take from the first object ball to the first rail, then they decide whether to drive the cueball ahead or cut it to one side. In either case they hit the same point on the first rail.

Caution—I'm talking only about naturally rolling cueballs. Sliding, top-spinning, or backspinning cueballs give very different results.

Speed, interestingly, has no effect on the deflection angle if it is properly measured, but for the examples in this discussion I'm considering moderate to soft. That speed has no effect is a point made by George Onoda, a scientist at IBM's Watson Research Center in Yorktown Heights, N.Y. It is true that the harder the cueball strikes the object ball the farther it will travel along the right-angle line before bending forward (the parabolic curve is flatter), but after the topspin is spent and the cueball is once again traveling in a straight line, that line, if projected backward, will always form an angle of 34 degrees with the original aiming line. For a full explanation, see Dr. Onoda's article in *The American Journal of Physics,* May 1989.

Now for a valuable practical application, the so-called in-off spot shot. In Diagram 35 the 1-ball is on the foot spot, the pay ball is hanging on the lip, and you have the cueball in hand behind the headstring. Should you cut the 1-ball into the 9-ball or go for the billiard shot? The billard shot is far better, provided you put the cueball in the right place to start with. That place is two inches to the right of the head spot. From there you simply go for the half-ball hit on the 1-ball. The cueball will carom toward the center of the corner pocket with wonderful accuracy. Try it ten times each way and you'll be convinced.

Two more applications of the half-ball spot shot are given in Diagram 36. Suppose the 9-ball is at point a, and the 8-ball is on the spot at g. The object is to pocket the 9 with a carom off the 8. You know that a half-ball hit with the cueball at point d will cause the cueball to cross point b. To make the cueball cross a instead and thus cut the 9 into the corner, place the cueball at point e. Since the distance from d to g is roughly 50 percent

Diagram 35. The half-ball hit

LINE OF AIM

34 DEG.
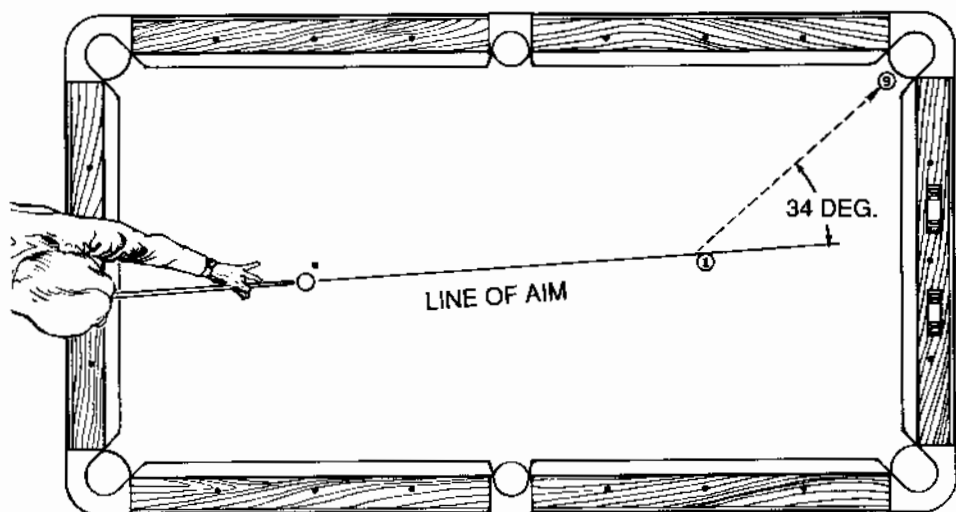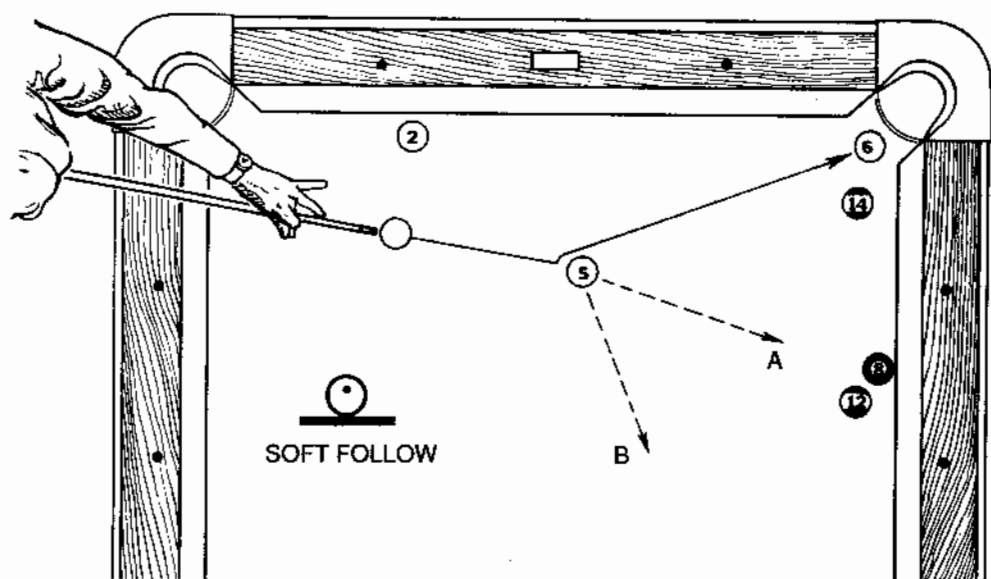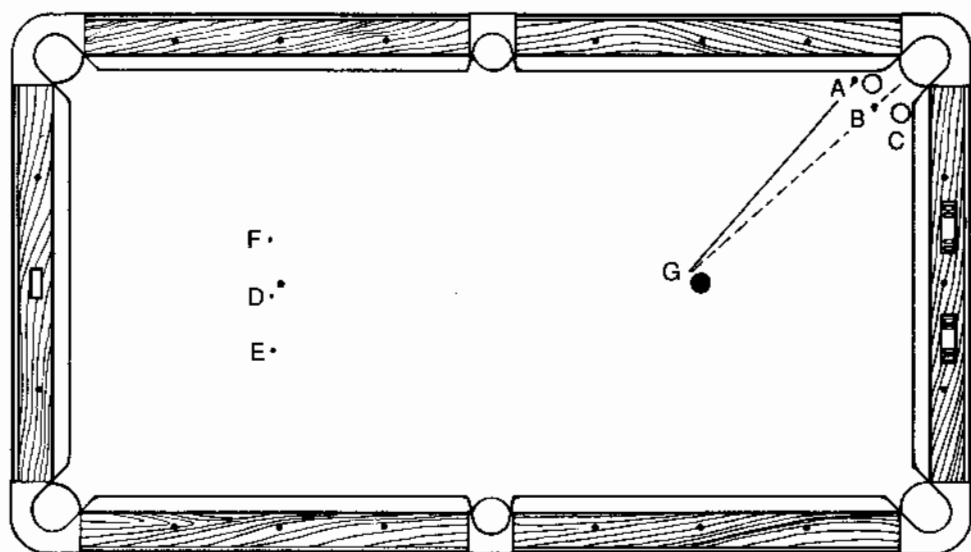
Diagrams 36 and 37: The half-ball hit

more than from g to b, it is necessary to make the distance from d to e 50 percent more than from b to a.

If the 9-ball is at point c, then use a half-ball hit off the 8-ball starting from point f.

To drive home the idea that the object ball can be struck in two places for a given angle of cueball deflection, I present Diagram 37, a position from a game of eight ball. The 2, 5, and 6 are open, but the 8 is trapped.

What should be done? Some might try to cut the 6 in with draw, hoping to knock the 14 into the 8, but that is not too promising in the given situation.

Without knocking the 8 loose, though, there is no way to run out. Consider the carom off the 5. Most pool players who wanted to make the 6 by caroming the cueball off the 5 would consider only the thin hit, driving the 5 along line B. Better here is the full hit, sending the 5 along line A and into the cluster. The cueball follows through the 5 into the 6. After the 6 the 2 is waiting, then the 5 and 8 (with a little luck). There is no need to hit this shot hard. Just use plenty of high follow and enough speed to barely make the 6 without scratching.

The Magic of Massé—Explained

Very few things in life turn people on more than a well-executed massé shot. A cueball that seems to defy the laws of physics by making a right-angle turn and gaining speed is an exhilarating sight for spectators. For the players, making one of the big, sweeping massé shots during competition is a thrill beyond compare. Joy reigns no matter how bad you are getting beat or how much money you are losing.

Certain geometrical secrets of the shot haven't been discussed in print since 1835. That was the year Gaspard Gustave Coriolis published his great work on the mathematics of colliding spheres, namely, *Theorie Mathematique des Effects du Jeu de Billard*. The book, which has never been translated into English, is unsurpassed on the physics of billiards.

Ponder Diagram 38, which is a view of the cueball from above. Assume that the cue is elevated to an angle of 70 or 80 degrees (not quite vertical)

Diagram 38. Massé shots

Top View
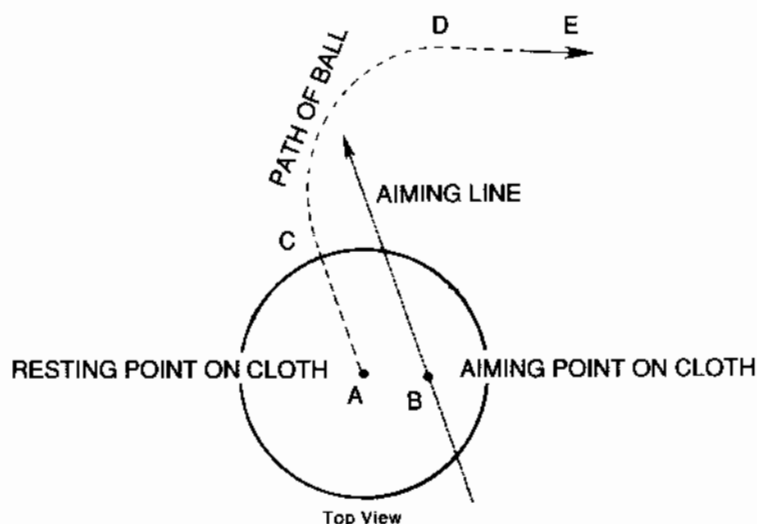
and that it will strike the cueball on the right side and a little behind center. Point A is the spot on the cloth on which the cueball rests. Point B is the point on the cloth the tip would hit if you followed straight through. In other words, point B is the spot on the cloth you aim at during a massé shot.

Point B must be chosen with care, unless you are so experienced that you can trust judgment alone—as practically all top players do when attempting massé shots. In the diagram, note how the cueball starts out in a direction parallel to the aiming line, then bends to the right. At point D the curve ends and the ball continues in a straight line to and beyond point E. The delicious secret is that line DE is parallel to AB. Thus you can make the cueball take the desired final direction by properly locating point B. This very helpful fact will come as news to practically every player in the United States and takes much of the guesswork out of what until this moment has been one of the game's most mysterious shots.

In planning the shot, you first choose the line of aim, AC, then how far you want the ball to travel before the curve begins, and finally the direction you want it to take after the curve is over. The lengths of AC and CD depend on the amount of elevation of the cue, how far off center you hit the cueball, how much force you use, and the friction between the tip and the ball and the ball and the cloth. Such variables require touch and judgment, but at least one essential factor can be calculated rather precisely, and that is the final direction. Once you have decided what you want the final direction of the ball, DE, to be, simply pick a point B so that AB is parallel to DE. When addressing the cueball, imagine the point where it touches the cloth. Imagine a point B on the cloth that will produce the desired final direction and aim your cue through the cueball at point B.

Naturally, your tip must be properly dressed and chalked to have much chance of success.

Before continuing, a couple of basic points. A massé shot is a kind of miscue. The cueball gets squeezed between the tip and the cloth in the same way a watermelon seed can be shot from between thumb and forefinger. You also hit down on the cueball when you want it to jump; it doesn't jump in a massé shot because the cueball is smothered by the tip.

Hold the cue against your cheek so that it crosses your ear. If you can't form a bridge on the table, or if you have to hit the ball hard, use a freehand bridge with the forearm pressed against the body for as much solidity as possible. Willie Hoppe's *Billiards As It Should Be Played* has several good photos of the correct stance and grip. Sometimes you can lift a knee onto the rail and base your bridge on that.

Not much force is required unless you want the cueball to go several feet before curving. In the small massés typical of straight billiards, where the total travel is only a few inches, the force is hardly more than dropping the cue onto the ball. The results can be magical.

Students often ask how far off center they should hit the cueball. The answer depends on the shot, your tip, and your stroke.

In Diagram 39, assume that the player, intending to put draw on the cueball, is hitting the ball as low as he can without danger of miscuing. That is, the perpendicular from point G, the center of mass of the cueball, and H on the aiming line, is as long as it can be. Each player should know how long GH can be on a standard draw shot. The rule is this: GH is the same no matter how much the cue is elevated. That is, when the cue is elevated, hit the cueball no farther off center than you would on a deep draw shot.

Now for the line of aim. Diagram 40 shows a position that might come up in nine ball. If you know what you are doing, it is not too difficult to skim the 8 and make the cueball curve into the 9 for a winner. Establish the aiming line with a level cue as shown—in this example you want a thin hit on the 8. Now imagine a vertical plane of glass intersecting the table and entirely containing your cue and the line of aim. Lift the cue to the elevated position (between 70 and 80 degrees from the horizontal), always keeping it within the imaginary plane of glass, and pick an aiming point on the cloth as explained above. A soft stroke is required to make the cueball path curve quickly and to avoid following the 9-ball in (Diagram 41).

In every several hundred points in the game of three-cushion billiards, opportunities arise for massé shots. Perhaps the easiest possible position is given in Diagram 42, left. Straight backspin is all that is required, but you need a steeply elevated cue to make the cueball hit the first rail twice. If you can't make it in ten tries, forget your dreams of making a living as an exhibition player. (For the geometrically inclined, on this shot both point A and B are on the aiming line. Refer to Diagram 38.)

Diagram 39. Massé shots

SIDE VIEW
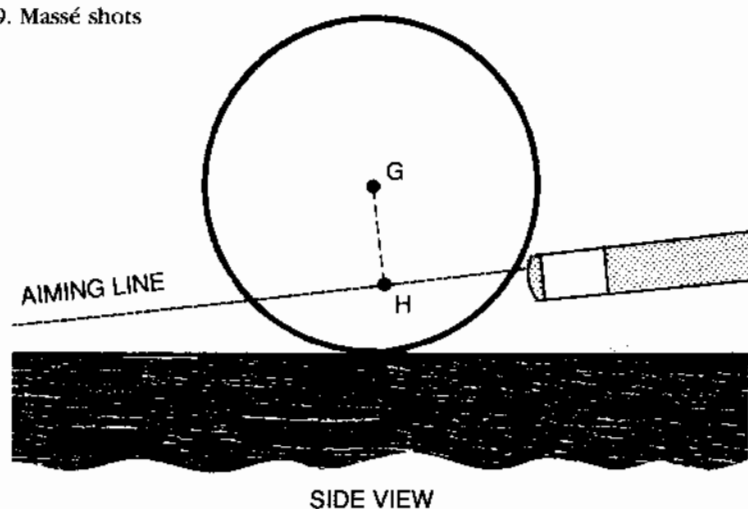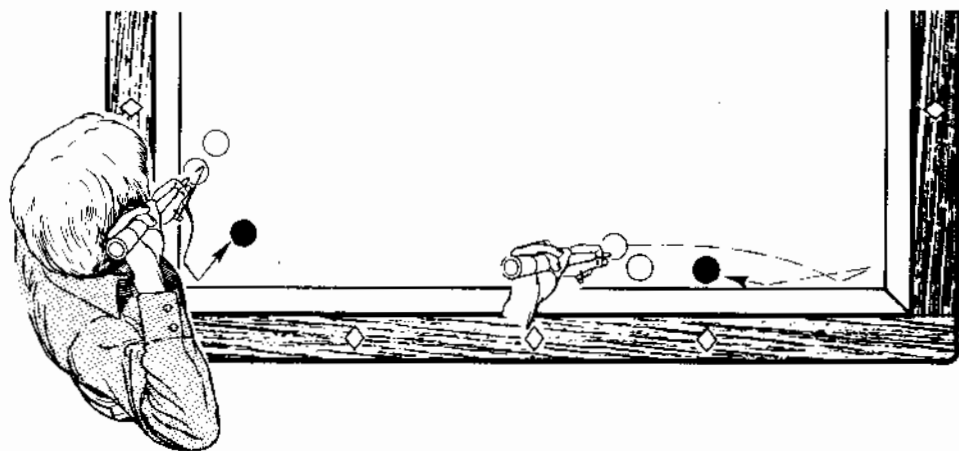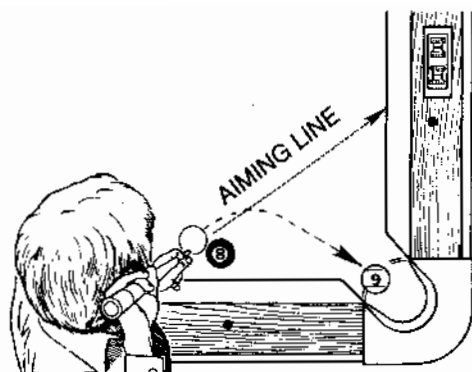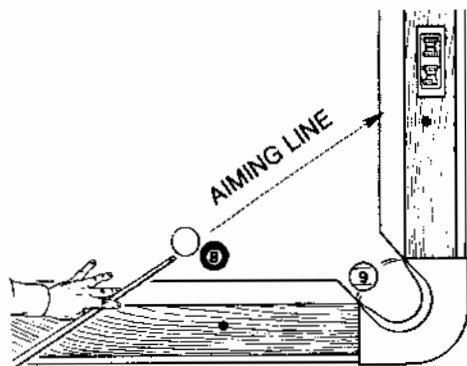
Diagrams 40, 41, and 42: Massé shots

At the right in Diagram 42 is a shot I saw Raymond Ceulemans try in Europe. The great Belgian champion, who has a very secure massé stroke (everything about his game is secure), went lightly off the white, curved around the red, and doubled the rail in the corner. It was an ideal that would have occurred only to a player used to games like straight billiards and balkline, which call for mastery of massé.

When and How to Shoot Jump Shots

Some old-timers claim that 50 years ago anybody who tried a jump shot in a money game would have gotten a fistfight for his trouble, yet the technique has long been legal in the United States in both pool and billiards. At one time, in fact, jumping even the cueball all the way off the table was not considered a foul in billiards provided the point was scored. Quoting from a 1925 rule book published by Brunswick-Balke-Collender: "Jump shots are

legitimate in all carom games. If an object ball or cueball be forced off the table, there is no penalty when a counting stroke is made, the count stands, the cueball is placed on the head spot, and the striker continues his inning."

In three-cushion billiards, there is no way to send the cueball off the table after scoring a point, and in that game a player's inning is over when the cueball hits the floor. Under old American professional rules for three cushion, however, it was O.K. to send the first object ball off the table—to miss a kiss, for example, or accidentally—but such dangerous flamboyance is not permitted under the rules that now govern international play.

In snooker, jumps of all kinds are barred. When I was in England in 1984, I questioned several officials on the point. The cueball must not leave the cloth, period. You can't even make it jump a little to get by an edge of an interfering ball. To do so is a foul. That is a poor rule, for great things are possible when players are allowed to play the game in three dimensions.

In the last ten years or so in the United States, the jump shot has . . . well, it has reached new heights. A dramatic example of what is possible can be demonstrated by Mike Massey. With a cueball at one end of the table and an object ball eight feet away, he can jump entirely over an interfering ball, pocket the object ball, and *draw* the cueball back the length of the table. My mouth fell open when I first saw him do it, and my jaw still aches. Such feats are beyond normal people, but many jump shots are not particularly difficult.

Look at the shot in Diagram 43. The game is eight ball. You have an easy cut shot on the last spot, but how can you get past the two stripes to get position on the 8? If you elevate the cue about 45 degrees, it is not hard to jump over the interfering balls and get the cueball to the other end of

Diagram 43. Jump shots
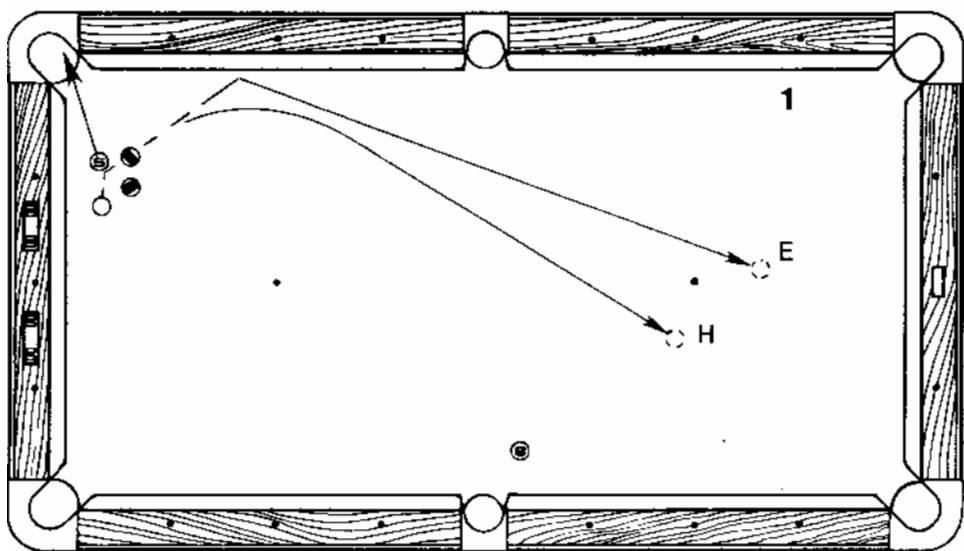
the table . . . to the position marked E, for example. If other balls block that solution, you can try a jump draw, elevating the cue as before but applying backspin. When the cueball lands beyond the interfering balls, its path will bend in the way shown by the line terminating at H.

George Conner of Fort Wayne, Ind., is especially fond of jump draw shots and I'm grateful to him for calling my attention to some of the uses for them.

Shot 2 in Diagram 44 is a little-known application of the jump shot. The problem is to make the 8-ball, which is not quite straight in, and get the cueball down the table. It might be possible to do it with a powerful

Diagrams 44 and 45: Jump shots
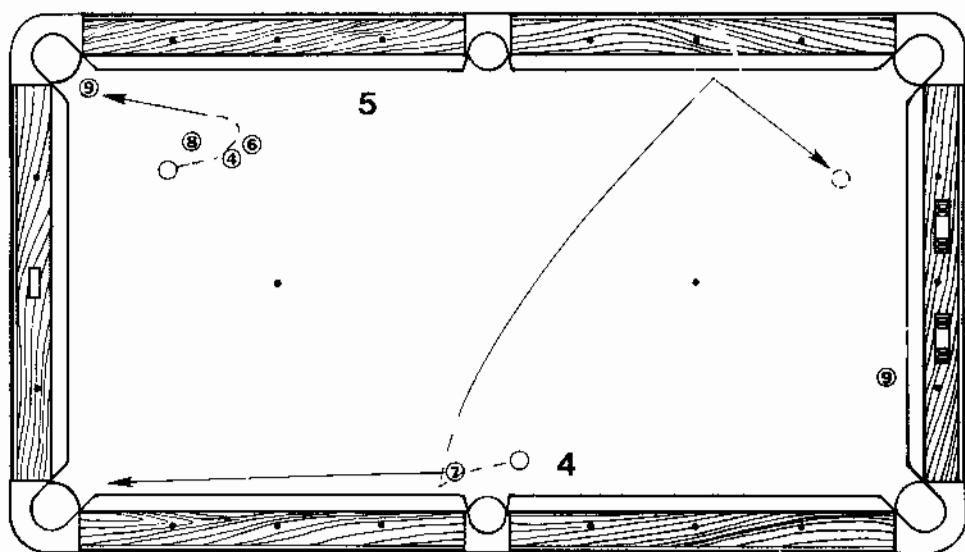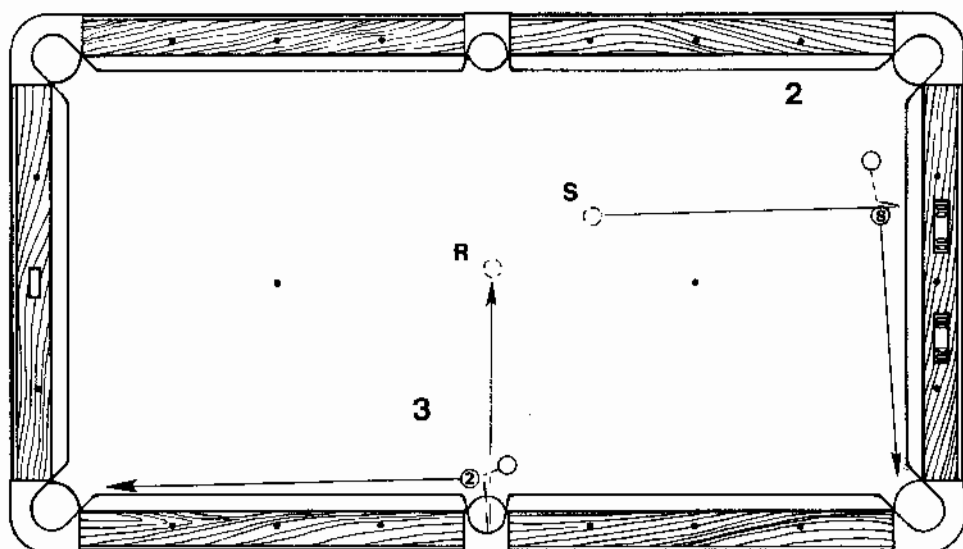
follow shot, but what if interfering balls make that impossible? Use a jump shot. If you can make the cueball jump several inches in the air and land on the nose of the cushion, not as hard as it sounds, it will scoot down the table as desired, sometimes all the way to the other end.

Shot 3 is an amazing Great Escape. Believe it or not, it is possible to make the 2-ball in the corner without scratching in the side. The trick is make the cueball jump just enough to hit the upper back rim of the pocket so that it bounces back on the table, avoiding both the hole and the floor. Whether or not the cueball will come to rest at R is, of course, not for me to say. The odds of accomplishing this in a game are slim to none, but it makes a good challenge bet. Some side pockets are friendlier to this shot than others. The shot was shown to me by Ricky Wright. If the angle into the first ball isn't too steep, it is also possible to avoid the scratch by using a soft massé, as suggested to me by Jeff Olney, a sailor based in Hawaii.

In shot 4, Diagram 45, which is straighter than shot 3, the challenge is not only to avoid scratching but to get the cueball in position for a decent shot at the 9-ball. Draw will either send the cueball into the side or into the point of the pocket. Again, a force-follow might be considered, but George Connor has a better idea: a jump draw. Elevate the cue between 30 and 45 degrees and hit the cueball below center. By making the cueball leave the cloth, it will go forward before coming back. It might not take the path diagrammed (which results from catching part of the rail nose), but you will at least make the cueball go beyond the side pocket before the backspin takes effect. The principle is the basis of many billiard trick shots, but I have never seen it made use of in nine ball, where it would be a handy weapon.

A possible application of jump draw is given in shot 5, Diagram 45. Instead of avoiding a scratch as in the previous example, here the idea is to distort the cueball's path to avoid the 8-ball and draw back to pocket the 9.

Is it possible to cue a ball more than 90 degrees? Willie Jopling claims that it can be done by jumping the cueball and landing slightly on the far side of the object ball.

Two balls are on the foot spot, frozen one behind the other. Can the second one be made straight into the corner? Mike Massey does it with a jump shot.

Jump shots, incidentally, are much easier on heavy, fuzzy cloth than they are on the fine, fast cloths like Simonis from Belgium and Granito from Spain. But even on those cloths there is a way of making jump shots easy while at the same time protecting the cloth from burn marks. The secret is great for trick shots but useless in competition. Needed is a small piece of pool or billiard cloth leftover from the last time your table was covered. It can be as small as a dime. Put it under the cueball, explaining that it will protect the table (which it will). Now see how easy it is to jump all the way over an interfering ball!

Jump shots are also easier to make with a light cue because it tends to bounce off the cueball and not interfere with it. It is common at professional tournaments these days to see players take out a short, light cue when they want to jump over a ball. Sammy Jones, perhaps the foremost practitioner, can jump over a ball when the cueball is less than two inches away from it. Nick Varner sometimes uses just the shaft of his cue when he has to get the cueball off the table in a hurry. The main feature of a jump cue is its light weight, not its short length. A shaft, for example, weighs only four or five ounces, which is an ounce or two less than a cueball. A cue lighter than the cueball will rebound on impact instead of following through.

In games, a jump shot can sometimes be used with devastating effect when breaking clusters apart. Diagram 46 shows a straight-pool position. The break shot is straighter than the player intended; follow will only send the cueball lightly down the side of the pack with little chance of breaking any balls loose. A downward stroke, however, might make the cueball land *on top of* the pack, in which case there almost certainly will be several balls broken free.

Something similar is in Diagram 47. Follow on the cueball might send it off the 4 or the 7 into the corner for a scratch. Even without a scratch,

Diagram 46. Jump shots
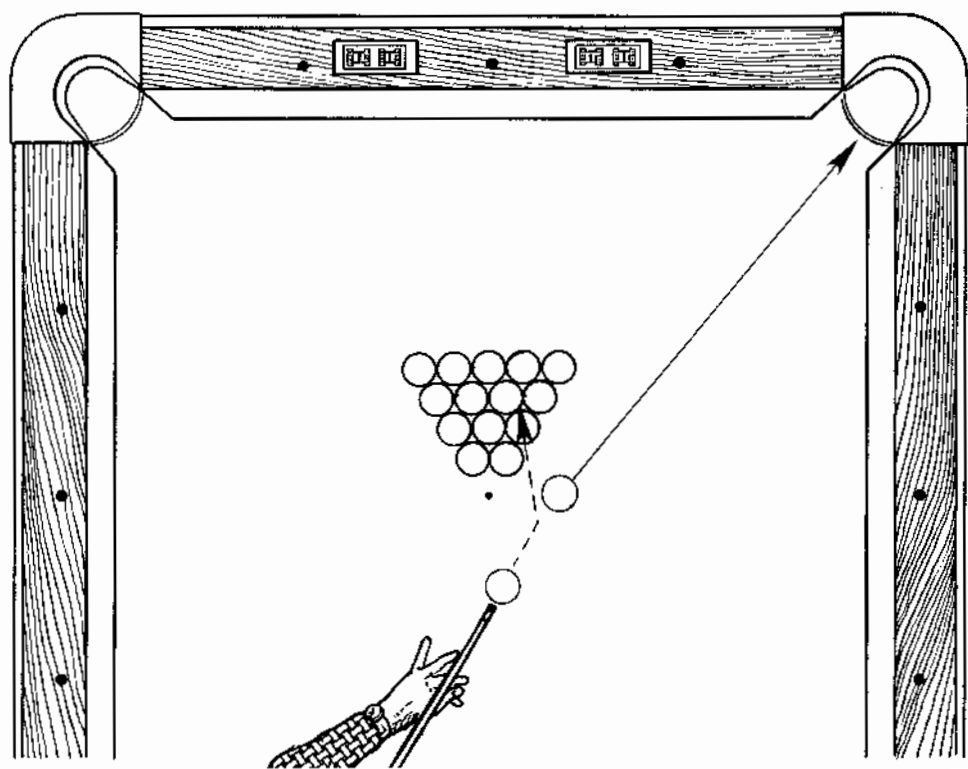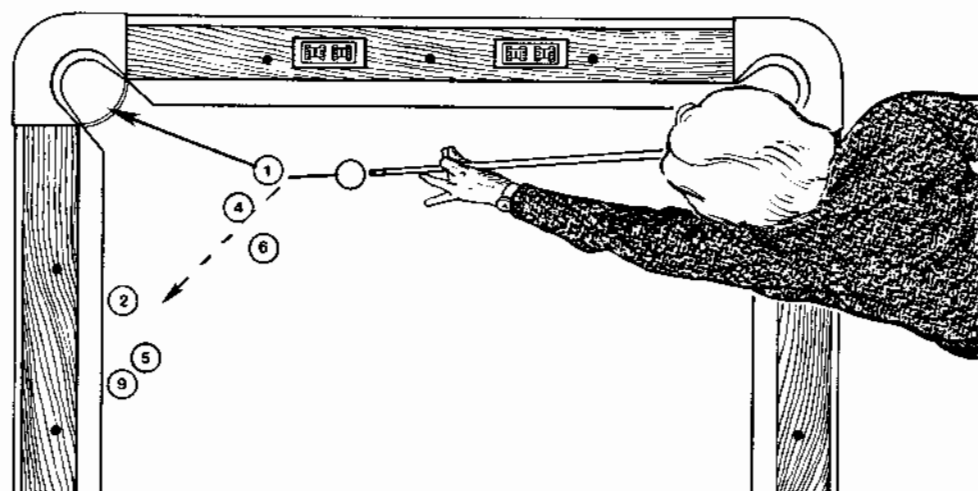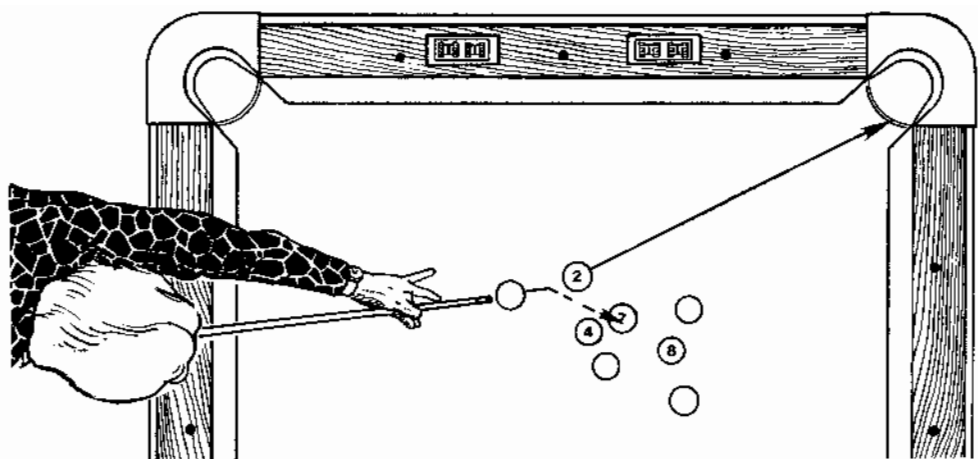
Diagrams 47 and 48: Jump shots

little force can be transferred into the cluster. A better option would be to get the cueball in the air so it climbs over the 7-ball.

Look at Diagram 48. What would you do in a game of nine ball? One possibility would be to make the 1 and stun over to the 6, then play safe off the 2. Cautious but playable. An aggressive (reckless?) player might try a jump shot here because of the chance of running out. Sending the cueball over the 4 and 6 and into either the 2 or 5 will almost certainly leave a way of continuing the run.

I don't mean to imply that jump shots of this sort are easy, but they are not beyond the reach of average players willing to practice. The trick is to hit hard enough to clear the interference, but not so hard to bounce off the table.

Diagram 49 is presented as a puzzle. The game is nine ball. The 8-9 combination is dead, but there seems to be no good way to drive anything
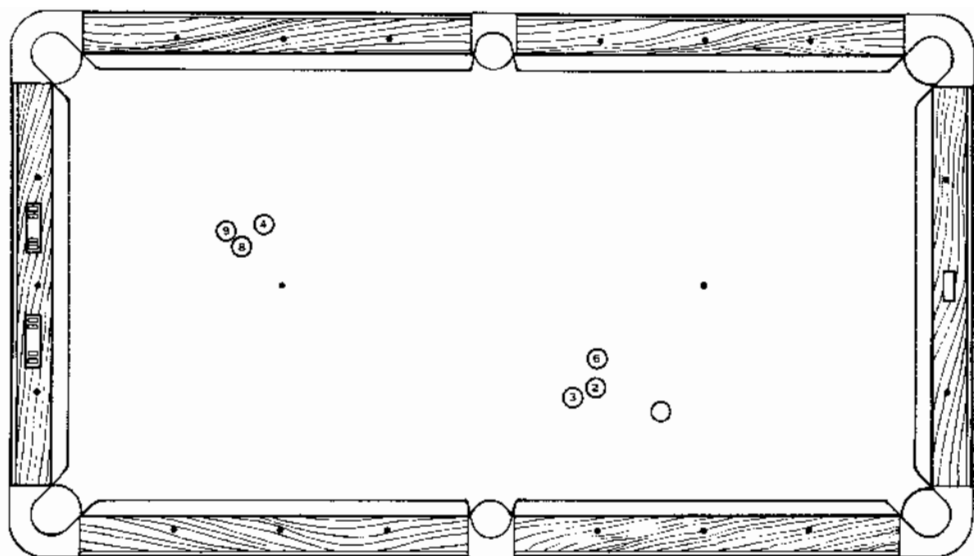
Diagram 49. Jump shots

into it. A safety off the left side of the 2 is what most players would shoot. Don't read the next paragraph if you want to look for another shot.

It's possible to win the game in one stroke. Elevate the cue to about 40 degrees and shoot straight toward the 2. Don't shoot so hard that the cueball jumps over the 2 without touching it; the idea is to hit the top part of the 2. If done right, the cueball will continue down the table and make the combination.

What if the 8 and 2 are interchanged in Diagram 49? Then, of course, you would want to leap over the 8 without touching it, not easy even for top players.

Students interested in other ingenious applications of jump shots and who have *Byrne's Standard Book* should check the diagrams on pages 127 and 128. In *Byrne's Treasury of Trick Shots* there is a whole chapter on jump shots, plus little-known examples on pages 132, 259, and 262.

New and Unusual Trick Shots

In 1981 I was devoting all of my time to collecting trick shots. In my effort to look under every stone, I attended Richie Florence's tournament at Caesar's Tahoe with the intention of picking the brains of every top player I could get my hands on. To encourage them to show me their pet shots, I demonstrated a few curiosities I had picked up from nineteenth-century books on the game plus shots I had invented myself.

The strategy worked well and I had productive sessions with George Middleditch, Mike Massey, Pete Margo, Nick Varner, and other knowledgeable players.

One shot I showed, which I had invented only a month before, has become known as the Penny Wrapper Shot. It's unusual, easy, eye-catching, and amusing. 1 knew I had found something good when I stumbled across the concept, because trick shots like that are scarce, but I was amazed at how fast the shot sped around the country.

Go to a bank and get two penny wrappers—the paper tubes used for rolls of pennies. Cut one to a length of two and a half inches, which is just longer than the diameter of a pool ball. Use the tubes to tee up two object balls so that they overlap each other, as shown in the enlarged inset in Diagram 50, and put them in the center of the table so that they are aimed at the opposite pockets. When you shoot the cueball under them, knocking the tubes aside, the balls drop straight down, collide, and scurry into the pockets. In the diagram I show the cueball knocking in a third ball; of course it is possible to make the cueball do something more heroic than pocketing a single ball, but I feel that would detract from the central idea. A nice feature of the shot, in addition to its almost dead certainty, is that spectators have no idea what is going to happen until it does. Shoot hard, because the balls must drop straight down.

Whether or not the many fine players who have added the Penny Wrapper Shot to their repertoires have come up with any variations I don't know, but in my trick shot book I explain a dozen shots of the same type,
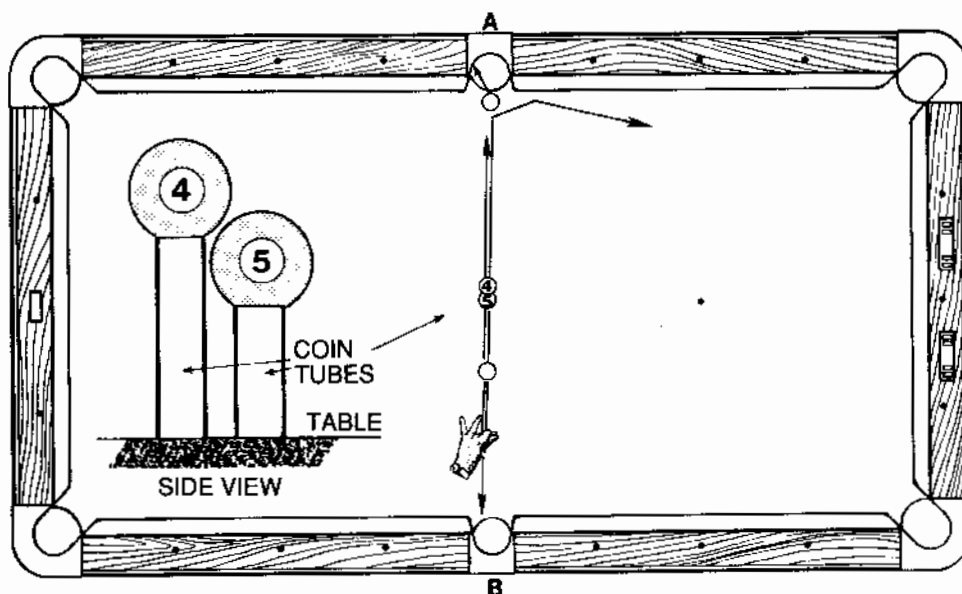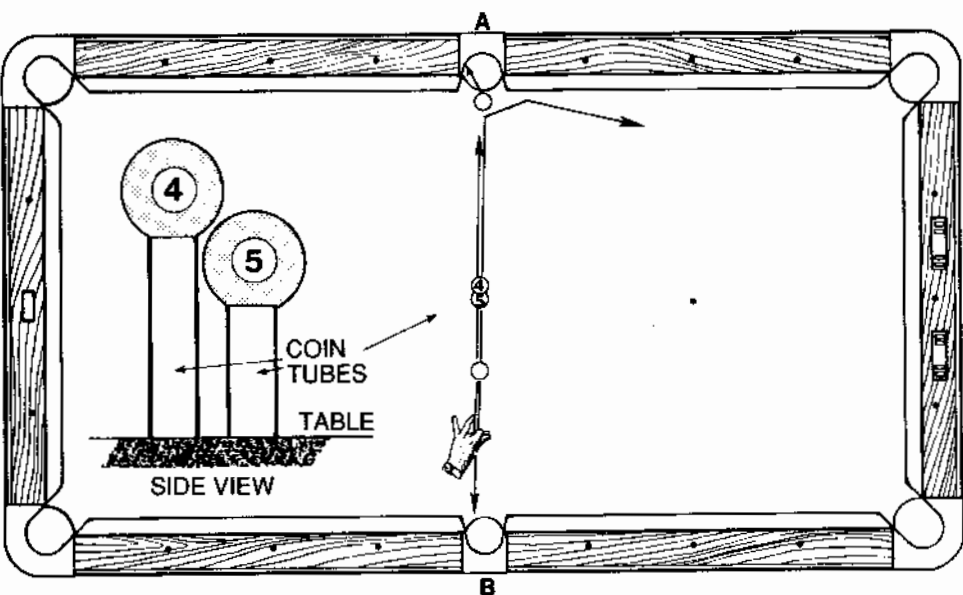
Diagram 50. Trick shots

The strategy worked well and I had productive sessions with George Middleditch, Mike Massey, Pete Margo, Nick Varner, and other knowledgeable players.

One shot I showed, which I had invented only a month before, has become known as the Penny Wrapper Shot. It's unusual, easy, eye-catching, and amusing. I knew I had found something good when I stumbled across the concept, because trick shots like that are scarce, but I was amazed at how fast the shot sped around the country.

Go to a bank and get two penny wrappers—the paper tubes used for rolls of pennies. Cut one to a length of two and a half inches, which is just longer than the diameter of a pool ball. Use the tubes to tee up two object balls so that they overlap each other, as shown in the enlarged inset in Diagram 50, and put them in the center of the table so that they are aimed at the opposite pockets. When you shoot the cueball under them, knocking the tubes aside, the balls drop straight down, collide, and scurry into the pockets. In the diagram I show the cueball knocking in a third ball; of course it is possible to make the cueball do something more heroic than pocketing a single ball, but I feel that would detract from the central idea. A nice feature of the shot, in addition to its almost dead certainty, is that spectators have no idea what is going to happen until it does. Shoot hard, because the balls must drop straight down.

Whether or not the many fine players who have added the Penny Wrapper Shot to their repertoires have come up with any variations I don't know, but in my trick shot book I explain a dozen shots of the same type,

Diagram 50. Trick shots

Diagrams 51 and 52: Trick shots

most of which are my own and have never been demonstrated. Here are two of them.

Place the 7-ball on a tube in the center of the table six inches from the end rail (see Diagram 51). Place the cueball so that a line of aim perpendicular to the side rail would pocket the 7 if it were not elevated. If you can shoot under the 7 without English, the 7 will drop straight down and be pocketed in the left-hand corner pocket by the cueball rebounding off the rail. The dashed circle is the rebounding cueball at the moment of impact. To make it easier, elevate two balls on tubes, putting the second one in the position of the dashed circle. It's easy to make the 7 on a combination.

A different idea is illustrated in Diagram 52. If a paper tube with a ball atop it is placed against a rail, then when the cueball removes the tube the elevated ball will drop onto the nose of the cushion and will be sent straight across the table. My use of that discovery is shown. Shoot under two balls and pocket a ball in the left corner with the cueball. The two elevated balls cross the table, one a little later than the other, and follow each other into
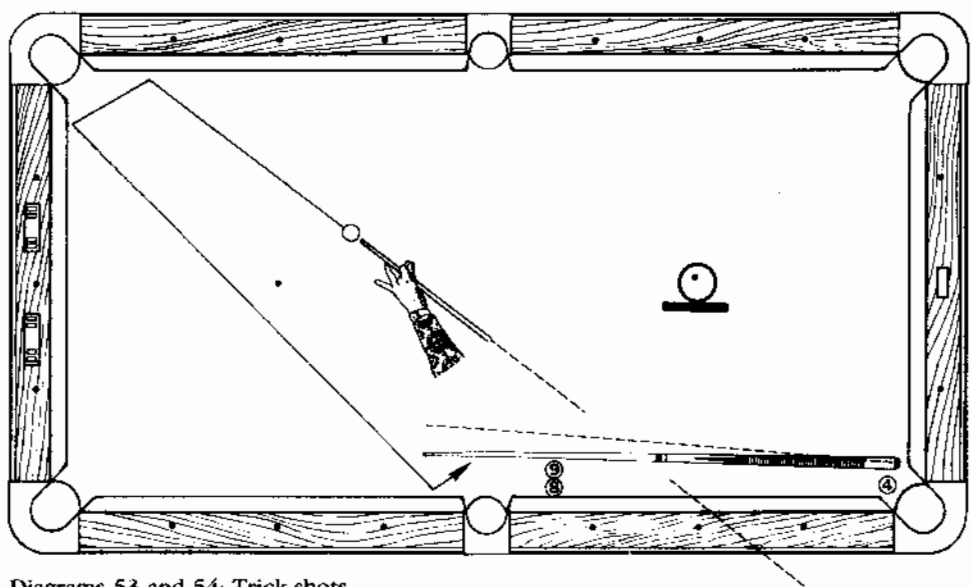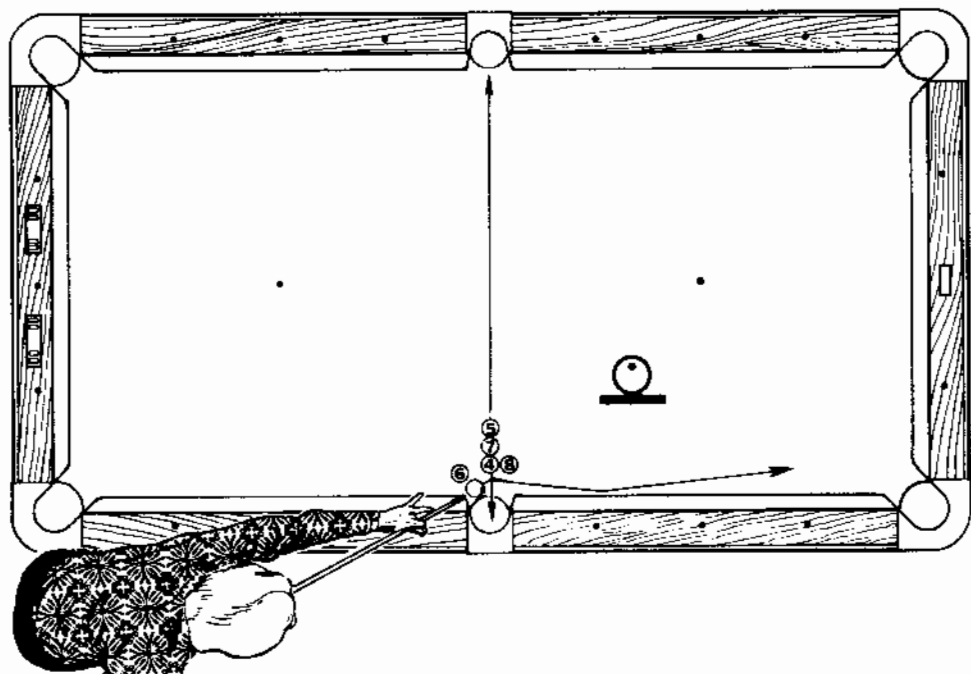
Diagrams 53 and 54: Trick shots

the side pocket after caroming off the two "bumper" balls. The action will come as a surprise even to expert players.

Diagram 53 is a shot I have shown only to a few trusted friends. The 4-ball is the one closest to the side pocket. Who could guess that it can be pulled back into the side from the given position? Use high follow and hit the 4 a hair less than half full. Because the 4 is supported by three balls it can be made to pick up enough reverse English from the spinning cueball

DOWNWARD STROKE
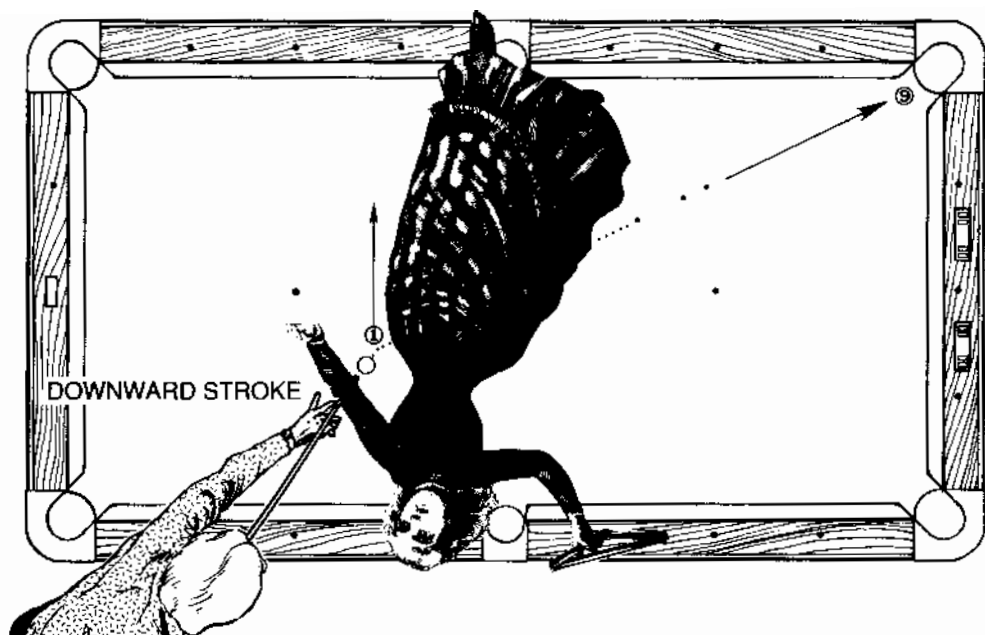
Diagram 55. Trick shots

to make it trickle the few inches that separate it from the pocket. It doesn't seem possible.

Diagram 54 is my adaptation of a billiard shot well known in Japan. From the given position announce that you will pocket the 4-ball (lower right) without jumping over the cue, knocking it in with the cue, or touching the other two balls. The solution is a three-cushion bank. The cueball realigns the cue just enough so that it is guided around the two interfering balls and down the side of the cue into the 4. A clever idea.

The shot in Diagram 55 is so old it has almost been forgotten. Put a victim on the table and with an elevated cue jump the cueball off an object ball so that it hurdles her and pockets a ball in the corner. The main problem is finding a victim who will let you practice until you get the hang of it.

Coping with the Heavy Tavern Cueball

Having grown up on 4½-by-9-foot tables in Dubuque, Iowa, I've never been comfortable playing on anything smaller. One problem I have is philosophical: I tend to think that the smaller the playing surface, the more trivial the game. Marbles and tiddlywinks are never on television, while snooker, played on a gigantic 6-by-12-foot table with tight pockets that present the players with a truly awesome challenge, threatens to devour the world from its power base in England. Maybe our game would be better for television if

the major championships were played on 5-by-10-foot tables, as they were 50 years ago. There were compelling commercial reasons for dropping the size of pool tables to 4½-by-9 and then to 4-by-8 and to 3½-by-7, but providing a true test of top-class skill was not one of them.

Another problem I have is adjusting to a cueball that is not the same size and weight as the object balls. Playing on a table smaller than normal is in many ways easier, but the big cueball creates certain difficulties . . . and opportunities.

Rail shots. Making a ball that is frozen to a rail is harder when the cueball is larger. You can see why in Diagram 56. If you hit the ball and the rail at the same time, the line of centers (dotted line) is at such an angle to the rail that the shot will fail unless the pocket is generously wide. As I have explained, cut shots to a ball frozen to a rail require either outside English (in this case, left) to eliminate friction between the balls or hitting the rail slightly first. On a coin-op table, you'd better make sure you are doing one or the other, or both, especially if you have to run the object ball down the long rail past the side pocket.

Cut shots. Some players aim cut shots by imagining where the cueball will be at the moment of contact with the object ball and then aiming the center of the cueball at the center of the imaginary ball. If you learned to do that on regulation equipment, then you might have trouble with cut shots on coin-op tables unless you remember to visualize the imaginary cueball as larger than the object ball. Along any given aiming line, a large cueball will reach the object ball sooner than a same-size cueball. In other words, with a large cueball you must aim for a slightly thinner hit. Diagram 57 shows a single aiming line and two cueballs contacting the object ball. Note how the big one is hitting too much ball. (Exaggerated for clarity.)

On the other hand, players who normally aim by thinking of what point

Diagram 56. The heavy cueball

LINE OF CENTERS

CONTACT POINT

CONTACT POINT

RIGHT ANGLE LINE
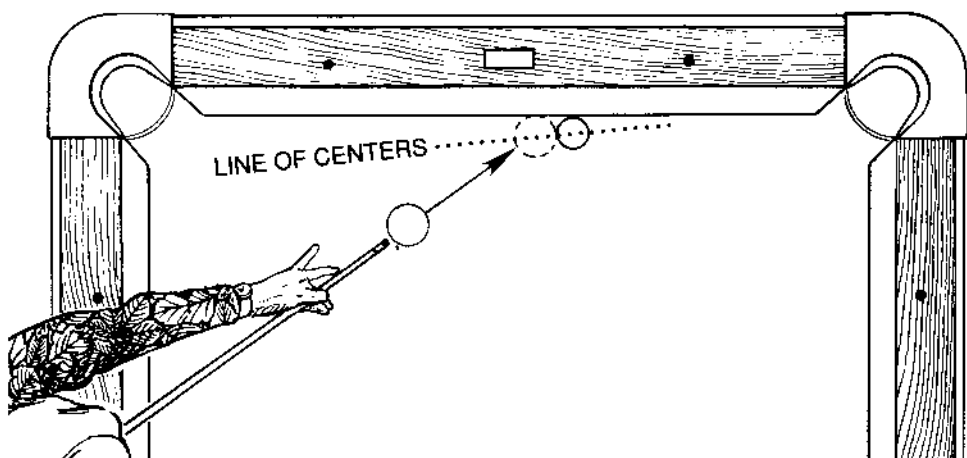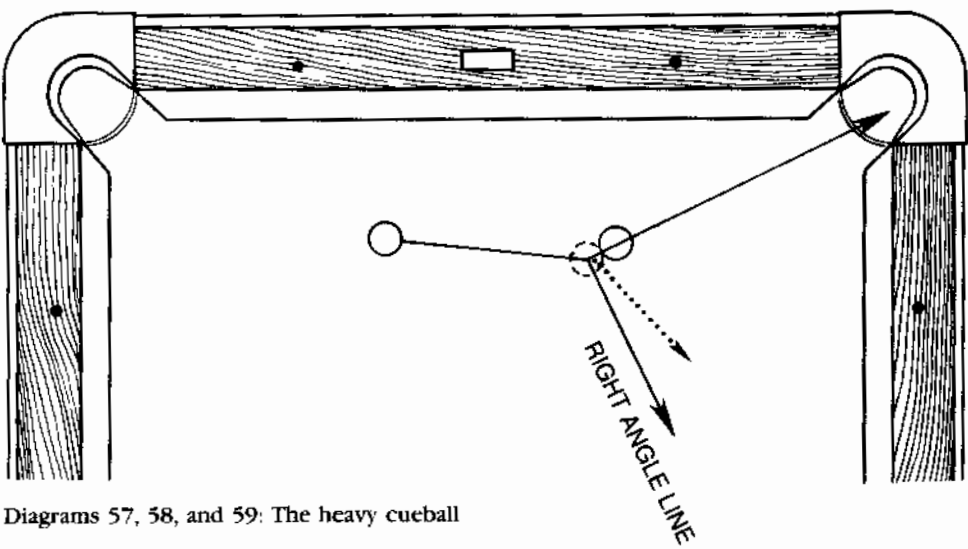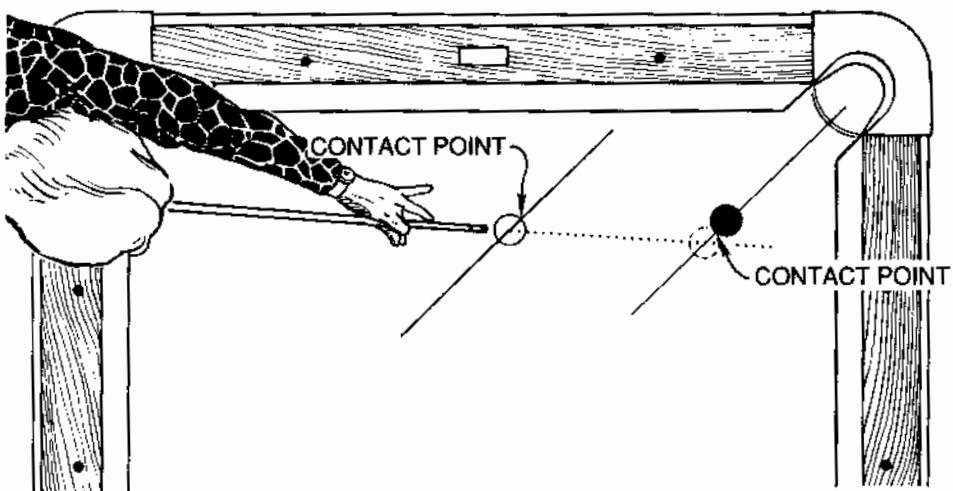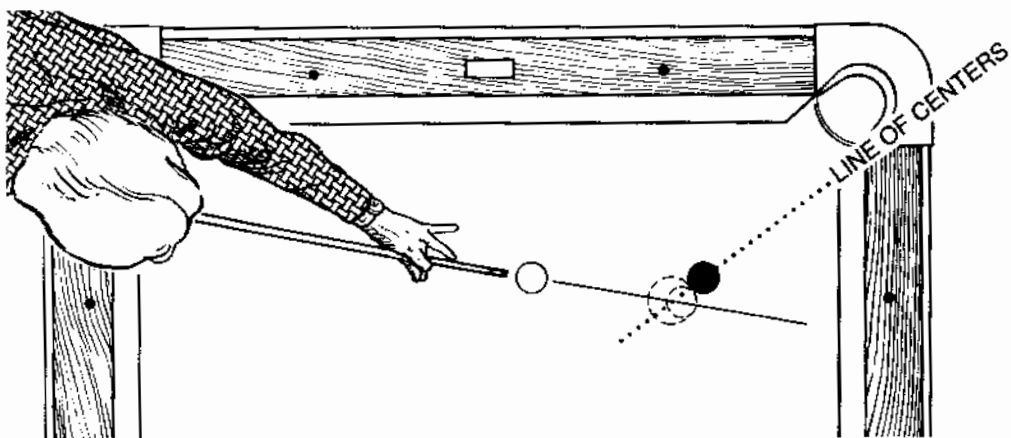
Diagrams 57, 58, and 59: The heavy cueball

on the side of the cueball must hit the object ball don't have as much trouble with oversized cueballs. Diagram 58 shows how to locate the point. The line through the object ball is the desired ball path; where it emerges from the ball on the side opposite the target is the contact point. Imagine a line through the cueball parallel to the object ball path; where that line intersects the rim of the ball is the point on the cueball that must hit the object ball.

Carom angles. On simple cut shots, the angle the cueball takes off the object ball depends on how much heavier the cueball is than the object ball. (The point can be made dramatically by using a tennis ball for an object ball.) When the balls are identical in weight, the diverging ball paths initially form a right angle. In Diagram 59, the dotted line represents the approximate path that would be followed by a big cueball.

Draw shots. Everybody knows that draw shots are harder with an oversize cueball because it is heavier. Not everybody knows that on draw shots a heavy cueball will advance slightly through the object ball on contact before coming back. That changes the cueball's path considerably and can alter a player's positional strategy.

Consider the shot in Diagram 60. The game is eight ball, and the shooter has the stripes.

What to do? Shoot a head-on draw shot. The opponent's ball will go in on the combination, and the cueball, despite having backspin, will advance far enough to make the striped ball as well before backing up for position on the 8.

Stop shots. A *perfect stop* shot is difficult on a bar table because of the heavy cueball.

Follow shots. Good follow action is easier to get with a heavy cueball, and because of that certain shots which would otherwise be poor choices

Diagram 60. The heavy cueball
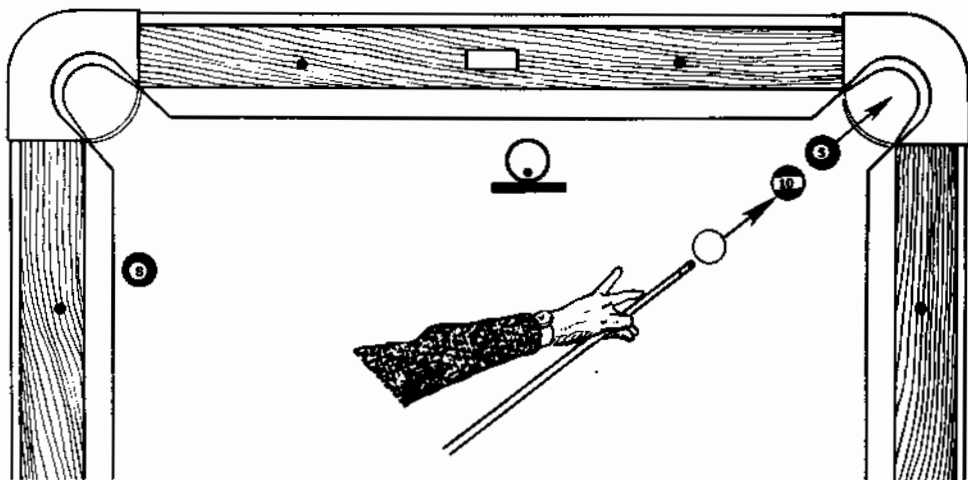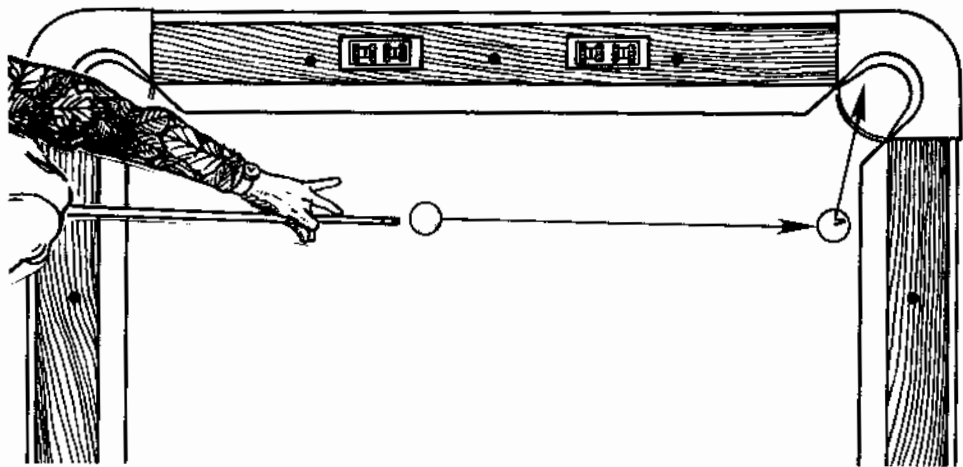
Diagram 61. The heavy cueball

now become eminently feasible. An example is shown in Diagram 61. On a bar table it is easy to double-kiss the object ball into the corner pocket.

I wish manufacturers of coin-op tables had never made the decision in the first place to make the cueball bigger and/or heavier to solve the problem of scratches. Better, I think, would be to eliminate the cueball return mechanism entirely, thus cutting manufacturing costs, and furnish three same-size cueballs with each table. Two cueballs could be lost by scratches during a game without affecting play; whoever scratched the third cueball would be the loser.

Thirty-three Secrets of the Game

That so many top professional players know so little about such things as the coefficient of friction, the conservation of angular momentum, action and reaction, parabolic curves, vector analysis, and angles of incidence and reflection proves that understanding them isn't essential to championship play. But it can't hurt, and it may help. Besides, the physics of the game is fascinating.

Here in summary form are the main assertions I've made over the years in the technical area, leaving out most of the supporting evidence and arguments.

1. The throw effect is most obvious on frozen combinations because the direction of the line of centers can be seen clearly, but it also occurs on simple cut shots.
2. Dirty balls throw more than clean ones because the friction between them is greater. The condition of the cloth does not affect the amount of throw.

3. For average balls, maximum throw is about 6 degrees, which amounts to about six ball widths over the length of a 9-foot table.

4. Maximum throw occurs on a half-ball hit (the angle of approach is 30 degrees).

5. Throw is greatest with very soft speed. Shooting extremely hard reduces the amount of throw by roughly half for angles of approach greater than about 20 degrees.

6. On a simple cut shot, a cueball without sidespin will throw the object ball forward because of friction. To compensate, cut the ball slightly more (make a thinner hit) than geometry would suggest.

7. The throw effect on cut shots can be eliminated by using outside English, which causes the cueball to roll against the object ball instead of rubbing against it. With the right amount of outside English the object ball will travel along a line exactly opposite the cueball contact point.

8. Moistening the contact point between balls almost eliminates throw because it reduces friction to near zero.

9. Chalking the contact point between balls greatly increases friction and therefore throw.

10. The direction, speed, and spin of the cueball are results of how hard the cue hits it, how the cue is oriented in space at the moment of contact, and the eccentricity of the hit (how much off center). Having nothing to do with cueball behavior are such things as the wrist (rigid or flexible), the grip (tight or loose), the follow-through (short or long, straight or crooked), the mental attitude of the player, or body English. Those who believe such things affect the cueball are guilty of voodoo pool. (I'm not saying mental attitude isn't important, only that it doesn't affect the cueball once it's rolling.)

11. Following through is desirable because it is a waste of energy to stop the cue short. After the instant of contact between the tip and the cueball, the cueball can no longer be influenced.

12. A straight follow-through and a snug bridge minimize miscues and help the player hit the cueball at the desired spot and in the desired direction. In addition, a smooth, flowing stroke looks pretty.

13. Sidespin does not significantly affect the angle the cueball takes off the object ball; that angle is influenced by topspin and backspin. Sidespin is used to change the rebound angle and the speed off a rail.

14. If the cue is exactly level, sidespin will not make the cueball curve. To make the cueball curve, it must be struck a downward blow. However, since the cue is at least slightly elevated on most shots, sidespin makes it harder to get a precise hit on the object ball.

15. It is possible to make the cueball curve left with right English. Put the cueball on a piece of chalk on the rail, kneel on the floor, and hit it from beneath.

16. If you strike down on the cueball it will jump . . . unless you trap it under the tip, as in a massé shot.

17. If sidespin is used, the cueball will not initially travel along a line parallel to the cue—it will deflect in a direction opposite the English. The term *squirt* can be used to describe the phenomenon in order to save words like deflection and divergence for other uses.

18. There is less squirt with stiff shafts than with whippy shafts. To test this claim, shoot the "Impossible" Cut Shot (*Byrne's Standard Book*, page 120) the length of the table and keep track of where you have to aim to compensate for squirt.

19. To keep an object ball on the rail on a cut shot, it is best to hit the rail first. Hitting the ball and the rail at the same time will make the object ball leave the rail because of the throw effect. To prove it, set up the rail shot on page 129 of *Byrne's Standard Book* and separate the black ball from the 7 about a quarter-inch. (The correct space depends on the force used and the angle of the cut.)

20. Only a very small fraction of cueball spin can be transmitted to the object ball, but it is enough to make the object ball throw off line by several inches over the length of the table and it is enough to affect the rebound angle significantly on bank shots. The throw occurs at the moment of contact; the object ball doesn't curve because it doesn't receive a downward blow.

21. Because so little spin can be transferred, it is folly to try to make an object ball spin into a corner pocket.

22. When a ball bounces off a rail, the angle of approach does not equal the angle of departure. Methods of calculating banks are not accurate if it is assumed that the two angles are equal. Natural forward roll bends the cueball's path as it leaves the rail, reducing the rebound angle.

23. A cueball struck on its vertical axis seven-tenths of its diameter from the cloth (a hair less than halfway from the center to the top) will have natural forward roll (no slippage between the ball and the cloth). It is almost impossible to get more topspin than natural forward roll, so trying to hit the cueball higher only increases the risk of a miscue.

24. When a cueball hits an object ball full in the face, it will stop dead (see item 33). After stopping, it will follow or draw back, depending on whether it has topspin or backspin. This assumes that the balls are exactly the same weight.

25. A sliding cueball (no topspin or backspin) that hits an object ball full will stop dead and stay there. If it had sidespin only, it will stop and spin in place.

26. On a cut shot, the cueball will leave the object ball along the right-angle line, which is the perpendicular bisector of the line connecting the centers of the balls at the moment of contact.

27. On a cut shot, the cueball will bend forward or backward from the right-angle line depending on whether it has topspin or backspin. The curve is a parabola, and its sharpness depends on the speed.

28. On a cut shot, the cueball will stay on the right-angle line if it was sliding (no topspin or backspin) at the moment of contact.

29. On a cut shot, the initial direction the cueball takes forms very nearly a right angle with the direction the object ball takes. To split hairs, the angle is slightly less than 90 degrees because of friction and the inelasticity of the balls. So caroms don't go *quite* along the tangent line.

30. On a massé shot, if you aim through the cueball directly at the point on the cloth that the cueball is touching, the cueball will spurt forward and stop dead. The cue must be elevated to at least 60 degrees. Less than 60 degrees and it is hard to aim at the resting point without miscuing. How far out it goes before stopping depends on the elevation of the cue and the force. Knowing this is very nearly useless.

31. On a massé shot, the direction the cueball ultimately takes is parallel to the line formed by the resting point of the cueball and the point on the cloth at which the cue is aimed.

32. Despite what I say on page 93 of *Byrne's Treasury of Trick Shots* about the "force through shot," draw isn't needed, though it helps.

33. At the instant of contact of the tip with the cueball when sidespin is used, the shaft bends toward the cueball.

34. The best weight of cue for breaking in nine ball varies with the size and strength of the player. Throwing the body into the break shot affects accuracy too much. Timing is the key. That is, making the cue reach its top speed at the instant of contact.
35. Generally speaking, the cueball leaves the tip at twice the speed of the cue. After the hit, the cue slows down to about half-speed.
36. A light cue is better for jump shots because it stops quicker after the hit and doesn't follow through as fast to interfere with the cueball.
37. A cueball with natural forward roll will be deflected most if it hits the object ball half full; that is, if the center of the cueball is aimed at the edge of the object ball. That angle is about 34 degrees for the balls used today.
38. Most of the above depends on having cueballs and object balls of exactly the same weight. Cueballs get worn down and tend to be lighter than the rest of the balls, which don't get struck as often. (Take a scale into a pool hall and see.) In bar pool, of course, the cueball is heavier by design.

Lucky Shots—Ancient and Modern

The shot that gets the biggest response from the audience, that makes the shooter grin the broadest, that makes the opponent hurt the most is the fluke. Forget the long-range cuts, the courageous do-or-die breaks, the sky-rocket power draws, the pinpoint position plays, and the subtle safeties; if you really want to see people whoop and holler, uncork a slop shot.

The injustice of it can be maddening. One player's beautiful run is stopped by a kiss nobody could have foreseen, while his opponent miscues and scores anyway. The best players win in the long run, but along the way we are all alternately battered and bouyed by surprising, even astounding, strokes of luck. All games involve luck, even chess (as when your move makes threats you didn't see at first or counters a threat you weren't aware of), but in pool and billiards it manifests itself in wonderfully dynamic, unpredictable, and stunning ways. In what other game can you try to score, fail, and then score anyway a few seconds later by accident? When it happens, who among us is not moved?

Part of the charm of fluke shots, I think, is that they enable us to witness extremely unlikely events. If the odds against something are a million to one, you can't fail to be excited when you see it happen. I've seen beginners playing eight ball so convulsed with laughter over lucky shots (okay, so they had a few beers) that they could hardly continue the game. The shot gets a greater emotional response than any other and is one of the main ingre-
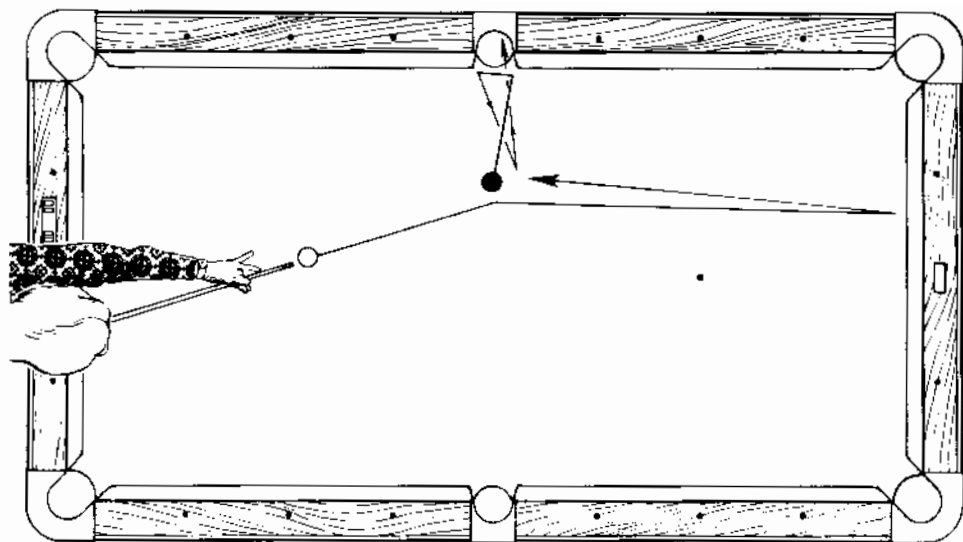
Diagram 62. Lucky shots

dients of the game's charm and appeal. Billiard publications at the turn of the century often diagrammed remarkable accidents contributed by readers, and I think they should again. I have a feeling that a lot of miracles are taking place on the pool tables of this great land without getting the recognition they deserve.

A few years ago, I was watching an eight-ball league match in Novato, Calif. Dr. John Strout, an oto-laryngologist (he takes out tonsils) was playing for game ball. He called the 8 in the side. What happened is shown in Diagram 62. The ball doubled the points of the pocket, rolled out toward the middle of the table, and was cut back into the called pocket by the rebounding cueball. You have to admit that there is something hilarious about this even for those on the losing side.

The most amazing accident that I ever was personally involved in, aside from my own birth, took place on an 8-foot table in a sleaze-bag named Walt & Hank's in Boulder, Colo., in 1954. (See Diagram 63.) My opponent tried to cut a ball inside and at the same time make the 9 in the corner. Well! He missed the ball entirely; the cueball went four rails and then executed the shot as originally planned! For reasons I have never understood, God had reached down and taken my dollar. It was years before I could go back to Colorado.

In pool, a scratch ends your inning; in three-cushion billiards a scratch means a lucky score. Flukes in three cushion have an extra dimension in that they sometimes take quite a long time to unfold. You have time to look at your opponent and watch the blood drain from his face.

A billiard player from Santa Rosa, Calif., named D. Mellinger was faced with the shot in Diagram 64 during a tournament in 1983. He tried to go
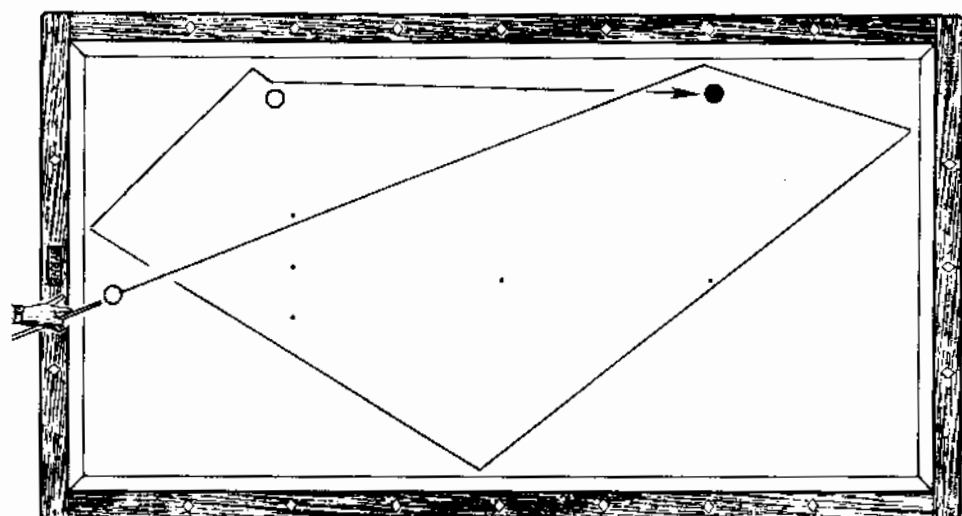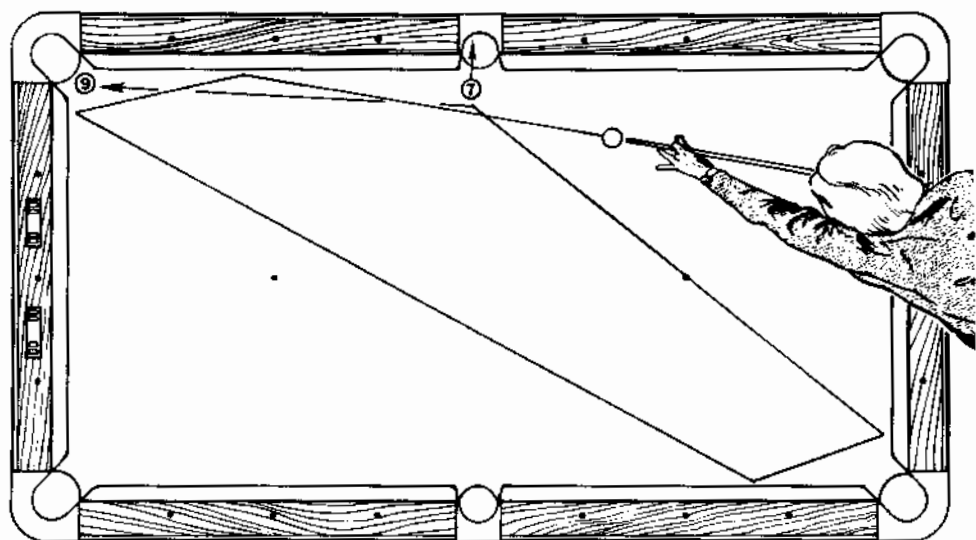
Diagrams 63 and 64: Lucky shots

rail-first off the red but missed the ball entirely. The cueball went around
the table and scored in the manner shown. He said he felt terrible about it.
More amazing than the shot itself is that during my efforts to find some
historical examples I found that the identical accident occurred once before.
John A. Thatcher in his *Championship Billiards Old and New*, published in
1898, credits it to one Ben Saylor.

Diagram 65 is also from Thatcher, who says: "A professional, disgruntled
and finding what to him seemed an impossible position, shoots hard, drawing
Cue Ball with heavy right Twist, taking five Cushions. The Cue Ball meets
the red and again going to the Side Cushion effects the Count."

A periodical that presented diagrams of flukes in almost every issue was
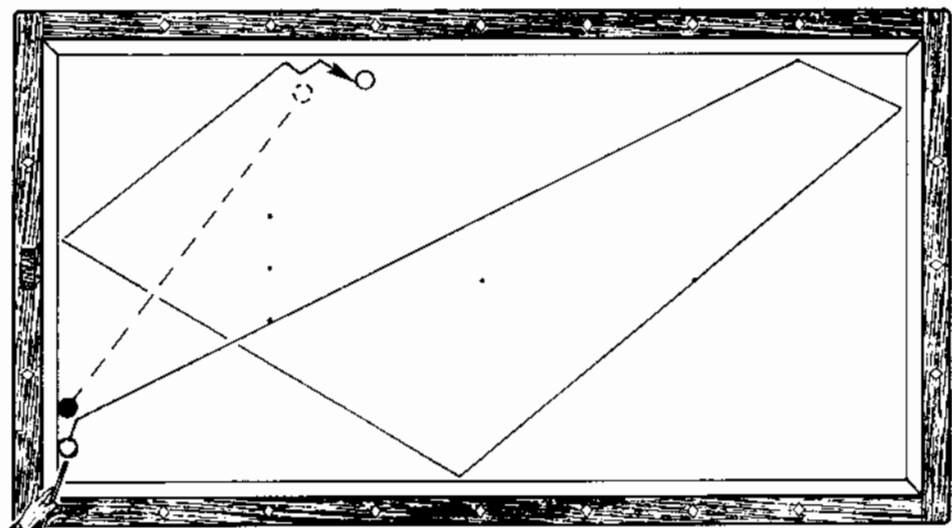
Diagram 65. Lucky shots

The Official Organ of the Billiard Association of Great Britain & Ireland, India & The Colonies, published at the turn of the century. (My thanks to Mike Shamos of Pittsburgh, curator of the Billiard Archive, for sending me photostats.) I haven't reproduced any of them here, though, because they are from the game of English billiards, which isn't played in the United States. One describes a player who accidentally jumped the cueball to the next table, where a point was scored. An example of that theme which took place in Boston in 1945 is described in *Byrne's Treasury of Trick Shots* on page 124.

Note that I haven't described any of my own lucky shots. The reason is that I never make any. I never get a break. My opponents, though! The luck they have is unbelievable!

A Selection of Alternate Games

Players keep coming up with new games, and it's been going on for hundreds of years. Inventors can become consumed by their inventions and go on earnest campaigns trying to bathe others in a heavenly light. I've had to fight off more than one new-game messiah.

Many little-known games deserve more play. Following are a few that languish in rule books or old magazines or that have been sent to me by readers.

A good game for practice or for tournaments is *Equal Offense*, invented by Jerry Briesath, which is straight pool without the safety exchanges. Players

begin each inning with an open break and the opportunity to run a maximum of 20 balls. For details see recent editions of the Billiard Congress of America (BCA) rule book or *Byrne's Standard Book*.

Bowlliards, a name to make you gag, is an interesting game that attempts to make use of the bonus scoring method of bowling, which may be part of that game's ungodly popularity. Rack ten balls, bust them open, and start with the cueball behind the line. Using straight pool rules, try to run ten; if you succeed, score it as a strike. If it takes two shots, score it as a spare. If after two shots you still haven't run ten, you get only the number of balls you made as your score for that inning. For more, see the BCA rule book.
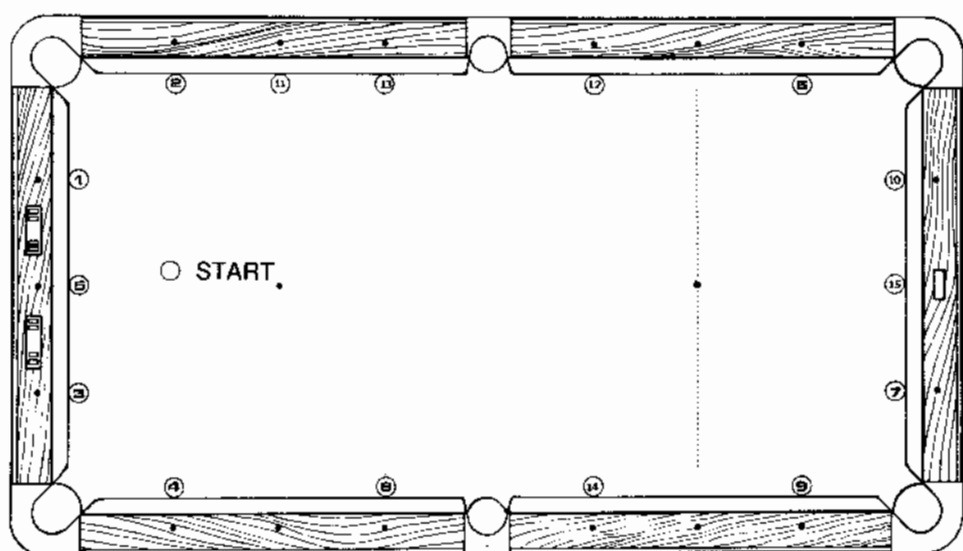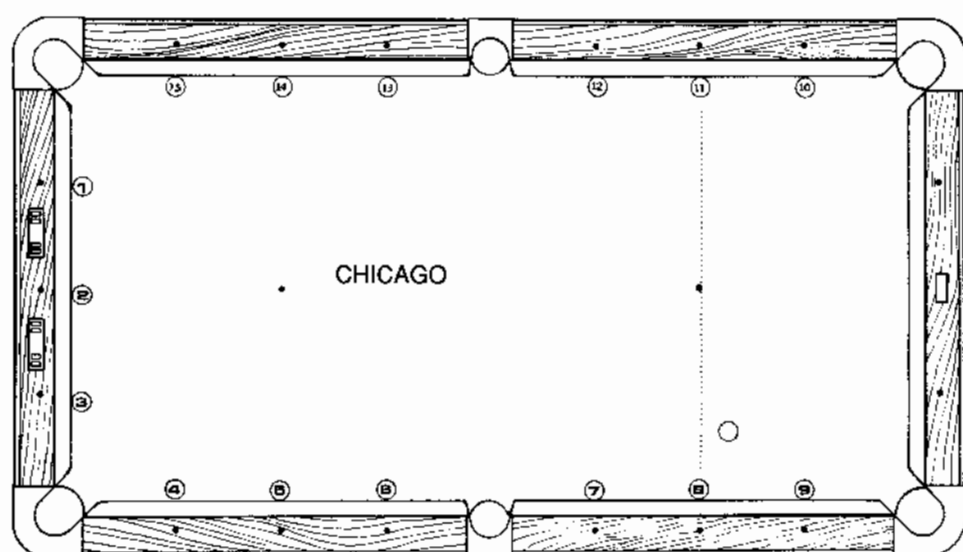
The idea of adopting bowling's scoring bonuses is an old one. A booklet published in 1919 by Irvin Huston of Detroit was devoted to a concept he called "Instructive Bowling-Billiards." (There's a catchy title!) Adaptable to any pool or billiard game, the rules require diagrams of ten shots. Scoring on the first try is a strike, on the second try is a spare. Missing twice counts zero and ends the inning.

Honolulu is a game that Kent Andersson likes so much he promotes tournaments for it in his Son of River City Billiards in Anchorage, Alaska. The game is played like straight pool with one huge exception: to count, a shot must be a bank, a kick, a carom, or a combination. First to score eight points wins. Write Kent at 322 E. Fireweek Lane, Anchorage, Alaska 99503, for the complete rules.

Popular in Mexico is a variation of rotation that was called *Chicago* in early editions of the BCA rule book. Instead of racking the balls in a triangle at the start, place them against the cushions a diamond apart, skipping the head rail. The starting layout is given in Diagram 66. The layout in Diagram 67 is excellent for practice because with perfect cueball control it is possible to run all 15 balls.

Kiss Pool. Willie Jopling of trick shot fame is crazy about this and would love to play you for money. It's a heck of a good game. To score, you must pocket the numbered balls by caroming them off the white ball; that is, you use the numbered balls as cueballs. To start, rack the balls with the white ball at the apex and one of the numbered balls behind the line. If you can send the numbered ball into a pocket off the white ball, shoot again, using any numbered ball as your cueball and trying always to "scratch" off the white ball. If the white ball goes in, the inning is over and the white ball is put on or behind the spot. For the full details, see the February 1981 edition of *Billiards Digest,* or write Jopling at P.O. Box 2215, Lynchburg, Va. 24501.

John Furda of Denver has trademarked the name of his game: *High-Cue.* It requires a special set of balls, which will make it tough to popularize, and a tricky scoring system, but a lot of players who have learned it like it, Denver's Danny Medina among them. The rules are in the August 1983 issue of *Billiards Digest.*

Diagrams 66 and 67: Alternate games

Mayhew. Here's a clever combination of pool, snooker, and poker invented by Barry Mayhew of Canada. At the start, each player takes a pea, the value of which is unknown to the other players. Each player mentally subtracts his pea number from 100 to find the number of points he must score *exactly* to win. Rack nine balls in a diamond with the black in the center. Call the other eight balls "reds." Players alternate pocketing the reds and the black; the reds stay down, the black gets respotted. Making a red counts from one to six points, depending on the pocket. Pockets are valued as shown in Diagram 68. (Barry suggests writing the numbers on the cloth

Diagrams 66 and 67: Alternate games

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Diagram 68. Alternate games

with chalk.) The black counts twice the value of the pocket. When scores approach 80, bluffing becomes important, for once a player's secret number can be guessed, other players can deny him a shot at his required pocket. As a throw-off, a player might deliberately shoot a ball at a wrong-number pocket and miss. For the full rules, write Barry Mayhew at 2470 Central Ave., Victoria, British Columbia, Canada V8S 2S9.

Stephen Dreyfus likes a game he calls *31 Ford,* which he says is popular in his neck of the woods. Jaw two balls in each pocket and put the remaining three in a line from the foot spot. The idea is to pocket all the balls in the fewest shots starting with ball in hand behind the head string. Since it's within reason to make four balls at once twice, it's possible to make all 15 in seven shots, or with luck, six. A player who misses or scratches must return a ball to the table, which makes a low score harder to achieve than it seems at first. Players continue shooting until they have made all 15 balls or have taken 31 shots. The difficulty of the game can be adjusted by how deeply the balls are placed in the jaws. Says Dreyfus: "Overconfidence and greed frequently result in frustration and defeat." Get the full rules by writing to him at 134 Excelsior Dr., Easley, S.C. 29640.

L. O'Barney Jr., came up with *Barney Pool*, a three-ball game. Put a ball on the head spot, one on the center spot, and one on the foot spot. Starting with the cueball in hand behind the line, try to make the three balls in three shots in the same pocket. (You can't start with the ball on the head spot.) If you do it you get one point, the balls are respotted, and you continue shooting from where the cueball came to rest. For the fine points, write him at Rte. 1, Bailey's Harbor, Wis. 54202.

Here's a really obscure game. It's called *2-Ball,* and it's played only by

George Fels. Put a ball on the head spot and one on the foot spot. The object on each stroke is to hit both balls with the cueball while pocketing one of them. I like it. The rules and some typical shots are given in the December 1982 issue of *Billiards Digest.*

A Selection of Tournament Formats

It's odd the way sports and games are wedded to certain kinds of tournaments. College basketball conferences use the home-and-home double round-robin for league play and the single elimination for postseason play. Tennis is a single-elimination sport. Chess is fond of the so-called Swiss system, in which a tremendous number of players can be accommodated in a few days. Three-cushion billiard tournaments in the United States are almost always round-robins for both preliminaries and finals.

Nine ball seems stuck with the double-elimination format, which is the clumsiest, most confusing, and least satisfactory of all. Golf doesn't even hold proper tournaments—everybody just goes out and plays, and the lowest score wins. The participants don't even have to see each other. (In pool, something similar are Equal Offense events, in which winners are determined by medal rather than match play.)

Following are brief descriptions of the major formats, a word about their pros and cons, and a look at some experiments that should be tried.

The Round-Robin. In a round-robin tournament, every player meets every other player and the one ending with the best record wins. Ties at the end can be broken by playoffs, by total points scored, or by the results of the games already played between the tied players.

It is the fairest format in that there is no "luck of the draw." Players like it because everybody plays the same number of games and nobody gets eliminated.

Disadvantages are that early matches lack tension and that a champion is sometimes determined before the final round. Another minus is that there are always a lot of meaningless games; toward the end, players with no chance at a prize must nevertheless play each other, much to the boredom of the audience, if any.

The concept is simple (all play all), but many spectators can't figure out how to read the wall chart.

The Accelerated Round-Robin. I pushed this variation for years, but my enthusiasm failed to be contagious. The idea is to retain the fairness of the format while eliminating some of the meaningless games. A chart is prepared as if all the entrants are going to play a complete round-robin. At some point during the tournament—the point depends on how many games

you want to eliminate—the players with the worst records are dropped. That way the spectators don't have to watch matches between players with no chance at prizes and the tournament as a whole is shortened.

The Blitz Twice-Around. There is another form of accelerated round-robin that I have never been able to sell to anybody, the short-game double elimination. Call it the Blitz Twice-Around. Every player in the tournament plays every other player twice, but to keep it from dragging on too long, the matches are very short. Keeping track is simple: use a standard round-robin chart and divide every square with a diagonal line; the first match result goes above the line, the second goes below. Rather than have, say, ten three-cushion players go through a round-robin of 40-point games, make it twice around with games to 20 points. More excitement and more upsets.

The Single Elimination. This is the simplest and best format for spectators and television because every match is crucial and the precise time of the championship match is known in advance. Spectators are clear on the concept: lose a match, and you're out. The winner is the only undefeated player left at the end. The chart is uncluttered and easy to follow. The reason it isn't used more in pool is that prize funds still come mainly from entry fees. You can't attract enough players if there is a risk of elimination after one round.

The Double Elimination. In this format, you have to lose twice to be eliminated. Winners advance on a chart exactly as in a single-elimination tournament, but losers keep getting fed back in on "the losers' side" of the chart. Casual fans are defeated by the complexity of the chart. Until they lose a match, players are plagued by long waits. Typically, the winner of the losers' bracket (who has one loss) must beat the winners' bracket winner (who is undefeated) twice to win the tournament, even though if he wins the first encounter he has a better record. Television directors hate this format because they can't tell in advance which encounter between the finalists will be decisive. There are ways to get around the problem, but the general public can't be expected to understand the chart.

The Swiss System. Chess tournaments all over the world now use this format, which was pioneered mainly in the United States. Hundreds of players can be accommodated in only a few days and everybody plays the same number of games. To make it work the players, or most of them, have to be accurately rated so that fair pairings can be made. In the first round, the upper half of the field (the highest rated) plays the lower half; after that players with the same won-loss-draw records are matched against each other . . . high against low within the group. Even with 100 or 200 players, after only five or six rounds there are usually only two or three undefeated players left who are playing each other for the title. It works in chess because of the sophisticated ranking system and because players bring their own tables (boards and men). It could work in pool if a lot of tables are available.

The Fullerton Formula. John Fullerton of Mill Valley, Calif., has a table in his house and wanted to host a nine-ball tournament with seven of his friends. Most formats would involve too much waiting between matches. After much discussion, we came up with a format we called the Fullerton Formula, which was enjoyed by all. There are three features. One is short matches—we played races to three. Second is team play—two-man teams compete and partners change for every match. The third is alternate stroke shooting—if you pocket a ball your partner takes the next shot. The result is that everybody stays involved in the tournament, nobody has to wait very long to get to the table, and a good level of sociability develops. Partners discuss strategy and position on each shot because of the alternate stroking. The format is continuous, and the tournament is over when you run out of time. The winner of the tournament is the player who has been on the most winning teams. (See accompanying box for a method of mixing partners.)

The Ladder. Room owners could borrow an idea from chess clubs and keep a continuous ladder tournament going. It never ends. Players are ranked on a posted list. You can only challenge players above you on the list. Your ranking points change with each match you play by an amount depending on the difference in the ranking points of the players. You lose few points, for example, if you drop a match to someone far above you. Handicapping keeps a large number of players interested. Money goes to a prize fund with each match played. Awards can be made monthly.

Mixed Format. Pool promoters should consider the structure now popular in Europe for pro three-cushion tournaments. Start with round-robin

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Pairing Chart for the Fullerton Formula
Assign players a letter from A to F. Matches are between two-man teams.

Round			
Round 1	AB vs. CD	AB vs. EF	CD vs. EF
Round 2	AC vs. BE	AC vs. DF	BE vs. DF
Round 3	AD vs. BF	AD vs. CE	BF vs. CE
Round 4	AF vs. BC	AF vs. DE	BC vs. DE
Round 5	AB vs. CE	AB vs. DF	CE vs. DF
Round 6	AC vs. BF	AC vs. ED	BF vs. ED
Round 7	AE vs. BC	AE vs. DF	BC vs. DF
Round 8	AF vs. BD	AF vs. CE	BD vs. CE
Round 9	AB vs. CF	AB vs. DE	CF vs. DE
Round 10	AD vs. BC	AD vs. EF	BC vs. EF
Round 11	AE vs. BD	AE vs. CF	BD vs. CF
Round 12	AF vs. BE	AF vs. CD	BE vs. CD
Round 13	AC vs. BD	AC vs. EF	BD vs. EF
Round 14	AD vs. BE	AD vs. CE	BE vs. CF
Round 15	AE vs. BF	AE vs. CD	BF vs. CD

play, end with single elimination. Let's say you have 64 players for a nine-ball tournament. Divide the field into 16 flights of four for round-robin play. Each player is thereby assured of playing at least three matches. The winners of the 16 flights then enter a single-elimination phase. In this way, the last part of the tournament is exciting and easy to follow, yet nobody gets eliminated after only one or two matches. This combination of formats for 64 players would require 111 matches; a full double-elimination tournament would require 126 or 127.

Experimental Formats. I've been tinkering with a format that might attract big fields because there is no entry fee. The idea is that losers must contribute money to a prize fund to continue playing. In other words, losers of up to, say, three matches can buy their way back in. The attraction is that you get to play at least one match before having to put up any money, which should appeal to lower-ranked players. I'm still working on the details. Any suggestions?

Bob Jewett has an interesting idea. Use the single-elimination format, but put the losers into 16-man, short-race, low-entry-fee, consolation tournaments. That would attract players who hate to take the chance of traveling a long way and getting knocked out in the first round. A possibility would be to let the winners of such consolation flights back into the chase for the main prizes, or let them buy their way back in. Something similar would be to modify the double elimination by making losers' bracket races very short until near the end.

How to Argue for a Pool Hall

Want to open a pool hall? Want to expand one you already own or extend its hours? In many precincts you would have an easier time opening a bordello, an arena for dog fights, or a public dump.

It is absolutely amazing how opposed to pool halls some communities are and how differently applications for them are treated from other business proposals. There are cities where the necessary permit is issued by the police department rather than the city council or board of supervisors. There are cities that will give you a permit, but with restrictions so severe you will lose your shirt. (A common ploy is to require unrealistic parking accommodations.) There are cities that will simply say no, get lost, we don't want a pool hall here.

You are in deep water if you want to serve cocktails at tableside. You want to let a person have a drink while he plays pool? Where children might see it? Not in our town! Never mind that the bar down the street has four coin-op tables surrounded by nightly boozers. Never mind that you can have

a drink at Gutterball Lanes while bowling with your kids. Pool halls are different. Pool halls are smoky places where crimes are plotted, curses are uttered, and thumbs are broken. We don't want dives like that in River City.

How do you combat such thinking? What do you say to a board of supervisors, no member of which is interested in the game or has ever seen a modern, clean, safe, well-run billiard room? The first thing to do is realize that their fears are not entirely misplaced. A billiard room that is not well managed *can* become a police problem and an eyesore. It will be your job to argue convincingly that what you are proposing is in a different category altogether. You may have to persuade the board to forget the dingy room that once plagued the town as a center for dope dealing, fighting, truancy, and drunks, and to give you a chance to prove that you can provide a recreational center that the community can be proud of. If there is a well-run room in a nearby town, get a statement from the chief of police there or a city council member. If you are a person of exemplary character, stress that. If you have some well-connected local friends, make use of them.

What prompts these remarks is the experience of a friend of mine, Tommy Thomsen. Like many other players, he had dreamed for years about owning his own room. The dream came true in late 1987 when he opened Tommy T's Family Billiards in Beaverton, Oreg., a suburb of Portland. It's an 8,000-square-foot facility with 15 full-size pool tables, three 10-foot billiard tables, and one 12-foot snooker table. Beer and wine are available, but not at the tables. Present Oregon practice forbids, for example, a father from having a beer while he plays a game of eight ball with his minor son. He has to retire to the bar to slake his disgraceful thirst. There is a lunch counter and a separate arcade with 25 video games.

Despite paying some $7,000 for various local fees and permits, Thomsen didn't have permission for the hours of operation he felt were essential for financial success. At first the city council wanted him to close at 10:00 P.M., but an appearance before the planning commission resulted in the right to stay open until midnight on a one-year trial basis. His request for two extra hours on weekends was turned down, which led him to appeal to the council.

Fearing that he wasn't silver-tongued enough to change the minds of the council members, he turned to me for whatever help I might be able to offer. I wrote the following statement and told him he could either read it as an endorsement from me or use it in preparing his own statement.

I make the same offer to readers of this book. If any of my arguments, words, or phrases might help you in an appearance before a commission, council, or board, feel free to use them in any way you see fit. You don't have to give me credit or ask my permission. Change the wording any way you want to suit your style and your particular situation.

Thomsen's request, by the way, was granted, and the council is still happy with the decision.

To: *The City Council of Beaverton, Oregon.*
Subject: *Request for extended hours of operation for Tommy T's Family Billiards.*

Ladies and Gentlemen:

Before you is a request from Thomas Thomsen, who asks for permission to keep his new business open until 2:00 A.M. on Friday and Saturday nights.

In ruling on this request, you quite properly must consider its overall effect on the community. The planning commission has recommended that Tommy T's be allowed to stay open until midnight seven days a week. You must now decide whether or not to grant the applicant another four hours of operation a week.

The game of pool, unfortunately for those who love it, is saddled with an image that is as negative as it is unfair. Books, magazines, newspapers, and especially the movies, when they deal with the game at all, almost always show it being played in decrepit public rooms that seem to be halfway houses for the nearest penitentiary. Journalists seem incapable of writing about the game without stressing sleaze. Two popular Paul Newman movies—*The Hustler* and *The Color of Money*—are prime offenders and have gone a long way toward creating the stereotype of the pool hall as a haven for felons, psychopaths, cheaters, con

men, drunks, and drifters. As a fiction writer, I can understand the temptation of portraying pool halls in this way, but as a longtime player of the game I know how false is the public perception of the game. The stereotypes have given rise to all sorts of restrictive municipal laws and policies and have interfered with the development in the United States of one of the world's oldest and most popular pastimes. A large segment of the population is being inconvenienced and in some areas even denied a place to practice a wonderful hobby.

How large a segment? Three major surveys by the A. C. Nielsen Company reveal the surprising fact that pool and billiards are second only to bowling in the United States as a competitive participant sport; there are between 20 and 30 million people who play at least one game of pool a year. Americans who want some friendly competition are likelier to pick up a cue than a golf club, a tennis racket, or a ping-pong paddle. And for the first time in its long history, women are playing in significant numbers. In some metropolitan areas, tavern leagues attract a thousand players and more to weekly matches, and as many as one-third to one-half are women.

The growth in the game to such a level has come in spite of resistance and even hostility on the part of many city officials to billiard rooms. The game has been forced to grow mainly by means of coin-operated tables in bars. A bar owner can install a coin-operated pool

table in most communities with no questions asked as long as he has a vending-machine permit; the businessman who wants to open a billiard room in which players are charged according to how long they play faces one hurdle after another, including the need to make appearances before public bodies such as this one. The difference is unfair and discriminatory.

It is often easier to open an establishment where customers try to get drunk than it is to open an establishment where they merely push balls around with sticks. Why that should be is a question that greatly disturbs players and those involved in the manufacture and distribution of billiard equipment and supplies, a multimillion dollar industry. Certainly there is nothing about the game itself that should raise special fears. Quite the contrary. The game in fact is a wonderful physical and intellectual challenge. It's an absorbing, relaxing pastime, and to play it well takes good eyesight, hand-eye coordination, imagination, concentration, discipline, practice, coaching, and brains. Yes, brains, for to analyze a random array of balls correctly and decide the best way of attacking it can be as complicated as a chess position. The game is also chesslike in its demand for balancing offense and defense. No wonder it has lasted 300 years and is so popular all over the world. In England, for example, a variation called snooker is the number one television sport, far surpassing soccer. To sum it up in a word, the game is *fun*.

Stereotypes must be set aside when dealing with the real world and the issue before you. Certainly there have been and are scary pool halls where you wouldn't want to take your mother or your date . . . unless they were out on bail. And there are billiard rooms that differ from those dens of iniquity as much as day differs from night. What counts, in the end, is the concept and the management. What sort of clientele will the room attract? How will it be supervised and by whom?

A well-conceived and well-managed billiard room can be a civic asset. It can be a bright, open, clean, inviting place that appeals to couples, families, housewives, and seniors—in short, anyone interested in a few hours of congenial social recreation—as well as to serious students of the game. Examples of this new breed of billiard room are springing up all over the country, as the game is enjoying one of its periodic booms. California Billiards in San Jose is one I am familiar with. Star Billiards in Santa Rosa, Calif., is another. Believe me, you can take your mother into either of those places and have a thoroughly enjoyable time. Rooms like those are civic assets because they provide another meeting place, another social focal point, another alternative to the local bar. How many things are there to do in your community on a rainy, snowy, or cold day? A businessman willing to spend money to

provide an attractive option should be encouraged and even applauded.

Regarding the specific issue of granting extended hours to Tommy T's, I ask you to look at Tommy Thomsen and his associate, Mort Brock. I can vouch for both of them. I have known them for ten years as men of the highest character and reliability. They are starting this venture because they deeply love the game and because they want to create a place for it that they can be proud of. As lovers of the game, they want to showcase it to its best advantage. I have no doubt at all that Tommy T's Family Billiards will be a credit to Beaverton and to the game. Playing conditions will be so good that I won't be surprised if even some members of this board start chalking up.

The economics of the business, however, require that the facilities be available when customers want to use them. Experience elsewhere suggests that the hours from midnight to two in the morning are often the most popular; in fact, being open during those hours can very well be the key to success of the room. People who have attended a late movie might want to shoot pool for an hour or two before going home on nights not followed by a workday. They might want to play on full-sized equipment in a quiet environment instead of on undersized tables found in bars, and they might want to do it in the company of people more interested in the game than in alcohol.

I urge you, therefore, to grant the petitioner's request for extended hours. Your action will make Beaverton an even more attractive place to live in than it already is.

The Mathematics of Slumps and Streaks

How do you break out of a slump? How do you keep a hot streak going? It's great when you're red hot, in dead stroke, grooved, unconscious, hotter than a pistol, etc., and not so great when you're ice cold, out of stroke, distracted, and unable to hit the broad side of a barn.

The problem of slumps plagues players in all sports and games, and coaches, trainers, the players themselves, psychologists, and gurus of every stripe spend a lot of time trying to solve it. Among the prescriptions are meditation, prayer, legal and illegal drugs, a change in equipment (golfers often credit temporary success to a new putter), psychotherapy, hypnosis, pep talks, sex or avoiding sex, a break from the game, harder or different training, and a return to practicing basics.

I have good news. Many slumps are simply the workings of percentages, odds, and probabilities. For relief look outward toward the impersonal world of statistics instead of inward to the murky depths of your own psyche. You may be doing nothing wrong and nothing may need changing. Recognize

that mathematical probability may be to blame, continue playing as you always have, and as surely as day follows night the time will come when you won't be in a slump anymore. You may, in fact, get hotter than a fire-cracker, which is the same sort of phenomenon. From the point of view of statistics, the difference between a slump and a hot streak is that human beings like one and not the other.

Sports writers are partly to blame for the attention given to slumps and streaks. They are always looking for a story line or a hook, and snake-bit slumpers, unconscious streak shooters, so-called "clutch hitters," come-from-behind teams, and the concept of "momentum" provide them. Evidence suggests that all are fictions.

Take flipping coins, where the odds are even on heads or tails. In 1,000 flips, there is a 62.4 percent chance there'll be a run of ten heads, or tails, in a row. Only 700 flips are needed to give a 50-50 chance of a run of ten.

Or take the spot shot in a game of pool: cueball behind the line, object ball on the foot spot. Let's say you can make it half the time, on average. If the shot comes up once a day, at the end of three years you'll have tried it 1,000 times. The odds are that at some point you'll make it ten times in a row. At another point you'll miss it ten times in a row. In the first case you'll figure you have the shot wired, that you "never" miss it. In the second case you'll wonder what went wrong and start looking for remedies. (If you can make the spot shot three out of four times, then, of course, the chances of missing it ten times in a row are much more remote, approximately one in a million.)

Consider basketball players who make half their shots. Over the course of an 82-game season, a streak of ten shots in a row or a slump of ten consecutive misses should be nothing to get excited about.

A year or so ago psychologists Amos Tversky and Daniel Kahneman studied pro basketball players who tended to make half their shots. No remarkable streak shooters or "hot hands" were found. The streaks that did occur were random and well within chance expectations, just like flipping coins.

Three-cushion billiards serves as a convenient example. By definition, a world-class player averages 1.000 points per inning, which means that he makes a shot and misses one on the average for every trip to the table. In other words, he makes half his shots. If such a player enters a 12-man round-robin tournament of 50-point games, he will take around 1,000 shots. Odds are he will have at least one run of ten, and if you look at tournament charts that's roughly what you find. National champion Al Gilbert's last three-cushion tournament was at the San Francisco Elks Club in February 1989, to cite a case I'm familiar with. Gilbert took the title by winning 12 straight 35-point games. Since he averaged close to 1.000, he took about 850 shots. His high run was nine. The records don't show misses, but it wouldn't be

surprising if he missed nine shots in a row at some point. He might as well have been flipping coins. His odds on running nine during the tournament, in fact, were 81 percent; his odds on running ten were 56 percent.

A player who averages .500 is 40 times less likely to step to the table and run ten in three cushion than a 1.000 player. A 1.500 player is five times more likely to run ten than a 1.000 player in any given inning.

George Onoda, a research scientist for IBM in Yorktown Heights, N.Y., who checked the math in this chapter, calculated the odds on a 1.000 average player making runs of various lengths in a 50-point game of three cushion. The player has a 96 percent chance of running five, a 54 percent chance of running seven, and a 9.3 percent chance of running ten. With 1,000 shots, Onoda figured, a .500 player has only a 1.7 percent chance to have a ten run; a 1.000 player has a 62.4 percent chance; a 1.500 player has a 99.8 percent chance. (Omitted from the equations are factors for the tension and pressure that build as the run gets longer.) To run 15 in 1,000 shots, the 1.000 player has a 3 percent chance; the 1.500 player, a 37 percent chance. Knowing these odds may help you win a bet at the next tournament.

Probabalistic reasoning can also be applied to games rather than shots. If you play eight ball with a friend who is exactly as good as you are, and if you play three games every night, then at the end of a year one of you will probably have enjoyed a streak of ten wins in a row at some point. The victim has no reason to think of himself as "a loser." Chance alone explains the disaster.

Of course it isn't *all* predestined. Flaws in technique do creep in and cut a player's skill level, as do health problems, financial and romantic reverses, and so on. Your emotions can rise up and tear you down, no doubt about it, just as they can help you play better than you normally do.

There may be a kind of self-fulfilling prophecy at work. If you lose a few games in a row or miss some shots you usually make, you may believe you are in a slump, tighten up, get nervous, "choke," and find yourself unable to play up to your capabilities. Taking a longer view may help you avoid such self-defeating emotional reactions.

Viewed from the icy, remote peaks of mathematics, slumps can be seen to be inevitable, a simple result of percentages. No need to get depressed or change your game. Just hang in there until the tide turns, which mathematicians call regression to the mean. There is no law that *requires* the tide to turn, but chances are it will over the long haul.

The short haul is different. If you fall several games behind a player of equal ability, chances are you will *stay* behind because the balls have no memory. In an equal contest, you can't afford to spot your opponent anything; both theory and experiments show that in a 50-50 situation, the side that takes an early lead tends to stay in front until the end. What this implies for a nine-ball tournament is that players should alternate breaking. When the

winner breaks, the winner of the first game is apt to win several in a row; between evenly matched players, such a handicap is too hard to overcome in a short-race format.

Beware, too, of the so-called "gambler's fallacy." It is widely believed that streaks can be spotted *while they are occurring*. Casinos get rich on such thinking. Crap shooters and blackjack players when they win a few times in a row tend to think that a streak is under way and raise the bet, when in fact streaks can only be identified *in retrospect*. Because cards and dice and pool balls aren't influenced by history, at each step of the way they are subject to the same odds as when the "streak" began and are just as likely to turn against you as before. There is no way to tell if a streak is going to stop or continue. When flipping coins—a pure 50-50 proposition—if a run of nine tails in a row has taken place, the odds of another tail coming up are still 50-50 . . . even though the chances of flipping ten tails in a row are, before the flips begin, 1 in 1,000. In other words, once you've got nine in a row, the odds on ten are 50-50. This assumes, of course, that the coin and the flipping method are fair.

Many books on gambling contain advice on how to bet to take advantage of streaks, to "ride with the winner." If the authors really could tell when a streak is going to lengthen instead of end, you wonder why they try to make money writing books, a long-shot proposition if ever there was one. Casino gambling for such fortune-tellers would be a sure thing.

Another fallacy your emotions might lead you into is generalizing from insufficient evidence. In pool as in life, it is idle to base a conclusion on a sample that is too small to be statistically significant. A couple of years ago I was in a bleachers in Denver, Colo., watching a nine-ball match between Buddy Hall and David Howard. Early on, Hall, breaking with the cueball in the center, twice failed to pocket a ball. For the remainder of the match he broke with the cueball near the right side rail. Later I asked him why he switched and he told me it was because he couldn't make a ball breaking from the center.

In the heat of battle I might have made the same change Buddy Hall tried, even though two successive failures to pocket a ball on the break mean little or nothing. Statistics compiled by Pat Fleming of Accu-Stats show that top players fail to pocket a ball about twice in every five breaks, which is probably oftener than most people would guess. The chances, therefore, of failing to make a ball on the break twice in a row are 4 in 25, or roughly once in every six tries. Three consecutive failures to pocket a ball on the break are a 1 in 15 proposition.

For your homework, write an essay on the following piece of logic: When you take an airplane, the chance is small that there is a bomb aboard; the chance is even smaller—almost zero—that there are *two* bombs aboard. Next time you fly, therefore, take a bomb.