Bob Jewett

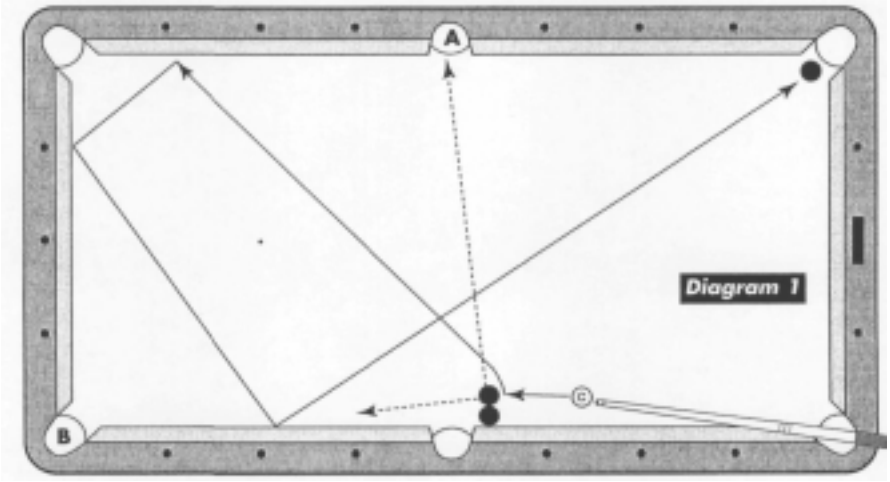
Tricky Business

Underneath their flashy exterior, trick shots offer useful principals.

Do you collect trick shots? You may have some hidden treasures if you look below the flashy surface. Within many good trick shots are useful ideas struggling to get out.

Shown in **Diagram 1** is a classic shot that has been in print for at least 50 years. Two object balls are frozen on the long cushion near the side pocket. They are aimed straight across the table. A third ball waits in the jaws of the opposite corner.

To play the shot, place the cue ball as shown and shoot with left follow, hitting about half of the outside ball. The cue ball completes a three-cushion circuit on its way to the hanger. In the mean time, the ball the cue ball struck goes into the corner, while the ball on the cushion banks cross-side.



What's wrong with this picture? The shot is not as simple as it may seem at first.

First, the ball that goes in pocket B has violated the standard rule of kissing balls: it should travel along the kiss line, that is to say perpendicular to the line of centers of the balls. Since the two balls are lined up straight across the table, the ball should go straight up the table and land one ball to the right of pocket B. If you hit the shot about as shown, the ball goes into the heart of the pocket. What's up?

The explanation is that the kiss line doesn't exactly apply when the cue ball hits two balls that are touching. The combination of all three balls being together at once causes the ball in the middle to be shoved slightly ahead of the line expected by the simple theory. In **Diagram** 2 are the details of the shot.

The shot is shown at the instant the cue ball arrives. There are three lines. The first is the kiss line, or the commonly expected path of the middle ball. The line of centers shows the path the middle ball would have followed if the other ball hadn't been behind it. The final line shows the actual path of the middle ball. It is close to the kiss line, but the path is about one-tenth of the way from the kiss line to the line of centers. (The ratio of the distances shown is therefore l to 9.)

In order to calculate how to hit the middle ball to get it to move over a ball from the kiss line on its way to the pocket, it's useful to remember that a diamond is about five ball diameters, or ten ball diameters is two diamonds. If you shoot the middle ball to a point about two diamonds to the left of the corner pocket — that would be out in the air on an imaginary extension of the end rail — the ball will go towards the corner pocket. If you miss the aim a little, and shoot the ball towards a point three diamonds to the left, the resulting error will be only half a ball at the pocket, and the ball will still probably drop.

This 10-to-one relationship of the paths was discussed here more fully in February 1996, when it was called the "ten-times - fuller" system. You may not have realized then that you had already seen it applied in nearly every trick-shot exhibition.

To test the theory, try separating the two object balls by a tiny gap. The prediction is that the ten-times-fuller system will not work, as it depends on the object balls touching.

Another puzzle is, what makes the ball on the rail go into pocket A? You might say off-hand that the English on the cue ball throws it in, but the cue ball has left side-spin to carry it around the table to the hanger, and if you work through the balls like gears, that should translate to left side-spin on the cushion ball as well. This would throw the ball in the wrong direction.

In this case, the answer is that the motion of the outside ball is what throws the other object ball and puts the necessary right side-spin on it. In studying any throw or transferred English situation, the important thing to note is how the surfaces of the two balls will rub. While the outside ball may have some small amount of right side-spin, it certainly has a lot of motion up the table, and that motion will dominate the rubbing. Imagine how much right side-spin the ball would have to have for the surface at the point of contact to be moving backwards.

Now we have explanations for the first object ball going towards pocket B and the second object ball throwing forward to pocket A. Both of these effects will tend to make the kiss more likely. Why don't these balls kiss? The reason here is the softness of the cushion. If the cushion was very hard, the banking ball would return immediately, and the middle ball wouldn't have time to escape up the table. What happens instead is that the ball sinks into the cushion — perhaps a quarter-inch on this shot — which takes time and allows the other ball to move out of the way.

The last part of the shot worth study is how consistently the hanger can be made by taking the cue ball three cushions. As long a you have a reasonable amount of left spin and hit about the right place on the first cushion, the shot seems automatic. Try varying the shot parameters to find the shot's "sweet spot," which is probably a moderate amount of follow and side and about a half-ball hit on the object ball.

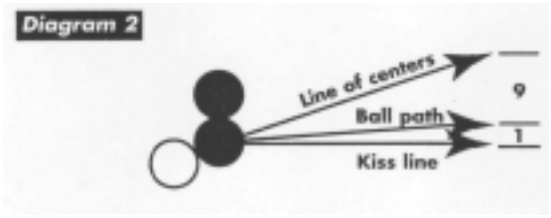
Also, try playing the shot with extreme side and a fuller hit on the first ball. The idea is to have lots of spin for the third rail so it really picks up speed and sets the eyeballers chattering. You may have to take off

some of the follow to get this shot to work best.

A very important idea is involved in the path of the cue ball. If you play about a half-ball hit with follow, the cue ball's trajectory is nearly independent of how full the contact is. Start with the path for a half-ball hit with normal follow. If you hit the object ball a little fuller, the initial carom angle of the cue ball will be straighter across the table, but the speed will not be as great, and the follow will be more effective at taking the cue ball forward. The result will be a final path for the cue ball that is nearly the same as before. Now consider hitting the shot a little thinner than half-ball. The cue ball have an initial path more forward, but will not give up as much speed to the object ball. That means that the follow will be less effective in taking the cue ball forward. Again, the result is a final path nearly the same as in the initial shot.

Why is a half-ball hit the angle that gives this nearly perfect repeatability of follow carom angle? The details are in the physics, and too complicated to go into here. A few results that are useful in play: Some cue balls have heavy centers. They will tend to follow less well than a uniformly constructed ball, and the final angle will be a little wider. Also, the best fullness to aim at will be a little fuller than for an ideal ball. On new cloth, the angle taken will be the same, but the cue ball will slide to the side more before it finishes its curve.

Here is a modification to the shot that relies on the very predictable path of the cue ball. Set up the shot, but be very careful to place the cue ball exactly one ball diameter off the cushion and exactly one diamond from the side pocket. Make sure the frozen object balls are in the same place each time you try the shot by tapping them into place. Now, shoot the shot and notice exactly where the cue ball lands on the first cushion. Move the hanger just in front of that point. It will now be made in the upper right corner pocket. This version is tougher, and will impress the more knowledgeable members of the audience. Practice it on the table before trying to show off so that you will know the best place to put the third object ball.



Of course there are many "trick" shots that depend on something outside normal play. They are of limited practical use, but they can be amusing. For example, place a bridge across the table and claim you can roll the 10 ball under the bridge without touching it. Pocket the 10 in a head pocket, and it will roll under the bridge via the ball return. If there is no ball return, roll the ball on the floor. If you try to place bets on such shots, take out thumb insurance.

Several collections of trick shots — useful and otherwise — are readily available in print. Mosconi's "Winning Pocket Billiards" was my first exposure as a raw beginner. It has a few shots at the end, and I practiced each one until I felt fairly sure of making it. For a monthly dose of fancy shots, check out Willie Jopling's column in this magazine.

Whenever you watch trick shots in an exhibition or see some in print, keep an eye out for the useful principles hidden within them. Your game will be the better for it.

Bob Jewett

Sources of Evil

Sometimes solid skills aren't powerful enough to deter mishaps.

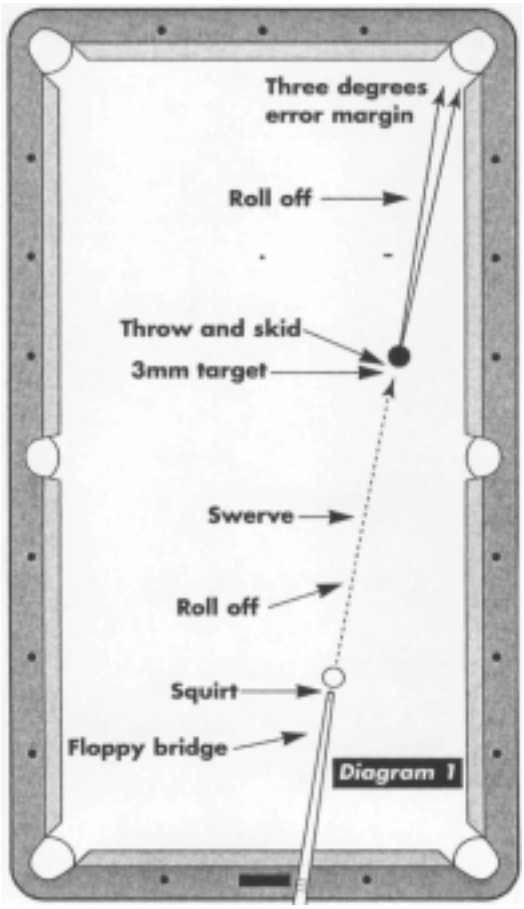
Have you ever thought about all the sources of error that cause your shots to be less than perfect? Some of them are under your control, but others aren't. For the major categories of incorrect alignment, bad delivery, wandering cue ball, and wandering object ball, let's look in detail at some' contributors.

For the initial stick alignment, errors can be due to bad visualization of the cut angle; inconsistent approach to the shot; an awkward stance, perhaps from stretching or leaning; inaccurate sighting from head misalignment, or vision inaccuracy; and bridge hand misplacement for the spin you want. These are all things you can work on — can you see how for each one? Can you think of other sources in this category?

Bad delivery of the stick through the ball results from another set of sources. While a perfectly straight stroke is the ideal, what is really needed is for you to bring the stick through the ball precisely where you expected to, based on your previous practice. Anything that causes your grip hand to depart from its usual, practiced path will lead to a result you didn't expect. Let's stretch our imaginations for this list: You haven't eaten in six hours; the shot is elevated more than normal, and your stroke is slightly "sidearm"; you hit the cue ball at the peak of your heart's pulse; you are inhaling as you stroke; you failed to take your usual pause at the end of the back stroke; your bridge hand is sticky; your grip hand slips on a power shot; the stick wobbles a little in your loose bridge; your arm is tired from carrying your suitcase through the airport, and the resulting timing is a little off. Some of these may seem completely negligible, but consider target shooting on long rifle ranges where the shooter's pulse can take the shot out of the bulls-eye.

The cue ball's path brings in another set of errors. It is rare that the cue ball will go in a perfectly straight line along the axis of the cue stick. Did you get as much squirt or deflection as you expected? Is the table flat? Are there lumps in the cloth? Is the cue ball round? (I owned a cue ball that would roll off left or right three inches in a table length, depending on where the heavy side was.) Did the swerve due to sidespin happen as expected, or were you surprised by the slippery cloth or sticky cue ball? Or maybe some extra elevation on the shot gave extra curve. Did the direction of the nap cause a roll-off?

For the object ball, we see about the same set of problems, but swerve due to sidespin is missing. Added is the very significant effect of throw — the object ball will be pulled to the left or right of the expected line by the rubbing of the surface of the cue ball. The extreme case of this is when a spot of chalk on the cue ball happens to arrive at the contact point between the two balls. The effect is called "skid," "cling," or "kick," and the result is usually a missed shot. Even without skid, judging throw can be tricky. Did you know that there is less throw with plain follow than with a sliding cue ball? While you might put "throw planning" mistakes under the "alignment" category, I think it's fair to blame the object ball for them.



How much margin for error does a typical shot have? Consider the shot in Diagram 1 with the cue ball at the line and the object ball halfway to a corner pocket. From the point of view of the object ball, the pocket is about three degrees wide. That is, the angle between the two extreme paths that still gets the object ball into the pocket is about three degrees.

How large a target does this represent on the object ball for the cue ball? The geometry works out to a simple result: For each degree of pocket width, there is a corresponding one millimeter of target for the center of the cue ball. For the shot above with a 3-degree-wide pocket, if the center of the cue ball arrives anywhere within the correct 3-millimeter zone, the object ball will be pocketed. That's a margin of plus or minus 1.5 millimeters around a perfect hit.

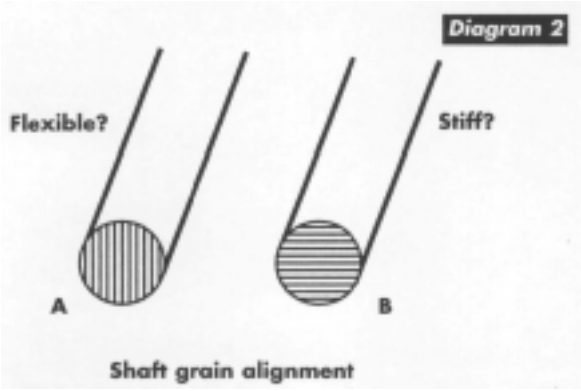
How big are each of the error sources discussed above? Let's consider them in relation to staying within the 1.5 millimeter maximum error. (Note: A penny is nearly 1.5 millimeters thick.) For the alignment category, the distance from your grip hand to your bridge hand is about how far the cue ball will travel. This means that if your alignment is off by 1 millimeter, the cue ball will land 1 millimeter off at the target. Take out that penny again and think about how thin it is.

For the "delivery" errors, we need at least the same level of accuracy. In fact, if errors have already crept in during the alignment, we need to keep the delivery errors even smaller to avoid reaching the 1.5-millimeter limit. How much does your stroke loop left and right? Almost certainly more than a millimeter. Your only hope is to have a consistent loop. In addition, I'd recommend removing as much as you can of whatever loop you do have. How firm is your bridge? Can the stick easily wobble one millimeter side to side? Even if you have only a half-millimeter of slop in your bridge, that's a major part of the allowed error in this shot. Could your heartbeat change alignment during the shot by a tenth of a millimeter? Maybe. That's the thickness of a piece of notebook paper. Could breathing change it by two tenths? I would-

n't be surprised. One tenth here, two tenths there; they start to add up and pretty soon you're seated, and it's your opponent's turn to shoot.

Now for the ball errors. The worst case is if you're using sidespin, since this will cause squirt and swerve. How big a factor is squirt? For some sticks, one tip of English — 12-millimeter offset from a centered hit — will result in 3 degrees of squirt. That is, the initial path of the cue ball will be on a line 3 degrees away from the line of the cue stick. If not compensated for, how much error would that be when the cue ball arrives at the object ball? Well, I picked the numbers so the arithmetic is just as before. Three degrees of error and three diamonds of travel results in two inches of offset when the cue ball arrives at the object ball. What's that in millimeters, you ask? About 50. How is it possible to make such a shot? Simple: You compensate by aiming differently; many players compensate unconsciously. You need to get that 50-millimeters-of-squirt error down to 1 millimeter or less by adding a compensation to your aim to the other side. Of course, such compensation is easier if the initial squirt is less, and some sticks have less than one degree of squirt for one tip of English.

For sticks that have a lot of squirt, here is something else to worry about: is the squirt the same regardless of the rotation of the shaft? That is, will the squirt angle change some if the grain is aligned vertically versus horizontally? I've never done the experiment myself, but someone has reported a 30-percent change with rotation. For our shot above, this might mean 40 millimeters of squirt with the grain like Diagram 2A, and 52 millimeters when the grain is like Diagram 2B. With a plus and minus 6 millimeters of uncertainty in where the cue ball will land with sidespin, you would learn quickly not to use any. The good news is that most sticks aren't as squirty or inconsistent as this example, but it would be a shame if you tried to play the game with one that was.



I hope the above has convinced you of the importance of fundamentals and that you will resolve to work on your major flaws. I suggest that you concentrate on only one at a time, and take them up in the following order, skipping the ones that are already perfect: your stick, your bridge, your approach to the shot (pre-shot routine), the straightness of your stroke, the timing and speed accuracy of your stroke, and your use of sidespin. You should immediately demand new, round balls, clean cloth and level slates from your billiard-room proprietor, so you won't have to worry about that.

Next month, I'll go into more deeply into some of the errors above and look at some of the math related to how lots of small errors add together. Until then, you have lots of practice to get in. Remember that penny.

Bob Jewett

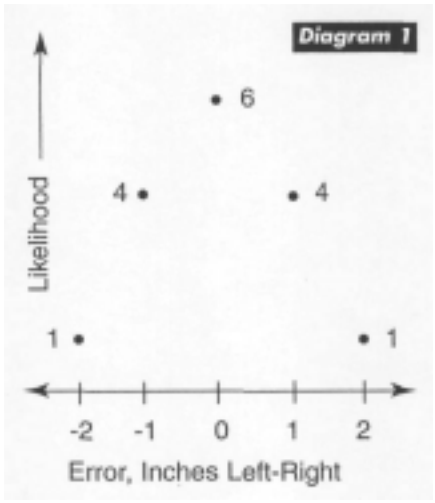
Add It Up

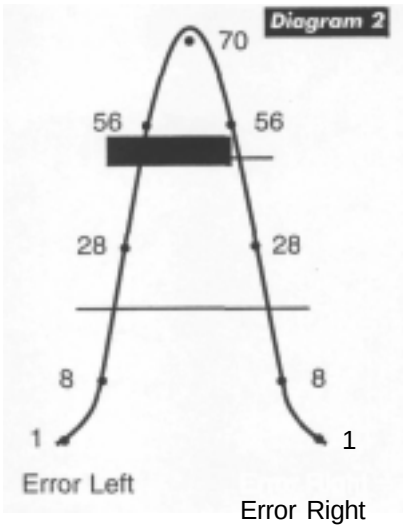
Finding the total of all your errors can lead to total perfection.

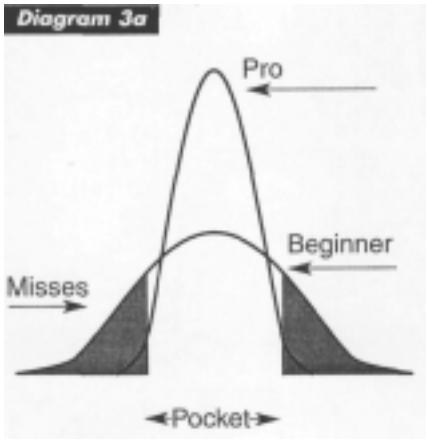
Last month, I tried to convince you that the error in your aiming has lots of sources — misjudging the angle, bad bridge placement, unexpected throw, a swoop in the final stroke — and that you need to reduce the errors that you can control. This time we will look at some of the theoretical background for errors in aiming. With this background, we can make some predictions about pocketing percentages. We might even uncover some faults that, when eliminated, may reduce your misses on certain shots by more than 50 percent.

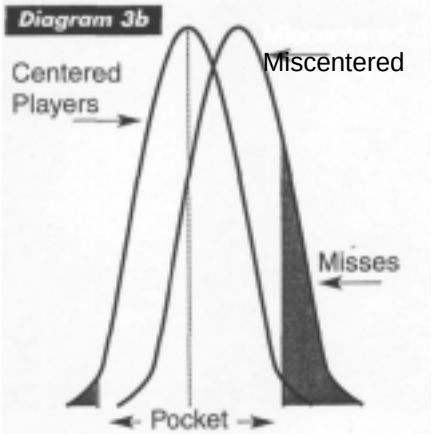
To see what happens when errors add together, let's start with a very simple case of four error sources of equal size. Each one alone causes the object ball to be off by a half inch to the left or the right when it arrives at the pocket. Imagine that the direction of each error is random, like the flip of a coin. If you have bad luck, all of the errors will be to the left, and the ball will land two inches to the left of the center of the pocket. Since even large pockets don't allow that much error, the shot will miss. If you get lucky, two errors will be to the left and two to the right, and the ball will be perfectly centered. An intermediate case is when there are three errors one way and one the other. All of the possibilities are shown in **Diagram** 1. On the vertical axis is the relative chance that each combination will occur. There is only one chance in 16 that all four flips will be "left," while the chance for two of each is six times greater because of the several combinations that result in zero net error.

Carrying this on to eight sources of error, we get the points plotted in **Diagram 2.** Also shown are two pocket sizes. The effective pocket size changes according to how long the shot is, so a shot that is twice as long (object ball to pocket) presents a target half as large. Similarly, if the cue ball is twice as far from the object ball, the target on the object ball is half as large. While a shot that's twice as long might seem twice as hard, look at what this does for the pocketing percentage. The wider pocket accepts all but two of 256 possibilities — those unlucky shots where all of the errors happened to add in the same direction — giving better than a 99-percent success rate. When the pocket size is halved, only 71 percent of the balls are pocketed (182/256). From missing one in a hundred shots, you've gone to only missing a third. Moral: Keep your shots as short as possible.



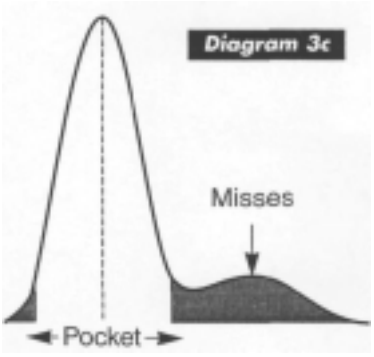






The above analysis is greatly simplified. In the real world there are, uncountably, many tiny errors contributing to every shot. A more detailed analysis would seem to be impossible. Fortunately, situations like this — many small errors adding together — are standard problems in fields as diverse as machining tolerances, noise in TV sets, and IQ tests. The result is that the spread of the errors is nearly always a bell curve, which is also called a "gaussian" or "normal" distribution. It has a very special shape that is drawn in Diagram 2 as the smooth curve. Since it has been studied so thoroughly, we can easily make several kinds of predictions such as the one above about pocketing percentages.

Does your "error profile" really match a gaussian curve? Maybe. If it doesn't, you may need to fix something. Let's look at several kinds of problems graphically. **Diagram 3A** shows the scatter for two hypothetical players, a pro and a beginner. For the pocket width shown, the beginner will make most of the shots, but the pro will almost never miss. The width of the bell curve is usually measured at about 61 percent of its height. For the case shown, the width or typical error for the beginner is twice that of the pro. More practice and better fundamentals — to reduce the size of all

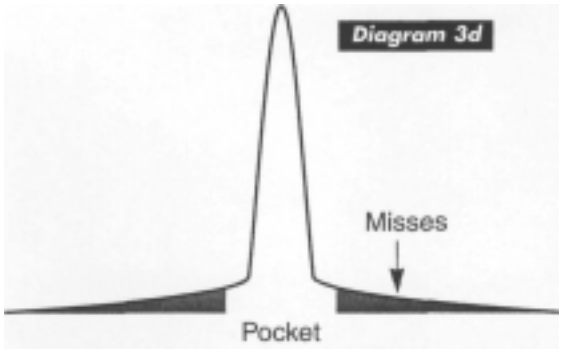


the little errors that contribute to the sum — will reduce the total spread.

Diagram 3B shows another problem. The good curve is for a player who knows where the middle of the pocket is; the other is for someone who shoots on average to the right of center. Again, the centered players will rarely miss. The off-center shooter will miss because he is always slightly off.

Are most of your misses to one side? You need to find the center of the pocket and make sure it's your target every time. For the corner pockets, the center is close to where the rail grooves cross; for side pockets, it is in the middle of the pocket right at the brink of the pocket opening in the slate. During practice, mark the centers of the pockets with stick-on reinforcements and strive to drive the object ball exactly over those marks.

Shown in **Diagram** 3C is a strangely shaped distribution, two humps rather than one. This indicates that on some shots, a single large error pops up. Cling or skid is one result that causes such large errors. Head alignment is another. If you use anything other than your usual eye to sight the shot, a large error in angle selection can result.



A final bad distribution is shown in 3D, where the distribution has a "long tail." Suppose you miscue 1 percent of the time. That will be a single, large error that again is not covered by the standard curve, which only addresses many small errors added together. When a miscue happens, the error will be spread out over a very large range, and even easy shots will be missed.

The bell curve predicts an interesting result for different sizes of tables. Suppose a particular shot is 95 percent for you on a 9-foot table. What are your chances on other sizes of table, assuming the same relative positions of the balls and that the pockets are equal in size? Of course the pocket appears to be smaller on the large table, because the shots are longer. For a 10-foot table, you would make only 89 percent of the shots, or miss about twice as often. On an 8-foot table, you get 98.5 percent, so you would miss one-third as often. On a 7-foot table, the theory says you should miss only once in 800 shots. Of course, if on 1 percent of your shots you miscue or have a head-alignment problem, you will never reach that level of perfection, even on easy shots.

The next time you're on the table, consider these questions: Are your shots centered on the pocket? Do you have any single large sources of error? When you have a shot that should be 99.9 percent, do you carelessly let your distribution spread out and occasionally miss? If your answer to any of these is yes, you've got work to do.

Bob Jewett

A Rub the Right Way

Make sure any actions involving throw result in a positive reaction.

Do you think you know how throw works? Here are some details that may surprise you.

Diagram 1 shows the forces involved when the cue ball comes up from the lower left and hits the object ball. There is a "push" force on the object ball from the cue ball that is along their line-of-centers. There is an equal and opposite force on the cue ball. Remember Newton's law, "For every action, there is an equal and opposite reaction."

In addition, there is also a force on the surface of the object ball from the motion of the cue ball across it. Let's assume that the cue ball has no spin at all when it arrives. Note that this force is along the tangent to the surface and perpendicular to the "push" force. Again, an equal and opposite friction force takes place on the surface of the cue ball.

The two push forces are easy to understand: The balls don't want to be in the same place at the same time. The result is that the upward speed of the cue ball is transferred to the object ball, sending it straight up, while the remaining rightward speed on the cue ball will take it straight to the right.

The frictional forces are harder to understand. They are caused by two things happening simultaneously the balls press together during the collision, and the surfaces are in motion relative to each other. In this case, the surface of the cue ball is moving to the right because the cue ball is moving (partly) to the right. Exactly what these sideways forces are going to do to the balls is not obvious. A more common situation for this kind of force is when the cue ball has draw or follow, and it is rubbing on the cloth. In this situation, the ball is pressed against the cloth by gravity, and the friction continues until the cue ball is rolling smoothly (no slipping) on the cloth. The ball-ball case is different in that the pressing together lasts only an instant, and the spin is, nearly always, only partly transferred.

There are two effects on the object ball from the sideways force. It will spin a little, just as a bicycle wheel will if you brush your hand along the tread. In the case shown, the spin will be counterclockwise. That's easy enough to figure out from the direction of the rubbing from the cue ball. What's not understood is that the change in the path of the object ball — the throw — is directly linked to the spin transfer. If the object ball is thrown, it must also be spinning in direct proportion to the amount of throw. How much of each is partly determined by how sticky the balls are. More sticky, more spin and more throw.

In **Diagram** 2A, we see the classic demonstration of non-sticky balls not throwing. Shoot the combination normally and the "dead" ball will miss the far corner every time, but if you make the friction vanish by lubricating the contact point of the two balls on the cushion — spit will work — the shot is easy. Throw will drive the last ball slightly into the cushion, and the rebound will take it wide of the pocket.

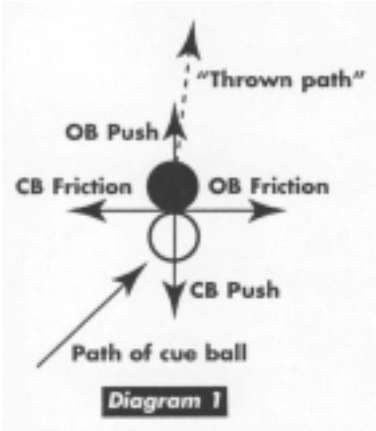


Diagram 1

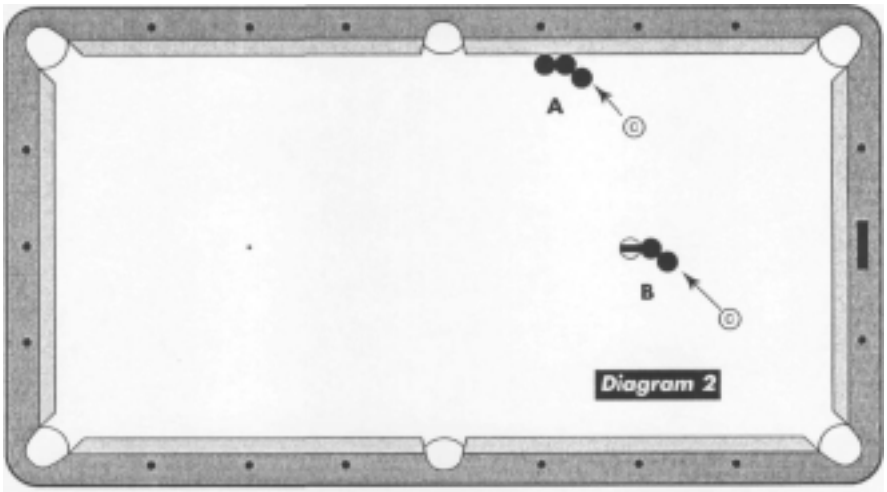


Diagram 2

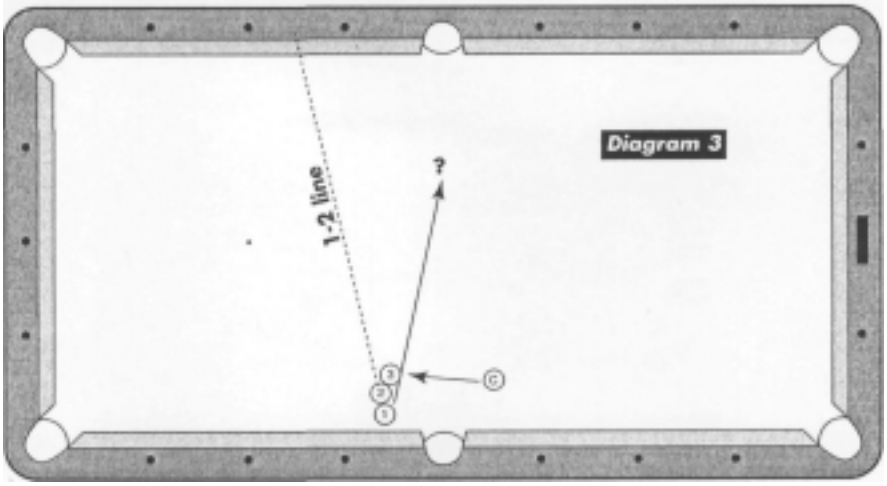


Diagram 3

To study this further, move the balls to the middle of the table, as shown in **Diagram 2B.** It helps to have donut-shaped paper reinforcements to set the positions of the balls consistently. Set up the ball that the cue ball will contact to drive the middle ball into about half the stripe. Note that the stripe of the stripe ball is aligned straight up the table to let you see any spin on it.

Shoot the shot normally, and notice both how much the stripe rotates and how far off the centerline of the table the ball moves. Now try the spit. To see what happens for increased friction, apply some chalk to the contact point on the stripe. The spin on the stripe may be a little hard to see due to the rapid forward motion of the ball. You can get rid of this by having the stripe run directly into a fourth object ball placed an inch up the table. Be sure to wet the contact point on that ball so that it can't rub off the spin on the stripe. You should be able to get the stripe to spin slightly in place.

On your table, can you get the stripe to bank back to one of the near corner pockets? Notice that the throw and the transferred spin are in the same direction to make the bank. What speed gets the stripe over the farthest?

Another test of this idea will also show how much the transferred spin on the object ball can affect bank angles. In **Diagram 3,** set up the 1-2-3 as shown. Paper reinforcements are a must for this setup. Place the 3 ball so that the 2 ball is driven about half full into the 1 ball. The object balls should be frozen to each other, but leave the 1 ball a couple of millimeters off the cushion.

Shoot the cue ball to hit about half of the 3 ball. The 2, 3 and cue ball should all clear out of the way to allow the 1 ball to bank somewhere close to the side pocket. You may get a kiss if the 2 ball is going into the 1 ball too full. If so, adjust the 3 ball for thinner contact. To see how speed affects this bank, try it both fast and slow. Mark carefully where the ball lands after it banks across the table. I use an object ball placed on the cushion where the other ball is expected to land. You should be able to land consistently within a few millimeters for a given speed.

Now to see how much spin is changing the angle, wet the contact point between the 2 and 3 balls, and try the shot again at different speeds. How much has the landing spot changed? If you compare this to the separation between the paths for the shot in Diagram 2B with and without lubrication, measured over a distance of four diamonds, the difference is how much the spin on the object ball changed the bank angle.

I think you will find at least two surprises when you try the above experiments, including a new perspective on bank shots.

If the cue ball has follow or draw on it when it hits the object ball, less side spin will be transferred, as part of the friction will be used up to put draw or follow on the object ball. Also, since the side spin works the same as draw or follow during spin transfer, if you shoot straight at a ball with draw, the object ball will actually jump into the air along a shallow angle that is the same as the throw angle. This angle is small enough that you probably can't notice it in normal play. Similarly, the cue ball is expected to jump up a little on all follow shots.

One time when this effect does become large enough to notice on follow and draw is for "vertical cling", when there is chalk at the contact point and much higher friction occurs between the balls. On straight — on follow shots, the ibly into the air, and then will fail to follow as far as expected. At the same time, the object ball will not go as far as expected, since it will have obtained a significant amount of draw, but this is harder to see. There is no way to make use of this in play; it is just another hazard of playing with dirty equipment.

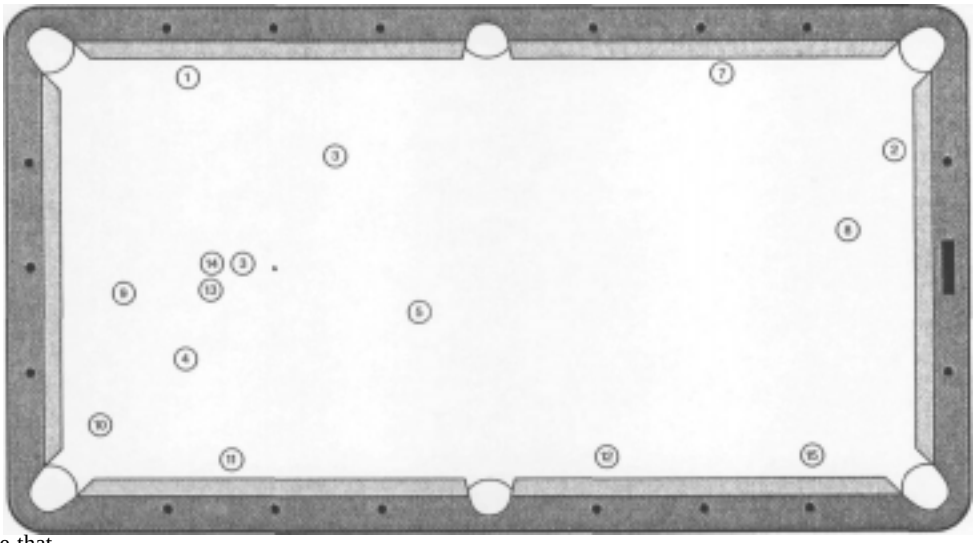
Bob Jewett

Practice Session 2000

Cyberspace isn't a bad place to look if you're seeking extra practice.

Do you want to put a little pressure into your practice? The following game will give a good test to beginners and experts alike, and if you can analyze your mistakes, you may find what you need to work on.

The game "Fargo" was born on the Internet. It is derived from "Equal Offense" (which had been played by on-line teams) and from Allen Hopkins' "Q-Skill" test, which also had a recent on-line tournament. In "Equal Offense," you smash the balls open and run as many as you can by the rules of 14.1 (straight pool). Your score is the total balls pocketed in 10 tries, with a limit of 20 balls for any one try, so a perfect score is 200. Hopkins' game begins about the same, although there are differences in where the cue ball is placed. There also is an added wrinkle that you have to run the last five balls of the rack in rotation, and there is no 14.1 break shot. Since each of the last five balls count double, it is possible to score 200 here as well.



Here are the main rules of "Fargo":

1. Rack 15 balls in any order you choose, and play a smash break. Scratches and jumped balls on the break don't count against you. Any ball pocketed on the break spots up. Place a coin on the cushion with "heads" up.

2. Take cue ball in hand anywhere on the table after the break, and start running balls as in straight pool for one point each. Shoot any ball in any pocket, but you have to call your shot. Extra balls made on a called shot count, too.

3. When you feel you can make most of the remaining balls on the table in rotation, turn the coin over, and begin shooting the balls in numerical order. The game is still call shot, but each ball, including extras, count two points each. The flipped coin is to make sure you have declared your intention to change to rotation.

4. Your inning ends on a miss, foul (which has no point penalty, but balls made on the foul don't count), or when you pocket all 15 balls of the rack. Start fresh from a new rack, and shoot a total of 10 racks for a competition.

The idea is to change from random order to rotation order when you feel you have things under control. It is possible to score 300 points if you run out all 10 racks in rotation. Possible, but unlikely, even for Efren Reyes, who warms up for 9-ball with racks of rotation.

If you note where you go wrong in each rack, you will pick up strategy quickly on your own, but here are some general tips.

The best break spreads the balls well without pocketing many. Remember that anything pocketed on the break is spotted, and that adds to whatever cluster remains where the rack started.

The best order to rack the balls in could take a while to figure out. I usually rack with all the high balls in front and the low balls behind, but after a break that really spreads the balls, it's hard to tell what started where. If you want to be fanatical about it, try this: Keep track of where each ball starts and goes to, and arrange for the low balls to end up at the head of the table. This will let you begin your rotation part in a relatively uncluttered area.

How to begin with ball in hand depends on your skill level. If you are scoring less than 50 in 10 racks, you need to concentrate on simply clearing the loose balls off the table, so place the cue ball for the easiest shot possible. See if you can start with three stop-shots in a row. A common mistake is to be careless about stopping the cue ball precisely (perhaps with an inch or two of movement) so that the next shot is also easy. If you don't have the hang of stop-shots yet, try to find a sequence of three balls that can be made with soft rolling shots. At this level of play, don't worry at all about the rotation phase unless the next several shots are already in rotation order, beginning, of course, with the lowest ball on the table.

As you advance to the next level, you need to consider breaking clusters early in the rack. An ideal time to do this is with the beginning ball in hand; you can get a good angle to break, and usually have a "safety" ball in case the cue ball settles against remnants of the cluster. You may have a few clusters to deal with, but don't get too ambitious. The rotation phase should still be avoided unless you get down to the end and a fairly easy series presents itself.

Once you consistently score more than 100, you're ready to plan the table for the rotation phase. You should be able to solve most of the problems within the first six shots or so. If you can do this, the remaining nine balls should be set up for an easy nine-ball run. Here are some major points to include in your planning:

— Get rid of balls in front of pockets. More generally, get rid of balls that block shots as early as possible. Try for example, if the 14 ends up blocking both the 5 and 7 to a corner pocket, it's got to go. If it were the 5 blocking the same pocket, it's not as big a problem unless you need that pocket to solve other problems on the table.

— Decide on which ball will start your

rotation phase and work out a plan to get to it. If the 1 ball is on the middle of the head cushion and the 2 ball is on the middle of the foot cushion, you should consider getting rid of the one early and starting the rotation with the 2, assuming the next ball is close to it.

— Get rid of balls on the long cushions. These are sure show-stoppers if there are two or three on the same rail. At straight pool, the solution is easy. Just leave the cue ball between them, and shoot to opposite corner pockets. The same situation in rotation is far more challenging, since you may have to return to that rail several times.

— Don't get married to your first plan. You will get out of line at times, and flexibility in shot sequence can fix things.

— Let your scores tell you whether you change to rotation too quickly. It is human nature to say, "I could make the 6 in the far pocket and slide over just right for the 7 and then draw back six feet to where I can see the 8..." but five balls at one each is better than zero at two apiece.

In Diagram 1 is an example situation right after the break. From the point of view of each level of strategy above, how would you start the rack?

A beginner should look for several easy roll-it-into-the-pocket shots to begin with. Play the 5 into pocket A with a little angle and roll up for an easy 7 shot, followed by the 8 and the 2. As long as the cue ball is not left straight in on that ball, getting the cue ball down the table for the 1 looks doable, but don't worry that far ahead.

If your sights are set on clearing the table, the main problem is the cluster near the spot. The 9 ball is a good ball to break with, and if the cue ball ends up against the 13 or 14, the 10 is your escape. Caution! Don't hit the shot so hard you drive the parts of the cluster against cushions or other balls. After the break, the only remaining problem is the 15 which blocks the 12 ball.

If you're going to try for a substantial portion of the rack at rotation, what are the main problems? Of course the cluster is still a hurdle, and the 10 blocks the 4, so beginning as above still looks good. The 15 is a major problem with the 12 where it is, but the 15 could be used to get shape on the pesky 2 ball. Although the 7 is one of two balls on that rail, it is in a perfect location for access to the 8. There is no need to plan all of that, though, until you see how your first shot moves the balls in the cluster. With a good break — move the 3 ball a foot towards the center of the table and spread the 13-14 slightly — you might take just the 9, 10, 15 and 2 out of order, and then the rest of the balls in rotation. That would score 4+22=26, which is very good for one rack.

A tournament in "Fargo" has already been held, and the results are available on the Web at http://www.playpool.com/asp/. Full statistics are there as a spread sheet. The 20 players shot three sets of 10 innings each, except for one set that was forfeited. The grand average rose five points (or about half a ball per rack) in each succeeding round — from 100 to 110 at the end — which suggests improvement of the participants. In 590 total racks played, there were 30 innings with 0 or 1 points scored. At the other end, there were 20 innings with scores over 22.

I'd like to thank three people who have contributed to "Fargo". The inventor is Mike Page, who happens to live in "Fargo". The name of the game is also a convoluted acronym better not repeated here. The tournament director, webmaster and statistician was Ed Mercier, who runs the Wisconsin State Pocket Billiard Championships in his spare time. Ron Shepard, the author of the on-line analysis of the physics of billiards mentioned in a previous column, contributed to the strategy analysis.

Bob Jewett

Systems Analysis

Take a closer look at three aiming systems.

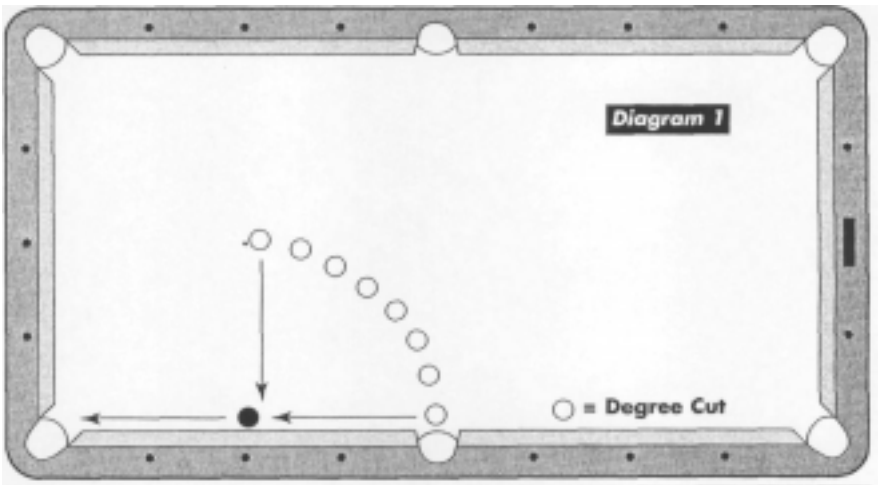
In the November 1999 issue, I briefly went over some aiming systems and asked you to first think about the accuracy you could expect from them, and to then consider whether they might be useful additions to your game. Here is a deeper look at three common aiming systems, with the aid of a little trigonometry.

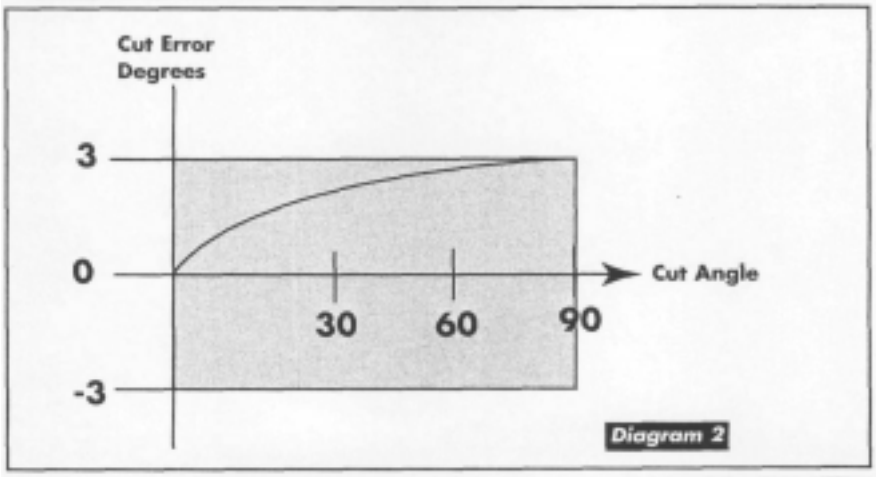
First we need a standard set of shots as a basis of comparison. In **Diagram 1,** the object ball is two diamonds from the corner pocket and the sequence of cue balls is a constant two diamonds from the object ball. Every shot has a margin of error, and these shots allow a cut-angle error of about three degrees to either side of perfect for normal pockets. Since the geometry gives the error in degrees, we can easily compare each system's error against the permitted error as a plot.

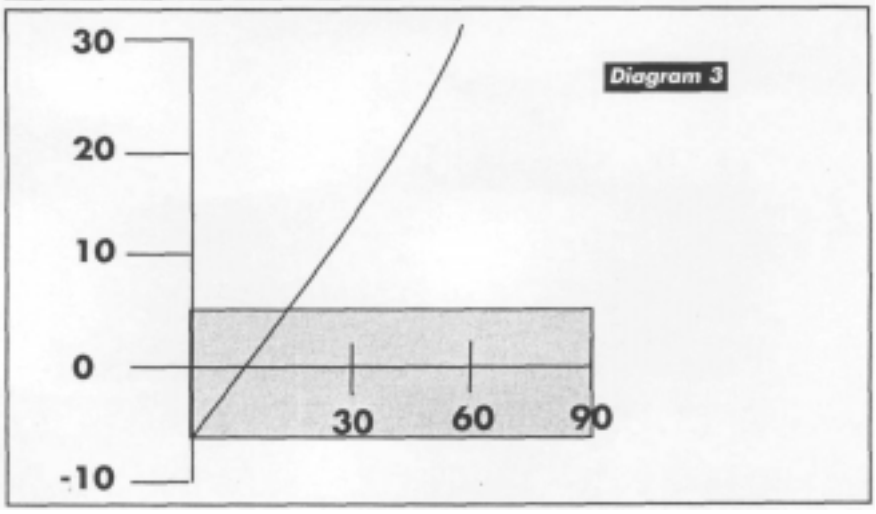
Diagram 2 shows the expected error for the simple ghost-ball system as a function of cut angle. For zero cut — a straight — in shot — there is no error. As the cut angle increases to about 30 degrees, the "collision-induced throw" builds up to about three degrees. The exact amount depends on how sticky the balls are and whether the cue ball has any follow or draw, all of which might make the error half or twice as much. The numbers plotted come from actual measurements, but are adjusted to match clean balls.

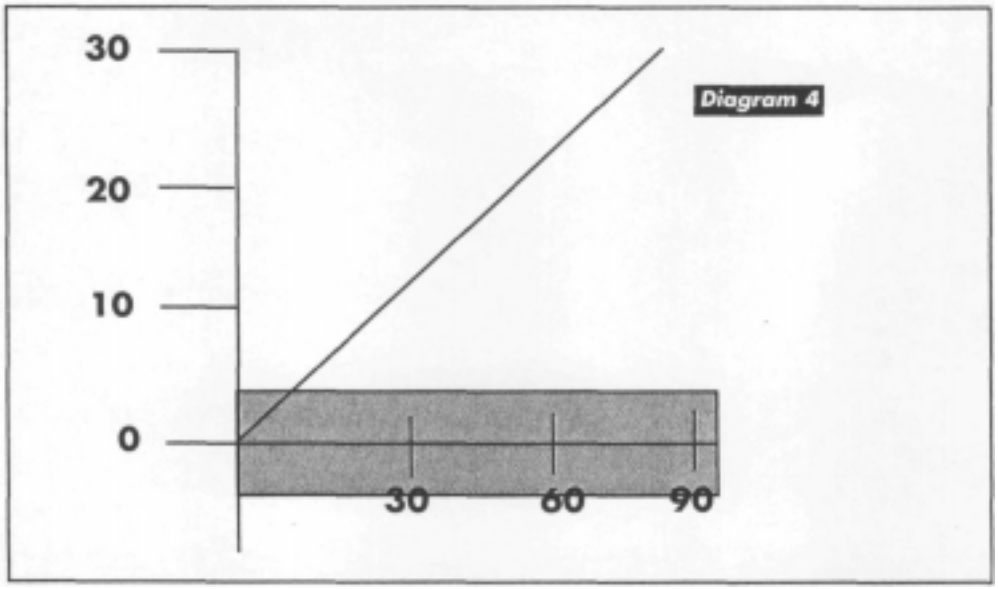
The conclusion is that on a shot that drives the object ball two diamonds, the simple ghost-ball system is on the hairy edge of working. If you remember the problem of adding up many sources of error, you know that to put one large source of error into your game guarantees mediocrity. You must compensate for that error, consciously or subconsciously. Note that the many variations of the ghost-ball system are all covered by this analysis.

Another system described last November has you align the inner side of the cue stick with the contact point on the object ball. The geometry of this system is a little more complicated, but I'll only bring out the arcsines and cotangents if you insist. Plotted in **Diagram 3** is the answer. Note the much larger vertical scale used to accommodate the huge errors. Again, the shaded area is the error allowed by the pocket. For small cut angles up to about 12 degrees, the system over-cuts the ball. As the planned cut









angle increases, the error builds rapidly, so that for a 90-degree cut, the error is over 45 degrees.

Some people have reported success using this system, but they're either cross-eyed or fooling themselves. Maybe they're putting in huge corrections. At any rate, the analysis shows this to be the worst system of any I've seen.

Another system that has appeared several times in print works like this: Find the spot on the object ball that is the farthest from the pocket. Find the spot on the cue ball that is the nearest to that same pocket. Drive the cue ball parallel to the line joining those two points. This is a little like the "parallel-stripes system" shown in Mosconi's *Winning Pocket Billiards.* That system is geometrically the same as the ghost-ball method. This new system is more difficult to analyze. Its error turns out to depend upon how far apart the balls are. To simplify, consider just the shots in Diagram 1. The resulting errors are plotted in **Diagram 4.** Amazingly, the error for each cut angle is exactly a quarter of the cut angle. For any cut over ten degrees, this system — if actually followed by the shooter — is a complete disaster.

The overall conclusion here is that most aiming systems will do you more harm than good. I'm surprised that so many pitifully-flawed systems are being promoted when a little simple geometry, or even a careful scale drawing, quickly shows them to be frauds. The only possible benefit is that they may help you to focus on the shot. Next month, I'll describe what I think is a much better way to focus. In the meantime, don't let bogus systems pollute your game.

Bob Jewett is a partner in the San Francisco Billiard Academy, one of seven Master Academies certified by the BCA for instructor training.

Bob Jewett

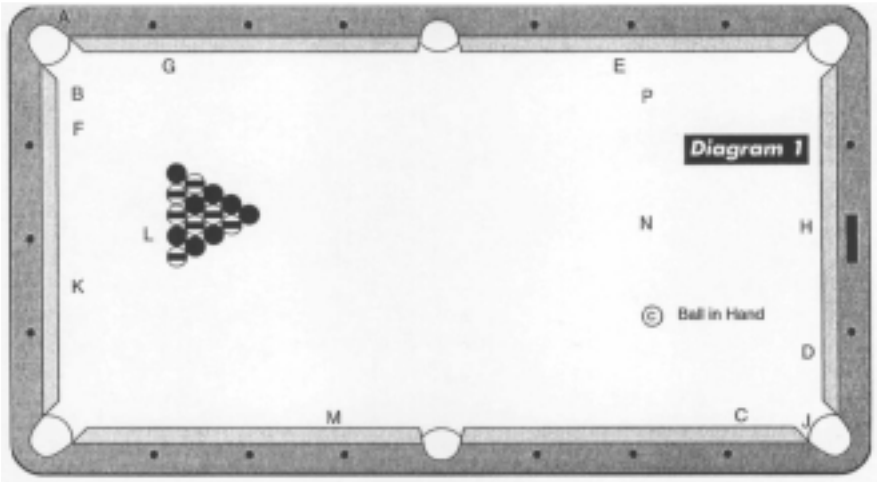
A Rusty Game?

Are today's players out of stroke when it comes to 14.1?

When the Billiard Congress of America U.S. Open 14.1 Championship was revived in New York City in April of this year, I had the pleasure of watching the stellar field for the final three days of competition. I first attended a U.S. Open in 1969, when players like Irving Crane, Danny Gartner, Jimmy Caras, Luther Lassiter, Joe Balsis and Steve Mizerak were the ones to beat, and 14.1 was the game to play.

While watching this year's edition, I noticed something that was echoed by my fellow spectator Ned Polsky, who has been watching straight pool even longer than I have. Many players in the 2000 Open failed to do the "right thing" in various situations. That is, they played safety or position in a way that the stars of the last millennium would never have considered. This made me wonder whether the secrets of playing 14.1 "properly" were being forgotten, perhaps because it has been so long between tournaments.

Below are some situations for you to figure out, along with some suggested solutions. Try to find your own answer before reading mine.



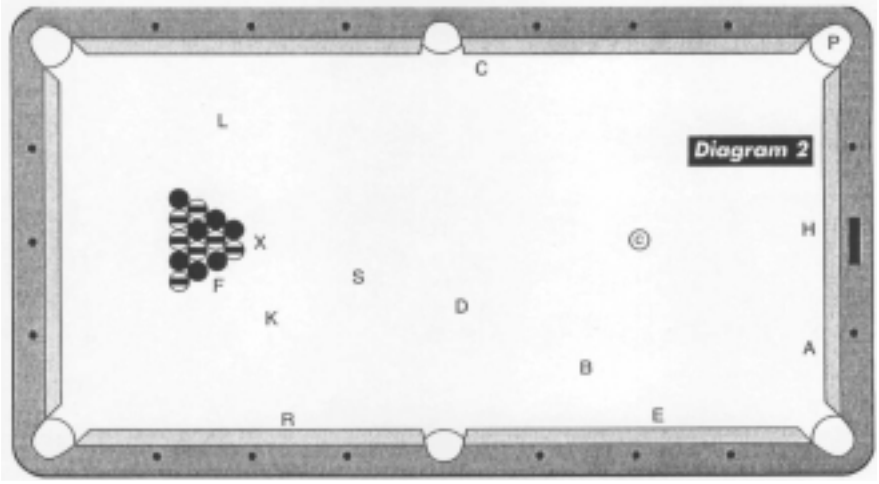


Diagram 1 is from one of the semi-final matches at the Open. Player A was on a run and Player B was not on a foul. Player A scratched on the break shot while pocketing the break ball and missing the rack entirely. The result for Player B is shown, shooting at a full rack with ball-in-hand behind the line. What is the best play?

The correct play is one no top player would normally have missed, but Player B did miss it. Player B placed the cue ball about as shown and shot to the rail at K to hit the rack at L, with the intention of taking a scratch while knocking a couple of balls slightly out of the front of the rack.

A much better play is to shoot from the kitchen to F and G leaving the cue ball at H. This is a foul, but your opponent is on the first foul and three in a row will cost him a 15-point penalty and he must shoot an opening-break shot with a new rack. Some players like to get the cue ball to H by shooting to E with right spin to go to C and then H, but the standard F-G-H path is much more predictable.

Some players with ball-in-hand try to place the cue ball at J and just tap it so it is frozen to the jaw of the pocket, thereby "corner-hooking" the other player. Do you know which rule forbids such foolishness? It's the one that requires you to drive the cue ball over the line when it is in hand.

Suppose you are Player A, and Player B has left you at H with the orthodox safety. What should you play now?

Never shoot to the head ball in hope of driving one of the far corner balls to a cushion. Nearly always you will leave an easy shot. Instead, take a second foul by shooting to M-K-L, hitting the rack just hard enough to send one or two front balls up the table and leave the cue ball stuck to the back of the rack near L.

Let's suppose your opponent has played M-K-L, but has shot too softly, and no ball is loose from the rack. What should you shoot? Note that your opponent is on two fouls at this point and you are on one.

The standard shot is along F-G-C-D without hitting any ball. Now your opponent is in the deep rough with no easy safe, and in peril of losing 15 points on a third foul. You are quite likely to have an open shot soon. If your opponent had shot the previous safety hard enough to move balls out of the front of the rack, your lag shot to D would be too dangerous.

Let's back up a minute and suppose that the cue ball is at H with a full rack and neither player has fouled. Another safety to consider that's far more aggressive than M-K-L is to play the cue ball to G and B to skim the side of the rack and then hit C to stop at D. This shot is in Willie Mosconi's *Winning Pocket Billiards* and is a favorite

of Irving Crane's, who has said that if he couldn't get a good safety along that line in three tries, he deserved to lose the 15 points.

If you want to try Crane's shot, you need a target that will get the cue ball to B reliably. Location B is as close to the pocket as possible without danger of hitting the jaw. From that spot, the cue ball sees a rather wide target of the edges of all five balls on the side of the rack. In contrast, if the cue ball hits G-F, only the back corner ball can be struck and a disaster is the sure result. The point A on the rail is the target you need in order to get to B. Try it from various points between N and P, and increase the running English (left) as necessary to get the right angle from B to the side of the rack. This is a fun shot to pull off, and not as hard as it looks, providing you've practiced.

You may wonder how the cue ball could be at H with a full rack and no one on a foul. Well, suppose a player has left the 15th ball (the 14.1 break ball) at D and had intended to leave the cue ball at N for a possible rack breaker. Instead the cue ball came to rest at H, leaving a straight — in shot. What is the orthodox play? Call safe, and pocket the ball with draw, returning the cue ball to H. Your opponent will need to play M-K-L and lose a point on the safe, and may leave a shot if he shoots too hard.

Diagram 2 shows another common situation. The 15th ball was in the rack area, so it moves to the head spot. Of course, this is hardly the optimum break shot no matter where you put the cue ball, but how can you make the most of it?

There are two good positions in which to leave the cue ball. The easier to achieve is D, so the cue ball will go along A-E-F after pocketing the ball in P. There is quite a large area for the cue ball from which this path will work. Don't power the ball; you want to land fairly softly on the rack to knock a few balls out of the back while the cue ball slides down to the foot rail for position.

The second way, which requires more precision in placing the cue ball, is at B. Pocket the ball in P with left follow, and the cue ball will spin off C and hit right between the two front balls at X. With practice, the cue ball often goes to R and then to S for position. Crank up the speed on this shot, but not to where you miss the object ball. This shot is also a favorite of Crane's.

Suppose you try for D, but leave the shot nearly straight instead. What should you do?

One possibility is to call safe and send the cue ball to our old friend H. Boring but effective. If you have an angle to draw straight to the rack, try it, but remember that too much speed will likely end in a scratch, as the natural angle off the side of the rack from mid-table is into the corner pocket. A safer play is to draw the cue ball to K. Playing on the ball at F will send a ball to the end rail and also something to the vicinity of L. Your opponent will be left with no good response. Practice this safety so that you can leave the cue ball frozen to the rack every time. Find the best angle and English.

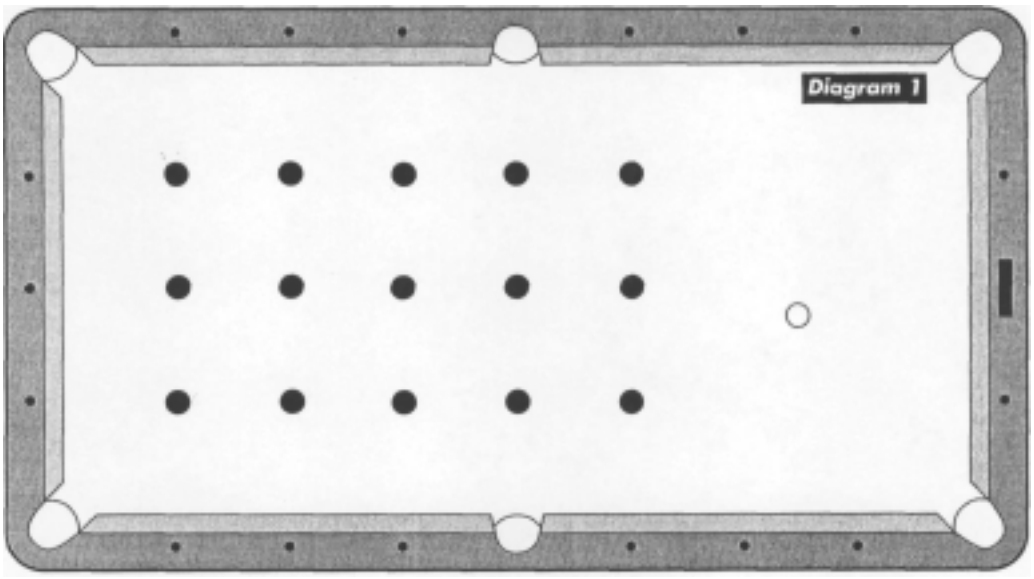
I hope this has whetted your appetite for straight-pool strategy battles. If so, you are in for a treat; a major new book on 14.1 has just been published, *The Straight Pool Bible* (The Lyons Press, $19.95, www.lyonspress.com) is by Laurence S. Moy and Arthur "Babe" Cranfield. The latter is a Hall-of-Famer, and may have more runs over 200 balls than any other player in history. My copy is on order.

Bob Jewett is an Advanced Level Billiard Congress of America certified instructor.

Bob Jewett

Into Focus

Concentrate, and bring your aiming system into focus.



In the June issue of *Billiards Digest*, while discussing aiming systems, I mentioned that one practical use of such systems is to help you focus on the shot at hand. All the systems had flaws, some so bad that it is amazing anyone can make a ball while claiming to use them. Below are some better ways to build concentration and focus on each shot.

I think a large part of focus is your attitude towards the game. I can't help you directly with this, since I'm not a sports psychologist, but I can recommend a book that helped my own game a lot, *The Inner Game of Tennis*, by W. Timothy Gallwey. Originally published in 1974, it has recently been revised and reissued in paperback. If you are in the camp that feels you have to hate your opponent, this may be the book that gets your game back on track. While it's not directly about pool, the applicability will be clear from the first pages.

Many instructors teach some kind of "stroke sequence" to use on each shot. This provides a framework to develop your game, and promote rhythm and consistency. It can also help you to focus. Some sequences are as simple as "take three strokes and then shoot," but I think it is better to get all the necessary actions into the routine explicitly. Here is the sequence I teach that is part of many Billiard Congress of America instructors' courses:

1. Plan. Before you even approach the shot, plan what you are going to do. Study the cut angle, and decide on the spin and speed needed to get the cue ball to its next position. This step prevents those embarrassing shots that are missed because you finally decide what to do on the final stroke.

2. Approach. Do not approach the shot from the side. Instead, stand a little back from the table, moving until your head is along the line of the shot. This step ensures that every shot begins with the same physical placement as closely as possible.

3. **Stance.** Move into your stance, keeping your head along the line of the shot. I'm not going into detail about which foot needs to be moved how many inches and turned which way. I'll assume that you know how to walk without thinking about it. You must, however, achieve the goal of the stance, which is to provide a firm foundation for the stroke.

4. Fiddle. Take some warm-up strokes. The tip should move from very near the cue ball to nearly back to the bridge hand. This allows you to get a better feel for the line of the stick relative to the line of the shot. Of course, your eyes should be switching back and forth between the object ball and cue ball during these strokes to see if the line is still correct. Stop with the tip at the cue ball. Yes, come to a complete stop, with your body motionless.

5. Decide. Make a conscious decision about whether you are ready to shoot to accomplish the plan chosen in Step 1. Is the line right for the cut? Is the spin right to move the cue ball? Do you have a feel for the speed? Does everything else about the shot feel right?

6. Adjust. If the shot does not feel right in Step 5, make an adjustment. If it is a minor adjustment, perhaps hitting with slightly more draw, do it in place. If the adjustment is major, or the shot feels completely wrong, get up and start over. If you make a small change, go back to Step 4, and repeat the Adjust, Fiddle, Decide cycle until you're satisfied.

7. Shoot. When the shot does feel right, take a final slow back-stroke, and come through as straight as you can to make the shot. It is surprising how many players will do their adjustment on the final stroke, moving the bridge a little, or swinging the butt of the cue to get a little helping spin. All that must be done before — in step 6 — if you want to be consistent. The final stroke needs to be as constant as possible, which means perfectly straight along the chosen line, with only the speed varying.

All of the above is a lot to put into each shot, but if you practice the sequence, it will become automatic. Note that each required part of the shot is accounted for, and the shot isn't triggered until you are sure you are ready. Work on your sequence on the practice table before trying it in a match.

Another kind of technique to focus your thoughts is to add an extra requirement to the shot. If you are having trouble keeping your stroke straight, try the "ferrule focus." Normally you will be watching the object ball on the final, power stroke. On a few shots, you may be watching the cue ball. For this drill, watch only the ferrule of your stick on the final stroke. If you have done the sequence correctly, you will be planted

solidly along the correct line to make the shot, and with a straight stroke, the shot has to score, even if you closed your eyes. Watching the ferrule will give you immediate feedback about the straightness of your final stroke.

Another added challenge to help focus is to try for a perfect entry to the pocket. This drill will help a lot if you are missing easy shots. On every shot, work to drive the object ball exactly over what Toby Vaughn calls the "Ideal Aiming Point" or IAP. That is the single point in the pocket that is the perfect target for all shots. In the corner pockets, it is where the two rail grooves would cross. For the side pockets, it is the center of the lip of the slate drop. Mark these spots, and do not be satisfied with a shot unless the object ball rolls over the mark.

A more advanced challenge is to play "no cushion" pool of some kind. You have to plan your run so that the cue ball never touches a rail. At 8-ball, this is not too tough if your opponent has obligingly cleared most of his obstructions from the table. At 9-ball, you will need to get a precise angle on each ball to allow a simple stun, follow or draw to get a similarly ideal angle on the next ball. Note that this is usually the "wrong" way to run a rack of 9-ball, where setting up for one- or two-cushion position allows much larger target zones for cue ball placement.

Diagram 1 shows a practice setup for this drill. The 15 object balls are on the intersections of the diamonds. Begin with the cue ball in hand behind the line, and run the balls off without the cue ball touching a cushion. If the goal seems impossible at first, allow yourself some number of "hand spans," in which you get to move the cue ball a distance up to the span of your stretched-out fingers before shooting the next shot. In the strict form of "no cushion" pool, the cue ball isn't allowed to bump any balls.

Many players seem to look for things to break their concentration. One player I know will notice any minor movement in his line of sight or to his side, or behind him, and will stand up and start over repeatedly. It's amazing to me that he can make a ball.

I saw the other extreme in a practice session of Nick Varner's. Nick was attempting to run as many balls as possible in one pocket (that's another challenge you might try for focused practice). He had been shooting sets of this for a few hours on the table right in the middle of the pool room, which was chosen because it had the best cloth, although everyone who came in would have to pass it on the way back to the counter.

Two policemen — levis, blue windbreakers with "POLICE" on the back, guns strapped to their hips — came in the front door and proceeded by the table and back to the rear of the building, to round up a teenager who hadn't really done anything, but wasn't where he was supposed to be. I was watching as they got the kid into an arm-lock to move him away from his friends by the pin ball machines. Nick continued to play. As the gendarmes moved towards the door, they stopped right by Nick's table to put the cuffs on for a more comfortable stroll to the car. Nick continued to play. He never mentioned the incident, and I believe he did not even notice that it was going on. The next time you hear someone whine about some minor distraction, you might relate this story. In the meantime, work on your own concentration — Gallwey's book will help — so you won't be the whiner.

Bob Jewett

Wales, Watching

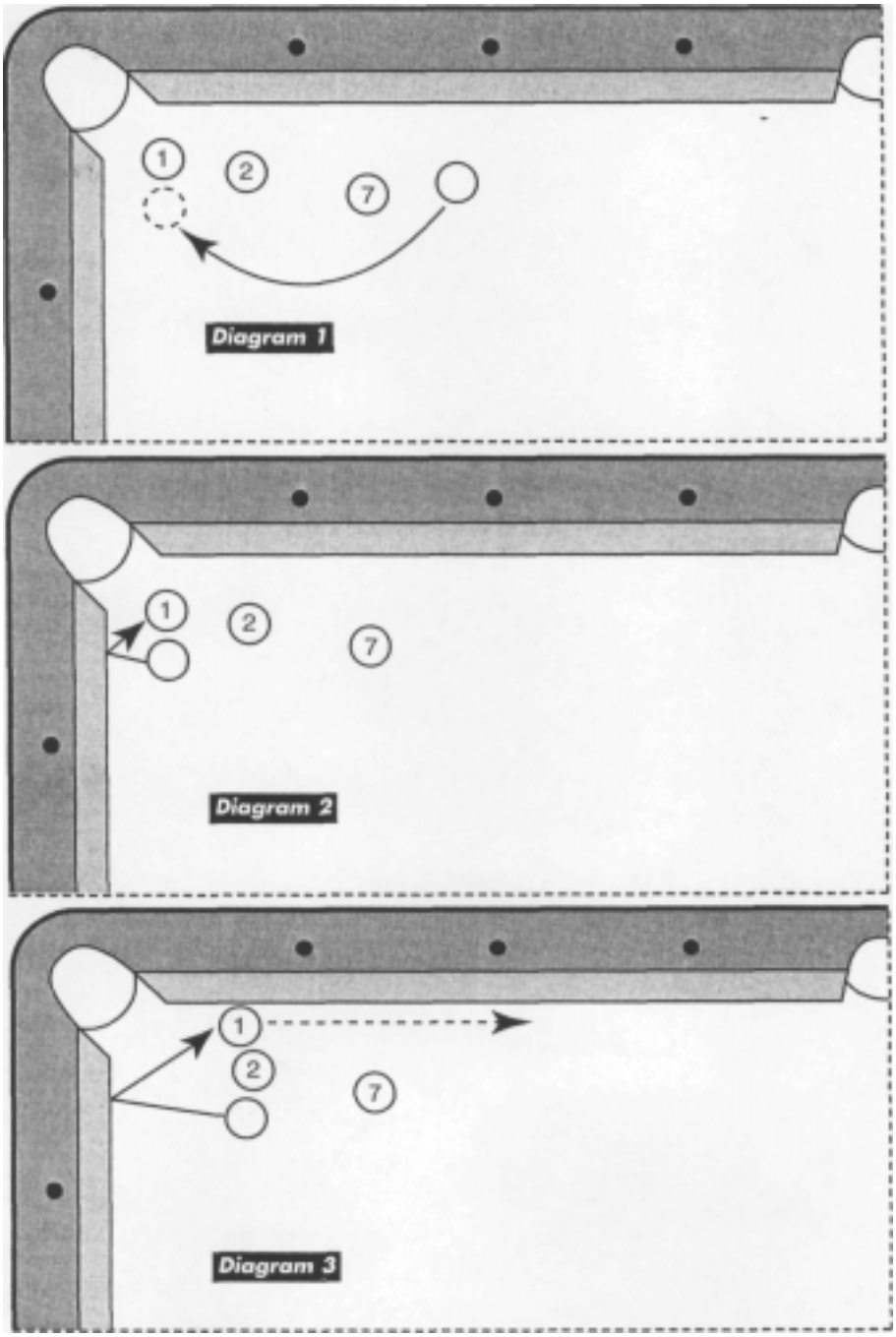
A potpourri from Cardiff.

Your education *as* a pool player can't be complete until you have attended a world-class championship. There is nothing like seeing the top players up-close and in — person, playing in a series of must-win matches. You will see a variety of techniques in action, and will be able to compare them side-by-side. My first pilgrimage to a pool Mecca was for the 1969 U.S. Open in Las Vegas. My latest was to the Victor Chandler World 9-Ball Championships in Cardiff, Wales, July 1-9. There is always something new to learn, old acquaintances to greet, and entertaining pool to watch. Here are some semi-random observations from the CIA — the Cardiff International Arena.

The setup for TV was awesome. Of course, if you're going to produce over 60 hours of live broadcast from an event, with plenty of sponsors, you can afford to do things right. I counted at least 13 cameras in operation simultaneously. There were two in the interview booth, one directly over the table to give the most accurate positions of the balls, two mounted at the top of the booth to give an angled overhead view, two on dollies that wheeled around the foot end of the table, two pocket-cams that must have been mounted to look through holes in the foot pocket liners, two on shoulders for close-up crowd and player shots, one on a long boom to give you that "swooping down like an eagle" view, and a last one with a view of the tables that were used for the non-broadcast matches. Whenever there was a question of whether one ball could pass another to a pocket, you could be sure that a camera would be in the perfect line for the answer.

The lights above the table held 56 four-foot fluorescent bulbs. There were lights in the floor below the table shining up, to give interesting lighting effects on the players. Rotating colored spotlights high up in the arena added sparkle to the wide-angle views. There was also a smoke machine under the table, which was turned on from time to time between matches. It seems that a little smoke gives a feeling of depth to a TV image. Spotlights were ready to light up the stars as they entered the arena. The table was surrounded on the three audience sides by a futuristic railing that emitted blue light.

The players were kept relatively comfortable with individual ice-buckets of bottled water, large padded chairs, and even personal fans, presumably to keep cool and dry under the hot lights.



The seating was comfortable theater-style. The price was right too — free for the first seven days, and then only about $40 for all of the last two days of play. A pleasant surprise was the large number of 10- to 16-year-old kids in the audience. One day, a whole grade-school class came in uniform. The game surely picked up a lot of new, young fans.

The food concessionaire was busy pumping out beer, sodas, meat pies — a warm, tasty source of serious cholesterol — hot dogs, muffins, crisps and sandwiches at prices that were reasonable but not quite as nice as the ticket prices. A request for next time, though: please get the French to make the sandwiches and see if the Germans will handle the hot dogs.

The balls had special colors for TV, with the four ball being pink and the seven ball a light brown. The broadcast had a cheat-sheet for those viewers who were unfamiliar with 9-ball. On the bottom of the screen was a display of colored circles for the balls still on the table with the numbers in order. The two commentators made frequent use of the telestrator to plot out expected shots for the viewers.

The referees on each table were in the traditional striped shirts. On the TV table, Michaela Tabb and Alan Chamberlain officiated in alternate matches. Besides racking and calling fouls, they had to pause and restart the match to allow commercials to fit in. Breaks between racks were the only times the spectators were allowed to go for refreshments.

The scores at each table were entered into portable computer consoles, and the results went instantly to a central system which in turn broadcast the results out to five or six monitors in the milling — around areas in the arena. The display would cycle through all parts of the 64-man chart as well as the day's schedule, so you could get complete up-to-the-minute info in a few seconds.

Near the refreshment areas were a dozen tables of various kinds for the spectators to use between matches and whenever they were bored, as some of the youngsters got after watching a few racks of play. The tournament management had arranged free clinics, challenge matches and trick-shot demonstrations on a regulation pool table. One table was an English 8-ball table in the shape of an hour glass. The "side" pockets were at the narrow waist of the hour glass.

The tournament play itself was interesting for the very wide range of styles of the players. Of the four semi-finalists, the player with the best style for a beginner to emulate was definitely Corey Deuel. As you watch him prepare to shoot, you will see what he plans to do, and then he nearly always does it in the simplest possible way. If you get to watch him, note how consistently he goes through his shooting sequence on each shot.

Steve Davis, the world champion at snooker for many years, also bears watching. He still has some things to learn about 9-ball strategy, but if he gets a makeable shot with the balls spread, expect him to run out with pin-point control of the cue ball. There are still people who claim snooker players don't spin the cue ball; Davis puts the lie to that myth. He also banks well; a long bank on the 6 ball from a safety by Efren Reyes was part of his comeback from 8-2 to a 9-8 win against Reyes.

An interesting safety sequence took place between Oliver Ortmann and Fong-Pang Chao. Ortmann had made a combination and left the 1 ball near the pocket, as shown in **Diagram 1.** Unfortunately, the cue ball had rolled behind the 7. His solution was to shoot a full masse shot softly to leave the result shown in **Diagram 2.** I expected Chao to play a kiss-back from the 1 ball to put distance between the two balls, but instead he played a very nice finesse kick shot to leave the cue ball and the 1 on opposite sides of the 2 ball. Ortmann then kicked the 1 ball into the other corner pocket. The next shot had the 2 ball slightly blocked by the 7, but Ortmann made the kick-shot shown in **Diagram** 3 look easy.

I hope you can arrange to further your pool education by attending a major tournament. If you get to Cardiff next year, the tickets are on me — for the first five days. See you there.

Bob Jewett

Jump Shots

Adding another dimension to your game.

While watching the World 9 Ball Championships in Cardiff, Wales, one thing was clear: it would be hard to keep up without a pretty good jump shot. Among the final eight or so, the only one I didn't see jump was Steve Davis, and he had good control of his kick shots.

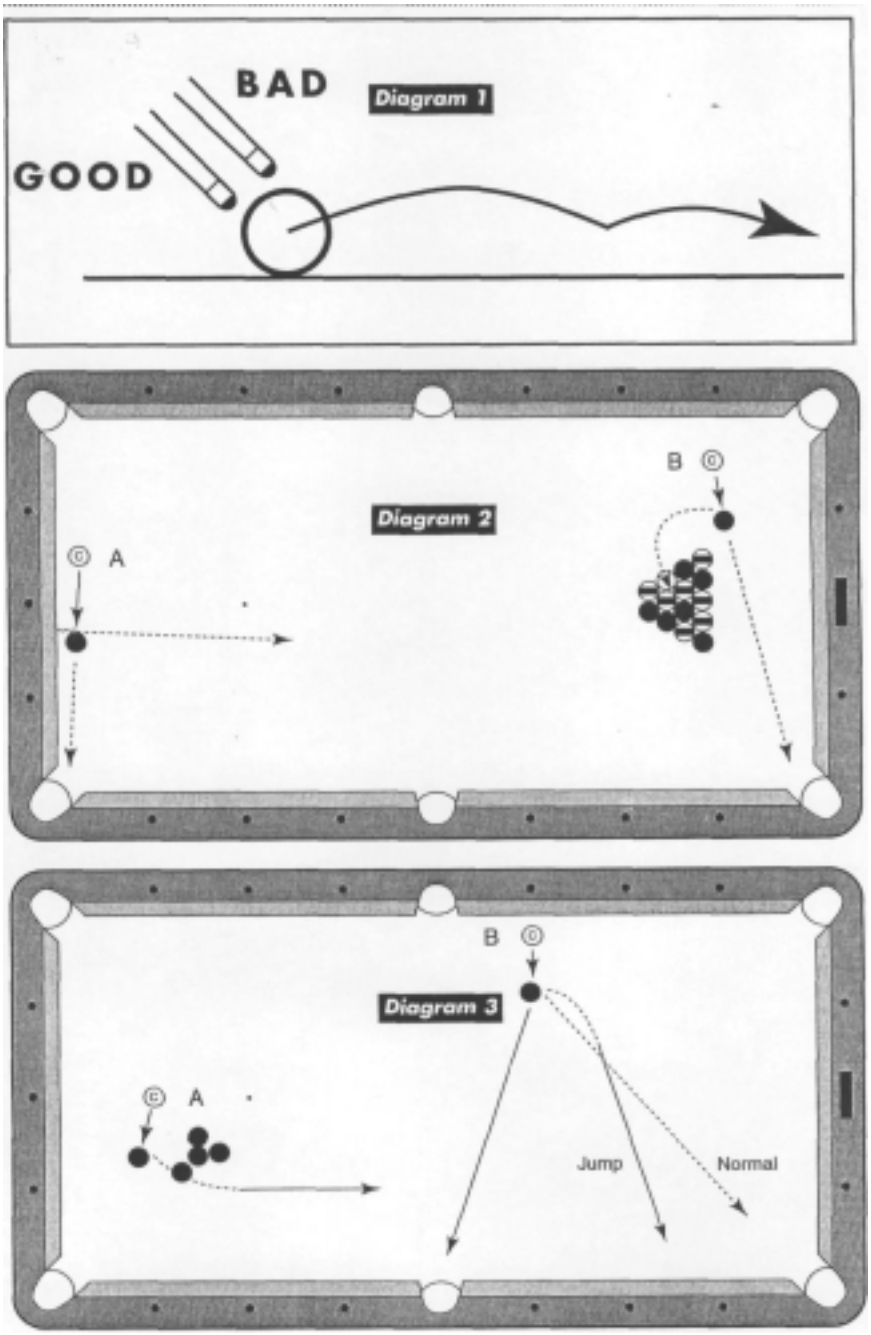
The rules today mandate a cue at least 40 inches long. This was a reaction to the "jump rods" that were popular in the early 90's. They were about 24 inches long, often equipped with a very hard plastic tip, and weighed not much more than the cue ball. With these characteristics, it was possible for a novice to loft the cue ball over an object ball only inches away. The damage to the tables and the traditions of the game was too much, and a ban on the rods went into effect in 1995. The Pro Billiard Tour banned jump cues entirely on the men's circuit.

A typical jump shot is shown in Diagram 1. The elevated cue stick drives the cue ball down into the cloth. The ball rebounds to leave the cloth, and continues to bounce down the table with progressively smaller hops. Each hop is about half the height of the previous one. The diagram shows that follow is not recommended. This will put the tip above the cue ball just as it wants to leave the cloth, and it will be trapped. Except for shallow elevations, you must avoid follow on jump shots.

This diagram also hints at why the jump rods were so effective. Since they were light, they would stop on impact with the ball, reducing the chance of interference. Also, the hard tip caused a very short contact time, further preventing trapping of the cue ball.

To be good at the tougher jump shots, you will need to get a jump cue. There are several brands on the market, including some that double as break cues when a third section is screwed on the end. Some players try to jump with just the cue shaft, but very few shafts are long enough to be legal.

Diagram 1 also shows that the highest point off the table occurs halfway between the take-off and the first landing. When you are practicing for height, have a friend watch from the side, and notice where the ball is landing. It's best to do this part without an object ball on the table, so there will be fewer balls on the floor. If you do get a jump stick, try this practice: Put a ball in the jaws of a head pocket and the cue ball near the other head pocket where you can bridge up on the rail. Practice first without an obstruction and with a spotter. Try increasing the elevation, but keep the speed down to keep both balls on the table. The challenge is to get a good hop with only moderate speed. Some players use a normal pendulum stroke, but this requires longer legs than some of us have. Others use a dart grip and



a very quick stroke. Experiment. Can you use center-ball, or is draw required? Once you get good elevation, try an obstructing object ball directly in the path, and see how close you can move it to the cue ball.

If you are going to try this sort of practice for any length of time, please ask the owner of the table beforehand. He has a right to say no. A compromise is to wait until he is going to recover a table, and use it for jump (and masse) practice for the last week of the cloth's life.

Even without a special stick, there are lots of three-dimensional shots that are useful and not too difficult. Shot A in **Diagram 2** is an interesting way to move the cue ball. The problem is that you are nearly straight in on the ball and you have to get to the other end of the table. A monster spin shot is a possibility, but either follow or draw may scratch. Instead, elevate a little and let the cue ball jump up after it hits the object ball. If you have the cut right, it will land on the nose of the cushion and scoot up the table. With five minutes of practice, this shot will be yours.

Shot B in Diagram 2 is a situation from 14.1. The break shot is nearly straight — in, which leaves only a follow shot to break. Instead, elevate a little more than on A, and jump the cue ball onto the top of the rack. Note how far forward the cue ball moves. If you aren't getting as far as the rack, you need to reposition the balls or shoot a little harder, but not so hard that the object ball leaves the table. This shot takes less elevation than you might think.

Another thing to notice on this shot is that you will need to aim fuller than for a normal stroke. This is because the cue ball will cut the object ball more in the air. There are reports of cutting the object ball backwards on some jump shots — the cue ball comes down on the far side of the object ball.

In **Diagram 3,** A is a good shot, but for positional play you don't want to disturb the two object balls that are a throwable combination to that same pocket. The idea is to jump over the dead pair with draw, and move the cue ball up the table. This is also useful if you just need to be up the table and you want to avoid the carom off the near balls. Experiment to see how softly you can shoot and still hurdle the obstruction.

Shot B in Diagram 3 shows a final use of the jump shot. Place the cue ball just off the diamond as shown, and the object ball about eight inches away, straight across the table. Adjust the position so that the "normal" line of the shot with follow is a certain scratch. Jack up about 20 degrees, aim a little fuller, and shoot firmly. The cue ball will jump forward and land on the long rail, well away from the scratch.

There is a rule you need to know if you are going to use these shots in competition. Any miscue on a jump shot is a foul. This rule is to prevent intentional miscues, which is the way most beginners try to get over blockers. I was surprised to learn recently that a jump-cue vendor was recommending not to use chalk on his tip. I'd hate to be the referee called over to watch such shots.

A final note about equipment: the cloth, and, to a lesser extent, the bed of the table, can make a difference in how well the ball jumps. I used to play in pool halls that used rubber-backed cloth, and it was easy to clear a full ball that was only a diamond away with a regular stick. With the thinner, finer cloths that are common today, it is much harder to get up so quickly with a normal cue stick.

Good luck with these shots, and please remember to talk to the proprietor before any serious practice.

If you want to try out some other fun jump shots, ranging from the easy to the impossible, three dozen of them are diagrammed in Robert Byrne's *Treasury of Trick Shots in Pool and Billiards*, along with hundreds of other shots, all for less than $20.

Bob Jewett is a BCA — certified Advanced Level instructor.

Bob Jewett

Half-Ball, Revisited

A refresher course on the long-acknowledged, under-appreciated cut shot.

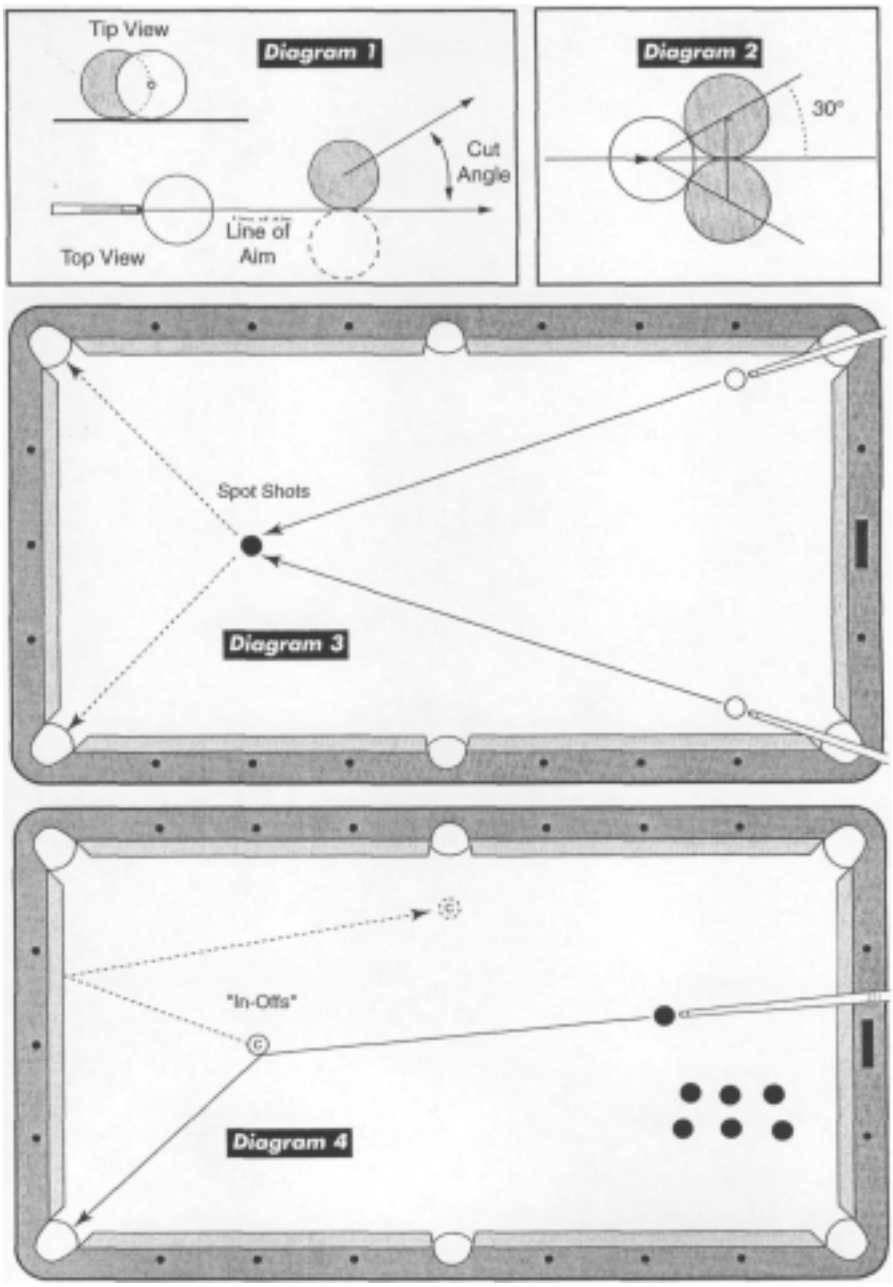
Of **all the** cut shots you encounter on the table, the half-ball shot is the first one you should study. Learning a few half-ball lessons will immediately improve your game. The importance of the half-ball shot has been appreciated for over 100 years — it's surprising that modern authors don't mention it more often. Some of these concepts have appeared in these pages before, so some of the following is review, but you'll find some new ideas as well.

First we need a definition. In a half-ball shot, the center of the cue ball goes directly towards the edge of the object ball, as shown in **Diagram 1.** In the top view, the center of the stick is aimed through the center of the cue ball at the exact edge of the object ball. In the tip's-eye view, you can see that half of the cue ball overlaps with half of the object ball.

What is the cut angle of this shot? Here's an easy demonstration. Place a second object ball where the dotted ball is shown in the top view. As the cue ball contacts both object balls, they will form a 60-60-60 triangle as shown in **Diagram 2,** so the two equal cut angles are 30 degrees. A common mistake is to think that "half also means half of the maximum cut of 90 degrees. If you include the friction between the balls, the actual cut angle you get for a perfect half-ball stroke is a couple degrees less than 30.

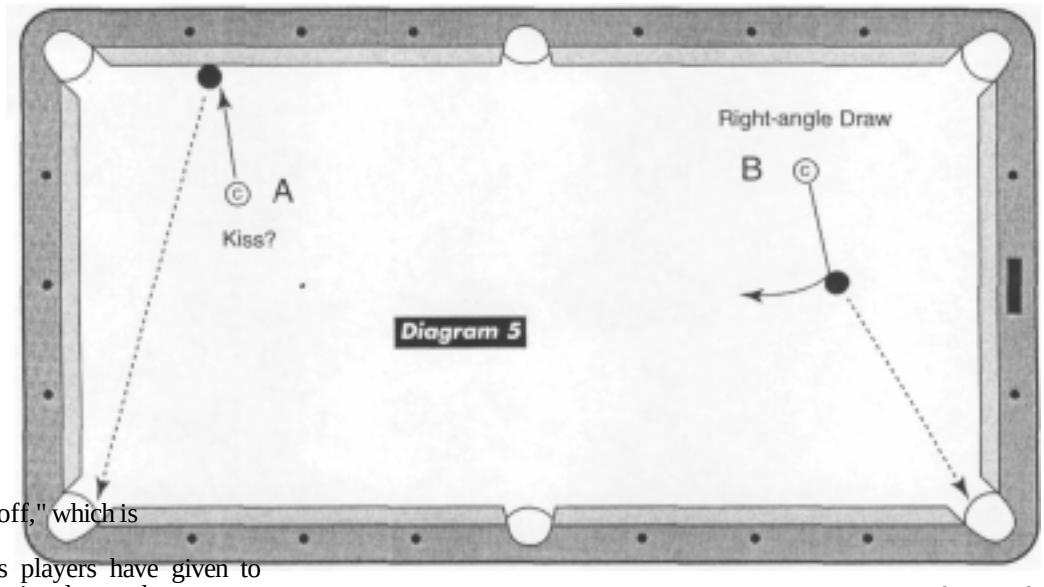
The half-ball shot is the only cut angle that has a distinctly visible target. Even on a full-ball hit, there is no specific place to direct your stick; you estimate a contact point in relation to the edge of the ball. **Diagram** 3 shows a practice shot for edge-aiming. Place a ball on the spot and the cue ball behind the line, as for a spot shot in 14.1 or One Pocket. Place the cue ball far enough away from the side cushion that your stick — when you are lined up for the shot — is over the corner pocket. Try aiming at the edge and see whether you pocket the ball. This aiming technique is probably unlike your normal method, so don't be surprised if the hit is too thin or thick at first, or if the shot looks a lot different from the left and right sides.

The real use of the half-ball shot is in accurately predicting the path of the cue ball. To learn this facet of the shot, play the "reverse pool" shot in **Diagram 4.** Put the cue ball on the foot spot and take "object ball in hand" behind the line. That is, place an object ball as shown — about four inches to the right of the head spot — and shoot it to hit the cue ball half-ball on the left side with the goal of "scratching" the object ball into the corner. The shot is easy if you shoot only hard enough to bank the cue ball to end up even with the side pockets as shown.



Also, play the object ball with follow; it must be rolling smoothly when it gets to the cue ball, so you might as well start it that way. If you are missing the pocket to one side, move the spot for the "object ball in hand" to the corresponding side until you find the "sweet spot."

While this shot may seem tougher than the spot shot, it is actually much easier. The angle of the rolling cue ball off an object ball when struck anywhere near a half-ball hit is so constant that you will find it hard to miss the "in — off," which is the name English billiards players have given to this kind of intentional scratch.



You must burn this half-ball carom angle into your brain. Knowledge of it will let you predict exactly where the cue ball will go on any rolling follow shot that is close to a half-ball cut. Here is a challenge to help you learn it: I'll bet you can make 15 of these "in — off" shots in a row in less than 60 seconds. You'll need a friend to catch and reset the cue ball as soon as it leaves the spot; it should not move more than six inches. While he's doing that, your job is to place another object ball on the "sweet spot" as soon as you've taken the initial shot. With practice, you'll shoot each ball before the previous ball is in the pocket. By the time you're done with this, you'll know the path the cue ball wants to take.

Another useful fact: On a rolling half-ball shot, the cue ball and the object ball will move nearly the same distance after the collision. This means that in Diagram 3, the cue ball must touch the end rail if the object ball reaches the pocket because the distance to the rail (at about one diamond from the center) is shorter than to the pocket. If you place the cue ball by the side cushion for the spot shot, the hit will be fuller, and it is just barely possible to avoid hitting a cushion with the cue ball.

Diagram 5 shows two final half-ball features. In 5A, the shot is to bank the object ball cross-corner. It is frozen to the cushion just far enough from the pocket that a half-ball hit will deliver it to the corner pocket when the cue ball is shot firmly and straight toward the side rail (and parallel to the end rail). On my table, the object ball is a diamond and a ball from the end rail. Here's the secret: if you shoot this shot softly, there's a kiss, but if you shoot harder, the object ball sinks farther into the cushion, allowing the cue ball to move to the side before its return. For this angle of the cue ball, the half-ball hit is on the boundary of a kiss-out of the bank. Shot 5B displays another useful fact. For a half-ball draw shot, after the cue ball curves, it will be traveling at a right angle to its original line.

Both 5A and 5B can be extended to similar shots. In 5A, if the cue ball is farther from the end rail, requiring a fuller hit, the bank will surely kiss, whereas there is no kiss in the bank if the cue ball is closer to the end rail. In 5B, if you need to get the cue ball to draw back even farther than the right angle, you'll need your very best, nearly-a-miscue draw. Also, if the cue ball is back farther, so significant draw is lost on the way to the object ball, getting to the right-angle line is nearly impossible — unless the cut is fuller than half-ball.

Now it's time to get to the table and work these exercises into your game. You'll find that time spent with half-ball practice will show quick results.

Bob Jewett is a BCA-certified Advanced Level instructor.

Bob Jewett

Bank Losses, Rolling Ratios

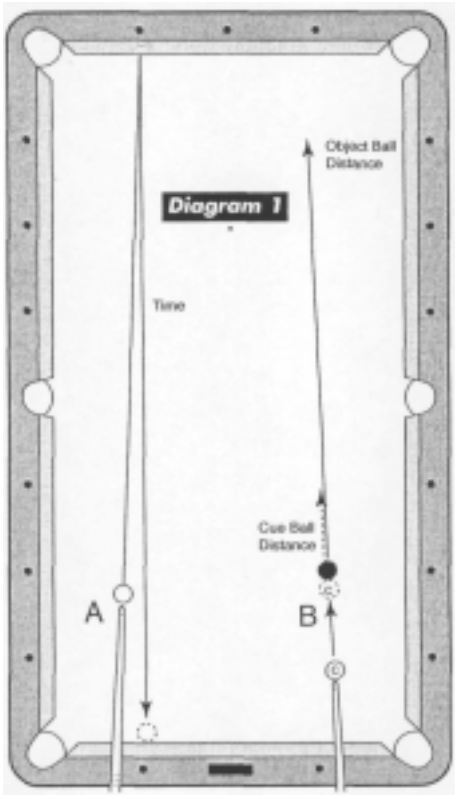
The numbers and formulas behind the results.

Two of **the** most important factors in how a table plays are the speed of both the cloth and cushions. If these two variables change, your position and banks will suffer horribly unless you compensate. I'm sure you have had the experience of playing on a new, fast cloth and watching helplessly while the cue ball rolls on and on at the end of the shot. Here is some analysis that can help you measure how fast the cloth is and how lively the cushions are.

In my April, 1995 column I offered the following way to measure the speed of cloth: shoot the cue ball as for a lag shot, and time from when it hits the far cushion until it stops. Only count those tries in which it almost hits the cushion you shoot from, as shown in **Diagram 1A.** Say it takes seven seconds to cover that distance. Square the seven (49) and then multiply by two to get 98, which is the "speed" of the cloth. The longer it takes the ball to cover that eight-diamond distance, the faster the cloth is. Take one over the speed number (about 1/100, or 1% in this case), and that gives the effective slope of the cloth. I've seen carom cloth as fast as 200, and some fuzzy, backed cloths that were down around 50.

This rule of thumb for cloth speed ignores a lot of the details in the physics, including the energy in the rotation of the ball, the possibility that the ball may decelerate faster at higher speeds, and that there may be some slide immediately after the far cushion is contacted. Fortunately for the physics fanatics among you, Wayland Marlow, the author of *The Physics of Pocket Billiards,* has written down all the details (contact me through this magazine for more information). One detail I will mention is that you need to correct for the distance traveled if it is not close to the length of a nine-foot table. For example, on a ten-foot carom table, the multiplying factor is about 1.8, rather than the rough two above.

The speed of the cushions is harder to measure. You might expect that when a ball hits the cushion, it loses a certain fraction of its energy, or equivalently, some fraction of its speed, no matter how much it started with. This problem is complicated by roll that the ball nearly always has when going into the cushion softly, as for the lag above. If we had a calibrated video camera, or a radar gun that could plot speed versus time, we could measure ball speeds into and out of cushions with various spins. There is a simpler way to make the basic measurement with just a tape measure and a couple of balls.



The first basic idea is that we can measure the energy in a ball by how far it goes on the cloth — the farther it goes, the more energy, and in direct proportion. Here we are interested in the ratios, so we will only look at relative distances traveled by the cue ball and the object ball.

The second major idea is that when a cue ball hits an object ball full, and the cue ball is rolling smoothly on the cloth, the cue ball and object ball end up with a certain ratio of energies. What happens is that right after contact, the cue ball stops dead but still has top spin, while the object ball is sliding away with all of the speed of the cue ball without spin. Soon the object ball starts rolling smoothly while the cue ball expends its follow to start moving forward. Theory says that the speeds of the two balls after they are both smoothly rolling should be in a ratio of 2:5, with the object ball moving two and a half times as fast as the cue ball. Because energy is proportional to the square of velocity, the object ball should end up rolling 6.25 times as far as the cue ball after the collision.

The ratio of about 6:1 is a useful rule of thumb when playing soft position. Suppose the object ball is six diamonds from a pocket, and you want the cue ball to follow straightforward not more than about one diamond after the collision. If you just get the object ball to the pocket — six diamonds of travel — the cue ball will roll forward about one diamond. Another way to state this is that on a full, soft follow shot, the cue ball will go forward one ball for each diamond the object ball travels.

The set up for the experiment is shown as **Diagram IB.** The object ball is on the head string, and the cue ball is close to the head rail. (Placing it close to the cushion makes it more likely that you will start the cue ball with follow, which is essential for the test.) Simply shoot a lot of straight-on shots at various speeds and measure how far the object ball rolls and how far the cue ball rolls after contact. Be careful on those shots that include a cushion, as the ball can't get all the way to the nose — its center only goes to the rail groove.

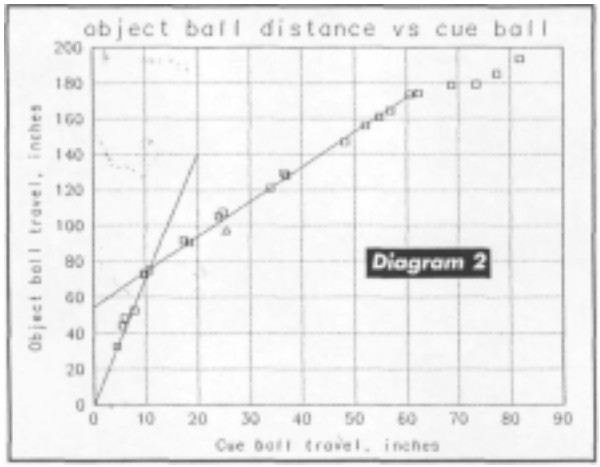
Plotted in **Diagram 2** are my results from a 9-foot pool table. On the bottom axis is how far the cue ball traveled, and on the vertical axis is how far the object ball went. The major features are the various straight slopes and the break, or "knee," in the curve when the object ball has gone about 74 inches.

The first straight slope — to the left of the knee — is where neither ball contacts a cushion. The ratio of the distances traveled is estimated to be 7:1, which is close to the 6.25:1 mentioned above. This can be crudely explained by invoking the friction between the balls, which tends to retard the cue ball more than the object ball. At any rate, until the object ball hits the cushion, the ratio holds up pretty well. The next section of the curve is again nearly a straight line, but with a considerably different slope. This is the region where the object ball has hit the far cushion and bounced back. Remember to add up the total dis-

tance traveled, and not the net distance. The change in slope is because the object ball lost a certain fraction of its energy when it contacted the cushion. The fact that the line is nearly straight until the next cushion is struck means that the cushion "efficiency" is nearly constant for this range of speeds.

By looking at the ratio of the slopes in the two regions, it is possible to calculate what fraction of energy is lost during cushion contact. This solid line fits the data well, with a slope of about 2:1. This means that the object ball only retains 2/7 of its energy in bouncing off the cushion. In terms of speed, the exit speed is 53% of the entrance speed. This is far from the perfect reflector that many people assume the cushion to be.

The wrinkles in the curve on the right side are due to both the cue ball and the object ball hitting more cushions. Starting from the setup as shown, the two balls will both reach cushions for about the same stating speed. This suggests an easy way to measure relative liveliness of cushions. Place an object ball about a diamond in front of the line, and shoot the bank shot with the idea of leaving the cue ball frozen to the far cushion and the object ball frozen on the cushion you are near after it has traveled about 13 diamonds. Move the starting location for the object ball nearer and farther, until you find a place that allows the double freezing with a smoothly rolling cue ball. Call this the "magic bank point" or MBP, because it allows you to do a shot at perfect one-pocket speed with nothing fancy on the cue ball — the object ball ends near your pocket and the cue ball ends frozen to the far cushion.



How does the location of this MBP relate to the speed of the cushion? Imagine a cushion that took no speed from the ball. You would have to shoot much more softly to keep from over-running the second cushion, and the cue ball would not go far after the collision. In fact, the object ball would start only a diamond and a half from the first cushion. So the rule is that the closer the MBP to the first cushion, the bouncier is the rubber. On the pool table where I made the above measurements, the MBP is five diamonds from the first cushion. I also measured a snooker table and a carom table, and they both had MBPs very close to the center of the table. The cloths on those two tables were very different. The snooker table had thick nap, while the carom table had super-fast worsted (napless) cloth.

Now you have two tests to use on a strange table, or even your own if you want to see how it stacks up against others. You will need a stopwatch for the cloth-speed measurement, but all you need for the cushion test is to find where the MBP is.

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