Bob Jewett

Make Your Own

Do-it-yourself help with aiming.

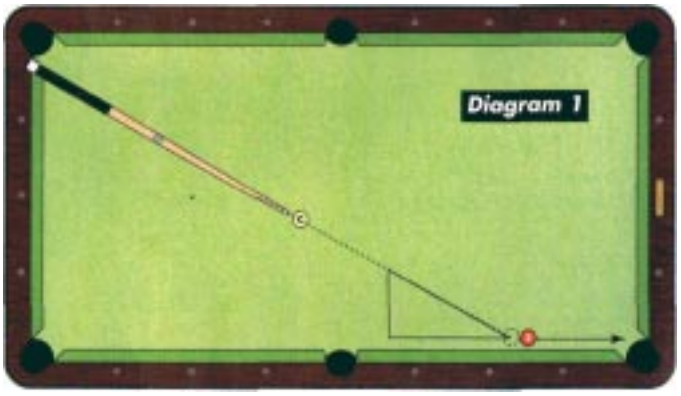
Last month I showed you some pool aiming aids. One of them was Colonel C. M. Western's amazing "Pointer," which has multiple rotating arms, sliders, finely engraved scales, and a mechanical monkey that plays the accordion. Well, almost. It tells you exactly how full to hit any cut shot on the table and where the cue ball will then go for any amount of draw or follow. If you're still scratching your head about how it works, you're not alone. As soon as I decipher the 154-page instruction book, I'll try to make its operation perfectly clear.

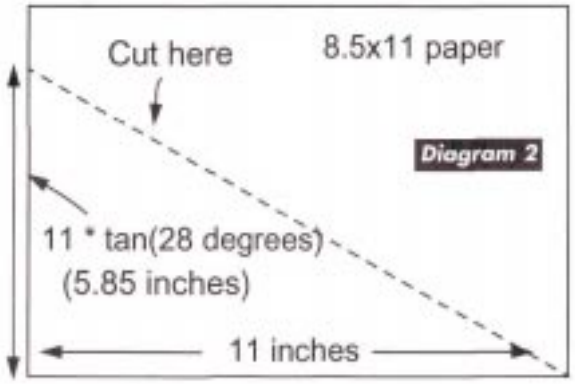
In the meantime, here are two simple devices that you can make yourself to help visualize both aiming and position play.

The first will help you find the true half-ball angle and aiming alignment. This sounds easy — anyone can see the edge of the object ball and send the cue ball in that direction. But in my own case, I found that even though the target is obvious, I was off by a little in my cue delivery and that cuts to the left were different than cuts to the right.

The aiming device is shown in use in **Diagram 1.** It's formed from two simple shapes: a triangle and a circle. The circle is placed at the ghost ball location (where the cue ball will be when it hits the object ball) with one side of the triangle pointed toward the pocket. Place the cue ball so it is along the extension of the other side of the triangle. It it is easier to see this line if the triangle is fairly large, but you could use a string to extend the line for a small one.

The circle is the easy part to make, but make sure that its diameter is exactly the same as the ball's: 2.25 inches. The triangle is a little harder. First you have to decide on the angle. If there is no throw, the angle would be 30 degrees, but with throw included, the cut angle is perhaps two degrees less — 28 degrees.





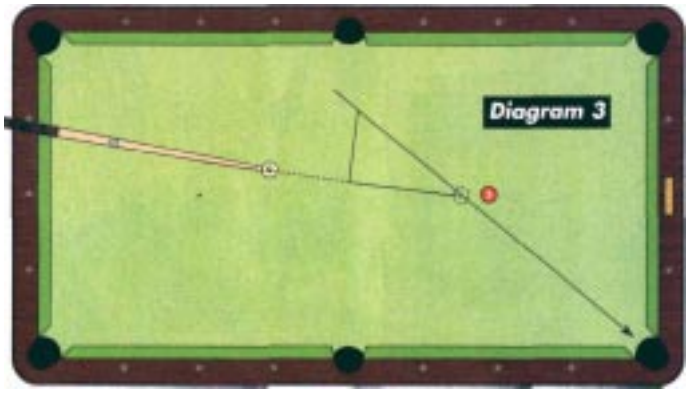


Diagram 2 shows how to make such a triangle. If you use regular 8.5-by-l 1-inch typing paper, and you use the 11-inch side for one side, the other side has to be 5.85 inches long. The formula is shown in the diagram: 11 * tan(28 degrees), where tan is the standard abbreviation for the tangent function of trigonometry.

Suppose your set of balls has less throw, or you want to use a different size of paper. You will need to somehow calculate the length for the unknown side of the triangle. Fortunately, www.google.com has generously agreed to do these calculations for us for free. Just go to its Web site, and type into the search window the formula in the format above. If you prefer to spell out "tangent," Google is smart enough to know what you mean. This will allow you to figure out the second leg for any size and angle. As a final example, if you want to make a 30-degree triangle with 22-inch paper, type in "22 * tangent(30 degrees)" and you will get 12.7 inches.

In **Diagram 3** is an example use of the second aid. It is shaped just like the first, but it tells you where the cue ball is going to go when it leaves the object ball for a half-ball shot. Placement is a little trickier. One side is still along the line of the cue ball's approach, but the circle is not placed at the ghost-ball position. Instead, it is pulled back some. This is an allowance for the fact that the cue ball slides some to the side just after it hits the object ball, and this gives an apparent starting position somewhat back from the ghost ball. How far? That depends on your speed, cue ball, cloth, object ball, and a few other things.

What angle should you make the triangle? Start with 34 degrees. That should get you close enough that you can place the cue ball for a scratch every time on the shot shown. Once you have that angle down so that you can split the pocket precisely, try placing a 9 ball, for example, half a diamond from the pocket and see if you can set up a billiard to make the 9. I think you'll be pleasantly surprised.

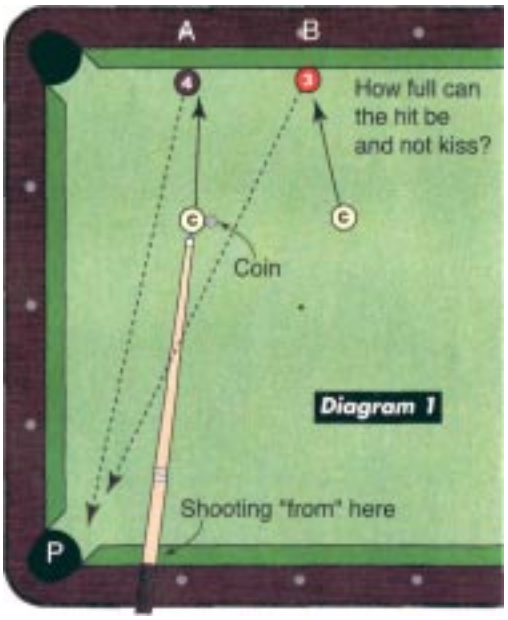
Bob Jewett

Frozen Bank Shots

Heat up the table with your new skills.

In Diagram 1 you'll find a situation that worries beginners and champions alike. The object ball is frozen to the cushion, and the only shot available is a bank shot. Will the cue ball double-kiss the object ball? After this column, you should be a lot more comfortable with this kind of problem.

First, you need to have some organized experience with the shot. Go to a table and try the following drill. Place the object ball in a convenient place such as at the first diamond from the corner pocket (A). Place the cue ball where you think you can bank the ball to pocket P without a double kiss. Mark that spot with a coin, as shown. At first, don't try any technique that you already know that might help prevent a kiss; just play the cue ball with follow and just enough speed to get the object ball to the pocket.



If you make the shot from one location, move the coin a little farther up the table and try again with the cue ball in the new position. Remember that if you do get a double kiss from one position, it doesn't necessarily mean that you can't make the shot, since your aim may have been off.

Once you have the coin up the table as far as you can get it, note where on the side cushion you are shooting "from." That is, note where your stick passes over the rail closest to you.

Next, try some techniques to advance the coin farther. For the shot shown, left English should help. Playing the shot with enough draw to be a stop shot should also help. (A stop shot with a little cut angle is often called a "stun" shot.) Finally, shooting the shot harder should permit a fuller hit.

The first two methods actually work by the same mechanism. The idea is to get the cue ball to rub on the object ball to put right English on it. This will be "reverse" English as the object ball goes into the cushion, and will make the ball leave the cushion "shorter," or more perpendicular to the rail.

Why is a stun shot the same as left English on the cue ball in this situation? The important factor in throw and transfer of sidespin to the object ball is the direction of the motion of the cue ball's surface when it hits the object ball. For the shot shown at A, there will probably be some cut to the left as seen from the cue ball, so that for a stun shot, the cue ball will be moving to the right when it hits the object ball. This will both throw the object ball to a shorter line and transfer right English to the object ball, which will also help to shorten the rebound angle.

Left English on the cue ball is a surer way to get this effect, because as the hit gets fuller, the "collision-induced throw" of the plain stun shot will have less effect. Also, if there is any draw or follow on the cue ball when it gets to the object ball, that will make the surface motion less effective in making the shot go shorter. To make the left English most effective, try for a stun shot along with the sidespin.

The third technique for extending the march of the coin up to a fuller hit is to shoot harder. Until recently, it was believed that shooting a bank hard caused some kind of rail deformation that would make the ball rebound at a shorter angle. In fact, on most tables the speed of the shot does not significantly affect the banking angle for a frozen ball.

Please note that I said "frozen ball." On a slow bank shot, if the object ball starts a distance from the cushion, it will have a chance to develop forward roll before impact. After impact, as the ball moves away from the cushion, it continues to spin toward the cushion. This will tend to carry the ball back toward the cushion, curving its path.

A very interesting (and useful) phenomenon having to do with banking is shown in Diagram

2, which looks like a film strip. The images are from the Jacksonville Project video, in which lots of stick/ball/rail interactions were captured at rates as high as 12,000 frames per second, which is 400 faster than typical video rates.

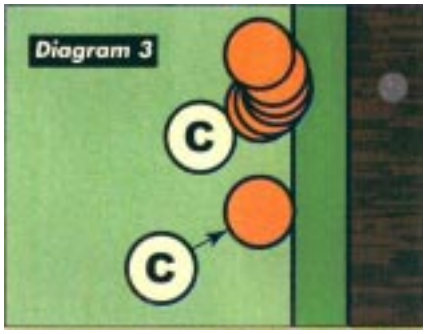
The images shown are of a cue ball with follow approaching an object ball (the 3) frozen on the cushion. The cue ball is coming in at five meters per second, which is about half of break-shot speed. The frames shown are 1/500th of a second apart, so the entire sequence took place in l/30th of a second, or in the time of a single frame of a standard video.

The cue ball hits the object ball, and stops almost dead. You can see it advance a tiny bit in the next seven frames. During this time, you can see it rotate in place as the follow doesn't have time to take effect.

What this sequence reveals is how deep the object ball sinks into the cushion before bouncing back out. While the cue ball is stopped, the object ball travels into the cushion to a surprising depth of almost half an inch. The object ball returns to hit the cue ball full, and stops nearly dead in turn. The cue ball is sent back out with a somewhat reduced speed, due to energy losses in the cushion and between the balls. Note that the cue ball still has its "follow," which has been turned into draw.

Knowing that an object ball sinks so far into the cushion makes it clearer why it is possible to bank short by shooting harder. Diagram 2 shows a straight — in shot, and results in a kiss. But for a cut shot, shooting hard can save you from a kiss, pushing the object ball deep into the cushion and creating an effect like that shown in **Diagram 3.**

In Diagram 3, the cue ball is shown coming into the shot at an angle that would not let the object ball escape if it reflected from



the rail instantly. (That approach angle for a full hit is ideally 45 degrees.) What happens is illustrated by the "multi-exposure" drawing (on top) which shows successive positions of the object ball. Initially, it goes straight away from the cue ball into the cushion. The cushion gradually turns the ball back out, and the ball finally emerges from the cushion some distance down the table, with no chance for a kiss.

How far down the table will the object ball be at the end of cushion contact? That depends on the speed of the shot — harder shot, deeper penetration — and the response of the cushion. I've played on tables that seemed to return the object ball much faster than the cushions I am used to, and a lot of the banks I was sure of got double-kisses.

With this knowledge in hand, try to advance your coin farther for the shot at A. Can you move your "starting point" another six inches up the side rail? After you have exhausted the shot at position A, try the object ball at B. Also, while banks to the side pockets should work about the same, try them for good measure.

Finally, see if you can form your observations into some kind of system or rule of thumb, even if it is as simple as "If the cue ball is straight out from the object ball, the ball has to be at least one diamond up the rail for the bank to be possible using all techniques."

Bob Jewett

Hoppe to It

Custom-fit your own system.

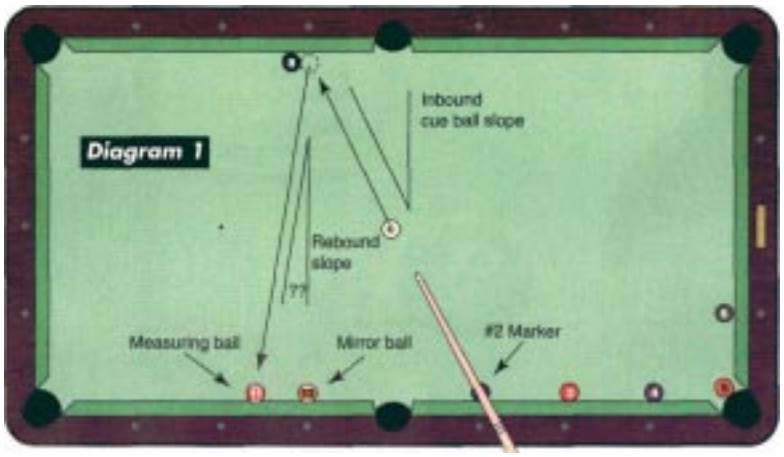
There are lots of systems that will tell you where the cue ball or object ball will go when you make a shot a certain way. The classic kicking system that is shown in Willie Hoppe's book, "Billiards As It Should Be Played," works when the cue ball is coming generally from a corner and hits the opposite side cushion with running English. It tells you where on the third cushion the cue ball will hit. You've recently seen here a mirror system and a shortened mirror system for banking object balls off the side cushion. Robert Byrne has explained dozens of systems in his books and articles, and Walt Harris has cataloged even more dozens in his "Atlas" series of books.

Most players want a little help on various kinds of shots, and each problem almost certainly has a corresponding system that addresses it. If you find a pre-fab system that seems to apply to your shot, there are a couple of potential problems. The system may not work well with your equipment — that's certainly the case for the "corner five" system when applied naively to pool tables. Or, the system may be very inaccurate over a large range of cases — the plain mirror system for banking springs to mind.

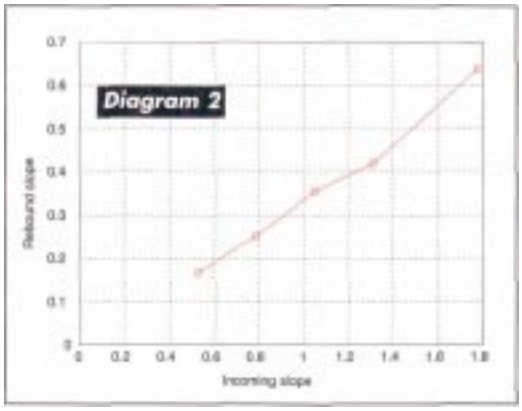
Below is a description of how to develop a system of your own that covers a particular kind of position shot. Because you will work out the system on your own table with your own stroke, it is far more likely to work for you.

The problem is shown in Diagram 1. You need to cut a ball down the side rail, and you would like to know where on the opposite side the cue ball will hit. Assume that the shot is played as simply as possible, which means without side spin and so that the cue ball is rolling smoothly on the cloth (normal top spin or follow) when it hits the object ball.

I think you'll agree that sidespin would complicate the situation, but what about that smooth-rolling requirement? Wouldn't it be a simpler case for the cue ball to have no spin at all (like a stop shot or stun shot) when it hits the object ball? The problem with playing the shot like a stop shot is that it is not easy to have exactly no spin on the cue ball when it arrives at the object ball. However, it's very easy to have a smooth-rolling cue ball, as that's what it does naturally.



So what does a system for such a shot look like? If the system simply said that if the cue ball and object ball are precisely as shown, the cue ball will land 17 inches from the side pocket, the system wouldn't be of much use, except for the one shot in a billion where the balls are exactly as shown. The system has to be of more general use. It should work for different angles of approach, and maybe different object-ball positions.



The first generalization is that the cue ball can start from a variety of positions without really changing the shot. For the shot diagrammed, it should be clear that if the cue ball starts a foot closer to the object ball along the path it will take to the ball, its rebound angle will not change. It could also start farther back. What's important is the angle of approach. I've placed a marker ball even with a diamond (the 2 ball). As long as the cue stick is directly over that ball when you're shooting the shot, the cue ball should have the same rebound angle.

So, we need a way to specify the cue ball's angle of approach, labeled as "Inbound cue ball slope" on the diagram. One common way would be to note the line of the shot, and see where that line crosses the rails as measured by the diamonds. For example, on the object-ball side, the line of the shot crosses the diamonds at about 2.8 diamonds from the foot rail, and the other rail at about 5.2 diamonds from the foot rail. You would say that the cue ball is "coming from 5.2" whenever you are shooting with your stick over that point in the "line of diamonds." Similarly, the shot is "going to 2.8" on the other rail.

While we could use the line of diamonds to measure our shots, I prefer to give the location by the position of an imaginary ball along the line of the shot that is touching the cushion. The marker ball is such a ball. Also note that the shot is set up so that the cue ball will be even with a diamond when it hits the object ball. We can now specify the inbound slope of the cue ball by the separation of the cue ball at impact and the marker ball over which the cue stick passes. It is exactly two diamonds for the shot diagrammed.

(In general, the first method, which uses the line of the diamonds, is called "shooting through," while measuring with a ball on the nose of the cushion is called "shooting opposite." One problem with shooting shots "through" is that they depend on how far back on the rail the diamonds are placed, and there is no standard for that. If

you want to understand systems that use the diamonds, it is important to understand the difference between through and opposite. Both ways are useful. Learn both.)

The first thing to do, now that we have a framework for measuring, is to gather data. We first want to know where on the second rail the cue ball will hit when starting "two diamonds above" the object ball, as in our diagram. Try the shot, and when you make it, note where the cue ball hits, place a chalk on the rail there and freeze an object ball even with the chalk. Now try the same shot again. Does the cue ball go to the same place? Make small adjustments to the measuring ball until you are confident that the cue ball will hit it whenever you make the shot.

When you've zeroed in on the landing spot, measure how far down the table the cue ball has travelled from the first to the second rail. This is easy to do —just freeze a "mirror" ball even with the diamond the cue ball hits on the first rail, and measure from the center of that ball down to the center of the measuring ball.

That's all for one incoming angle, so next measure for other angles. Move the marker ball a diamond farther up the table (shown as the 3 ball), and start a new series of shots. The measuring ball should end up moving down the table some. Record the measurement, and move on to the other marker balls. Note that for marker number 6, we have run out of long rail, so we will have to handle the results slightly differently. I drew up a table: In the first column, I indicated which marker ball the cue passed over. In the second column, I recorded the number of inches between the mirror ball and the measuring ball. Here are my results for my table and balls:

Marker Ball	Number of Inches
2	8
3	12
4	17
5	20
6	30.5

The farther up the table the cue ball starts, the farther down the table it goes on the rebound. This makes some sense, and I suppose you could memorize the numbers for later use, but let's try to find something systematic here. Plotting data is often a very good way to find trends. Let's try plotting the inbound slope and the rebound slope. For example, in the first shot, the line of the cue ball travels two diamonds (25 inches) down the table while travelling about 48 inches across, if we use the idea of the "from" and "to" balls. (Do you see why the distance across the table is not quite 50 inches?) That is a slope of 25/48 or 0.52. On my table the returning slope is 8/48 or 0.17. I've done the arithmetic for the other cases and plotted it in **Diagram 2.**

The thing to notice immediately is that when plotted like this, the data form nearly a straight line that would go through the origin (0,0) if extended. Whenever this is true, it means that the two quantities are related by a simple proportion. In this case, that proportion is three. This gives us a very simple way to express the "cross-table angle system:" When playing a cut down the rail with no English and a rolling cue ball, on rebound the cue ball will go down the table one-third as much as it did getting to the ball.

If you're shooting from three diamonds "above" the object ball, the cue ball will go one more diamond down the table while coming back across the table after the hit. This immediately suggests a test. Put the object ball a diamond, minus one ball diameter, from the corner pocket, and shoot "from" the opposite side pocket. The shot should scratch, or close to it, every time. If you happen to encounter this shot, you may want to play it with something other than plain follow unless a useful ball is sitting in that corner pocket.

Next month, I'll look at some details and extensions of this simple system. In the meantime, get onto your own table and make your own measurements. Does your table also have a 3:1 ratio of slopes?

Bob Jewett

Do Try This At Home

Here's another set of measurements to get you tuned into your table.

Last month, I described how you could make your own system that would answer the question posed in **Diagram 1:** If you run the object ball along the long rail, where is the cue ball going to land on the opposite side cushion? I hope you had time to get to a table and try the idea. Have I mentioned recently that if you remain in your easy chair and just read these columns, you may get better at sitting and reading, but you are unlikely to get better at playing pool?

Last month, the shot had the restriction that the cue ball should be rolling smoothly on the cloth and have no sidespin. The remarkably simple result that I got on my table was that for a shot from X diamonds "above" the object ball, the cue ball will go to X/3 diamonds "below" the object ball. That is, the cue ball will not come straight off the cushion, but will instead be bent forward by the follow and go down the table some. The factor of one third held over all of the approach angles I tested.

I'll urge you again to go to your own table and make your own tests for two reasons. First, working on a system like this is a very structured, focused form of practice. All of your attention is on one factor of the game. A major point that Dr. Bob Fancher makes in his excellent pool-psychology book, "Pleasures of Small Motions," is that you want to work on one thing at a time — you will learn it better that way. The other reason is that tables differ. My tests were on a pool table with slightly worn, clean cloth, and many tables are not like that. Similar tests on a carom table gave a factor of one-fourth for the angle ratio.

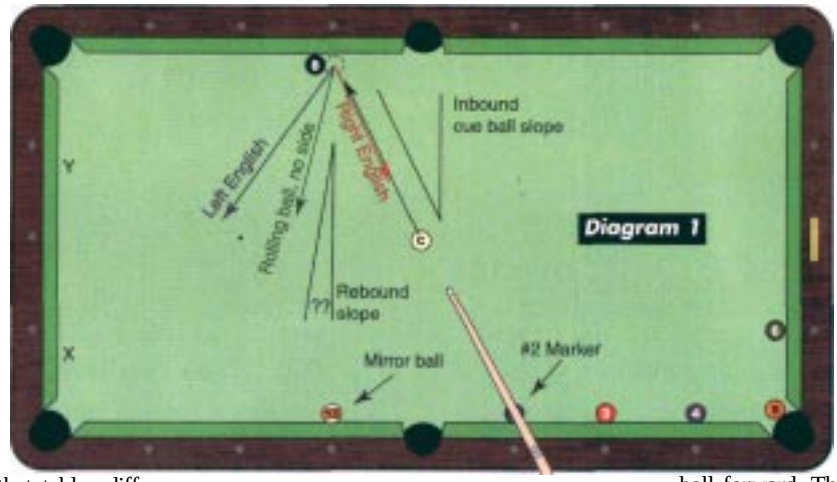
The test is shown with the object ball a long way from the pocket. The main reason for this is to keep you from cheating the pocket. If the object ball goes in, you know pretty exactly the line of the object ball. If the object ball were only one diamond from a gaping cavern of a pocket, you could take great liberties with the cut angle, and the measurement of the rebound angle would be useless.

This leads to a question I'll leave up to you to answer: If the object ball starts out from the rail a little, how does the rebound angle change?

For a similar reason, the cue ball is shown starting a fair distance back. This ensures that the cue ball will be rolling smoothly on the cloth as desired, unless you shoot hard or with draw. This removes one more variable from the test.

Although the shot is shown with the object ball going along a side cushion, the angles should be the same if the shot is along an end cushion. Can you see how to calculate the rebound for an end-rail shot? The ratio will be the same as for the side-rail case (unless your table is wacky), but it's harder to use the end-rail diamonds because there aren't enough of them. Get on the table and you'll see what I mean.

A major thing left out of the study so far is sidespin, which makes the shot harder but is sometimes essential for position. It's time to include it.



I tried the shot with two kinds of English. The first was with follow and "pretty good" right English. Your "pretty good" English will be different from mine, which is why it's even more important for you to do your own tests when working with sidespin. I shot relatively softly, so the cue ball was sure to be rolling smoothly on the cloth when it hit the object ball.

Like last month, I tried starting the cue ball from various positions along the long rail, and measured the rebound spot on the side cushion relative to the "mirror ball." The cue ball ranged from the position shown in Diagram 1, which I called "2" since it was two diamonds above the position of the object ball, to position "6." If the cue ball landed on the mirror ball, it would mean that the cue ball went straight across the table from where it hit the cushion on the right side.

For right English, the return of the cue ball was always "uphill," which means that it landed on the cue ball's side of the the mirror ball. The distances above the mirror ball for the various starting points were:

Marker Ball	Number of Inches
2	25
3	24
4	25
5	25
6	18.5

This is both a very monotonous and a very interesting result. Except for case 6, the cue ball always returns to location "2," or along the line of the cue stick shown in Diagram 1. There is no reason to plot the data as I did last time, since the obvious rule is: If a rolling cue ball cuts an object ball down the side rail with outside English, it will return across the table to a point two diamonds above where it hits the first cushion. This holds true until the cut is less than about 45 degrees, at which point the follow will begin to dominate and curve the cue ball forward. The English needed is "Bob's pretty good outside."

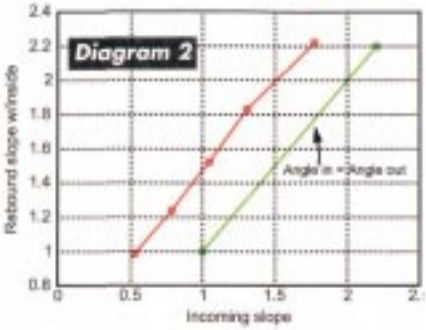
Is the amount of English a little nebulous? Sure. If you try the shot and adjust the spin to get results similar to those above, you will know what I think of as "pretty good" but not yet "extreme." You could then restate the spin in terms of "cue tips" of English, if you are familiar with that system.

Why is the result so constant? It's always possible that I subconsciously adjusted my stroke to make the cue ball land repeatedly in the same place, although the result was a surprise to me. One way to explain it is by

the balance of three interacting forces. As the object ball is hit fuller, there will be more sidespin relative to the speed into the cushion, as the object ball will take more speed from the cue ball on a fuller hit. The larger amount of relative spin will tend to make the cue ball come back up the table more. Also, for a fuller hit, there will be less speed back across the table, which will tend to make the spin more effective. Finally, with a fuller hit, the follow on the rolling cue ball will tend to make the cue ball go down the table more. Somehow, these three cancel each other for a fairly wide range of incoming angles.

As the hit gets even fuller, the cue ball's sideways speed is so low that the sidespin cannot take effectively on the rail, and the follow begins to take over and move the cue ball down the table. Unfortunately, I stopped measuring at position "6" because that's where I stopped the no-English measurements. I (and you) should return to the table to find the steepness that will make the cue ball go straight across the table for this kind of hit. I suspect it will be from about the name plate for the shot diagrammed. This would give a good rule of thumb to use in play.

I also tried inside English. This was also of the "pretty good" variety. The results are plotted in **Diagram 2.** Also shown in the plot is the line for the "ideal reflection case" — angle in equal to angle out. The data for inside English show that the rebound angle I got was actually beyond ideal reflection.



The landing spots were all on the end rail for cue-ball positions from 2 to 6, which went to X and Y respectively. I was surprised to get the cue ball to X for the cut shot shown, but sometimes science does startle. Stated simply, the data say: With pretty good inside follow on a cut down the side cushion, the rebound angle follows "angle in = angle out," provided that you imagine the cue ball starting two diamonds farther up the table.

The "two diamonds" part is taken from the fact that the rebound slope is 0.5 slope units larger in Diagram 2 than the equal angle slope for all values of cut angle, and the four diamonds of travel of the cue ball across the table.

How to apply the system? In the shot shown for cue-ball position 2, imagine that the cue ball is coming from 4 instead, and the object ball isn't even there, and that the rail will reflect the cue ball perfectly. (That's a lot of imagining, but bear with me.) The result is that the cue ball should land on the side cushion four diamonds down the table from the mirror ball. That's beyond the end of the table, but if you imagine the rails extended, you get a spot pretty close to X.

If you work with the system a little, I think you'll get a feel for how to apply it even to angles where the diamonds aren't readily available. In those cases, you have to figure out how to get a rebound angle with a slope half a unit larger than the inbound angle.

Would it be useful to have an inside-English system where the rebound angle equalled the inbound angle? I think it would, since then you are liberated from the diamonds. See if you can find an amount of spin — a little less than "pretty good" — that makes the angles equal on your table.

Go to the table now and do your homework.

Bob Jewett

Faszinating

The Internet offers jaw-dropping pool pics from Austria.

There's a free video clip on the Web that you have to see. Get to your computer and view it before you read further. You won't be sorry. (Well, you may be sorry if your computer won't read Windows Media Videos, but I can't help that.)

The clip is:

http://www.bskunion.at/efler/Faszination_Dreiband_Windows_Media_9.wmv.

It needs to be typed perfectly or you won't be able to connect. An alternative link is at the bottom of the page www.sfbilliards.com/misc.htm, which is easier to type.

This remarkable video, entitled "Faszination," was made in Austria by a group including Robert Leitner and three-cushion champion Andreas Efler.

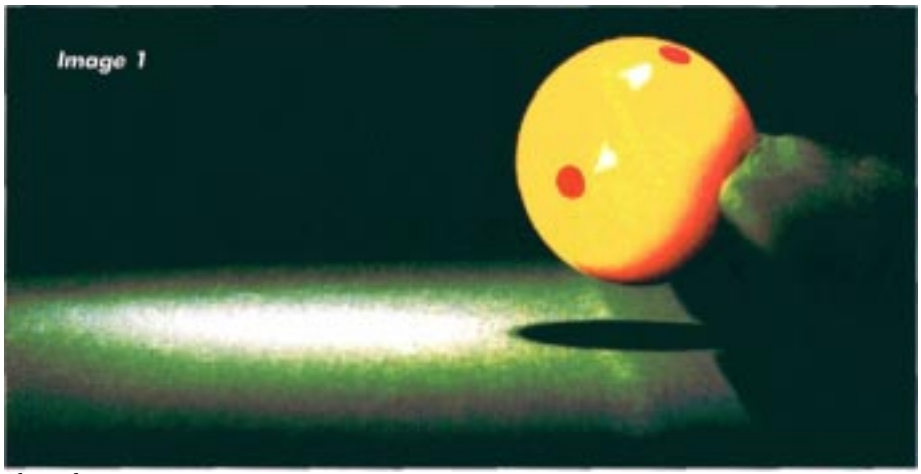
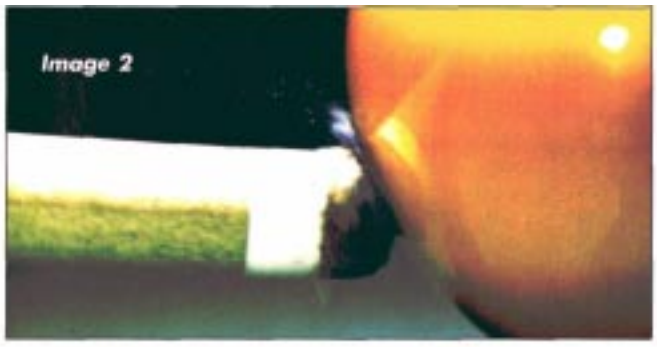


Image 1 shows a ball in flight hitting a cushion. This is like the diagram I had in a previous column on cushion compression, but it's a lot neater shown in high-resolution color. You can see the deep compression of the rail, and on the video you can see the cue ball lose its spin on contact. This is a flattish jump shot to the rail, and the cue ball bounces back at about the same elevation as its arrival.



In **Images** 2 **and** 3, you see a cue tip hitting a ball, with rather amazing flying chalk. I think that there was extra chalk applied for effect, and in earlier frames you can see the tip shedding chalk as it approaches the cue ball. Notice the compression of the tip while it is on the ball and how the tip seems to have recovered by Image 3.

If you look carefully, you can also see how much the front of the shaft has been moved down during the shot as the ball has rotated with draw. You can also see the reflection of the cue stick in the cue ball.

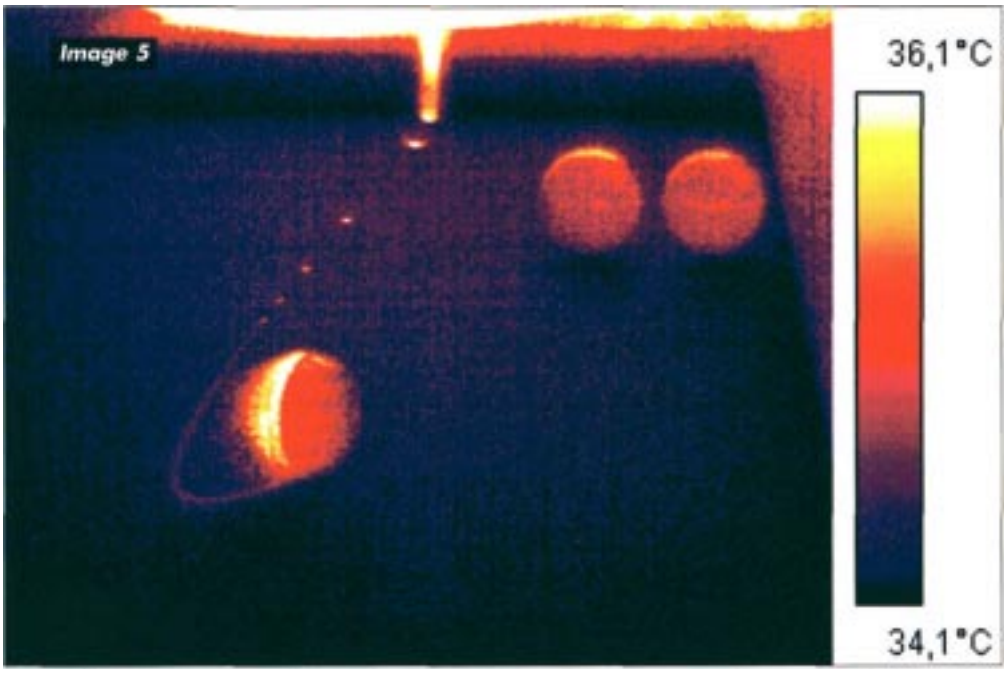
Image 4 reminds you to vacuum your table. The dust cloud between the retreating ball and the cushion came out of the cushion after the cue ball struck it.

And finally, **Image 5** is even more amazing. This is a still from a video clip shot with a very sensitive high-speed infrared imager. The infrared imager shows the relative temperatures of objects using different colors. The temperature/color scale is on the right-hand side of this image. What the image shows is a masse shot almost completed, in which the cue ball was shot out away from the two object balls. The spin then takes, and the cue ball comes back toward them (to score a billiard). The cue ball is the one that looks like it is on fire. In fact, that hot stripe is where the tremendous back spin of the masse shot has been rubbing on the cloth and heating the surface of the cue ball. You can see the hot stripe develop as the shot unfolds.

The path of the cue ball is shown by the lighter blue curve, which is where the cloth has been heated by the passage of the cue ball. The curve is a parabola — the same arc that you get when you throw a ball up in the air at a steep angle.

The start of the path is

different, though. You can see the hot, bright stick, which points to a hot spot on the cloth. That's where the cue ball was sitting at impact. It jumped on a shallow angle to the next bright spot that looks to be about one or two ball-diameters away, and then there are three or four more shorter jumps as the cue ball settles down on the cloth.



While this shallow jumping behavior has been predicted and is modeled in simulators like Virtual Pool, I think this is the first time it has ever been observed.

Anther segment of the clip is an infrared sequence that shows a frozen banked ball that is initially struck slightly into the cloth, leaves the table while compressing into the cushion, and then bumps down on the cloth again as it leaves the cushion. Another shows a jump shot with follow in which the stick wiggles like a snake after the hit.

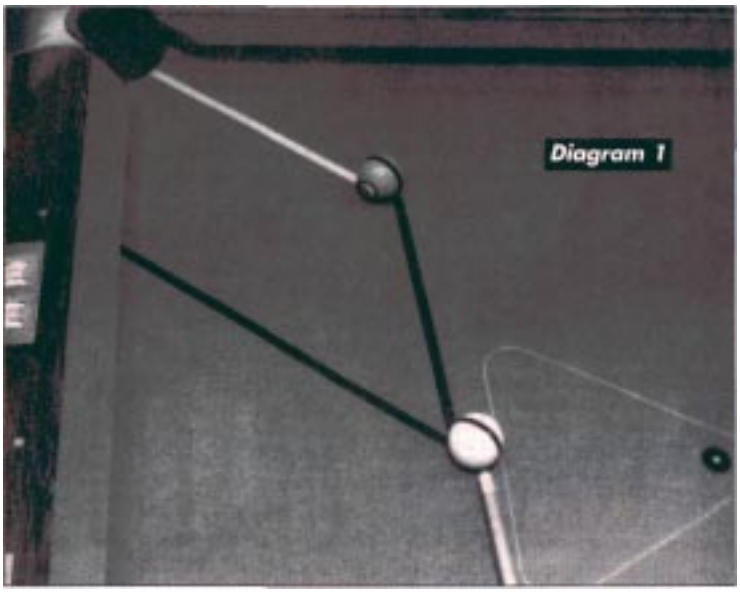
There is a 25-minute DVD that is the full version of the free clip, but for now it is only available in the European PAL format. A version that is suitable for U.S. players is in progress. Language is not much of a problem, as the audio track consists of "Ambient Sound" music by Sascha Borovcanin. This video is intended as entertainment and propaganda for billiards rather than as science, but I think it succeeds on all fronts. For more info, go to www.bskunion.at or e-mail andreas_efler@yahoo.com. Also available there are framed images of stills from the video.

Bob Jewett

By the Books

Parallel aiming through the years.

No matter how many times I protest that in the long run you will have to depend on your pool sense for aiming, people continue to seek out new aiming systems. If you're still developing a feel for how much of the ball to hit on various shots, maybe the systems (or rather, different versions of one system) described below will help you.

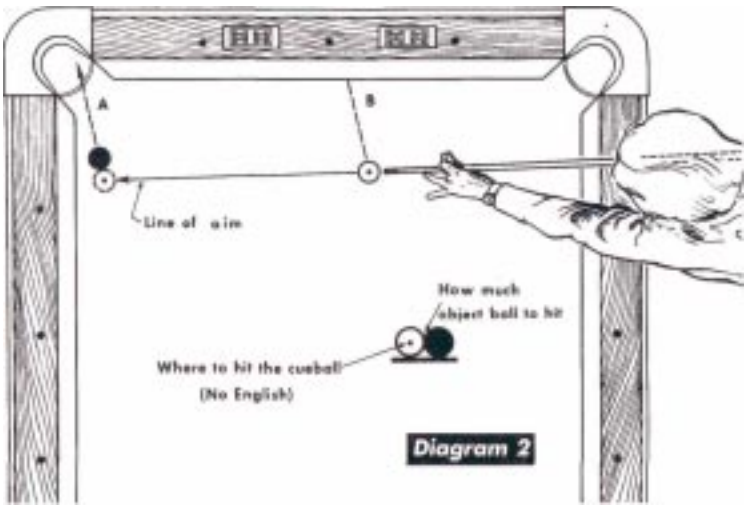


The first aiming system I was exposed to was in Willie Mosconi's 1965 book, "Winning Pocket Billiards," which is still in print 40 years later. **Diagram 1** demonstrates the main idea. You start with the line from the pocket to the object ball, and imagine that line going through the object ball. That line is white in the picture, and a ring has been drawn around the object ball to aid your imagination.

A line parallel to that white line is drawn through the cue ball, and a similar ring has been drawn around the cue ball. To make the shot, all you have to do is drive the cue ball forward so the two rings touch and they are both pointing towards the pocket. If you hit the object ball too full, its ring will overlap with, instead of just touching, the cue ball's ring. Too thin a hit, and the rings will not touch.

The first aiming system was exposed to was in Willie Mosconi's book.

In **Diagram 2** is Bob Byrne's take on this system in an illustration from his 1978 "Standard Book of Pool and Billiards." He recommends this system especially for thin hits, where it allows you to easily pick out how much of the cue ball needs to overlap with the object ball. (For fuller hits, Byrne recommends the ghost-ball method.) Notice the two parallel lines again, A and B.



When I first saw the parallel-lines aiming system, in Mosconi's book, I didn't really try to work with it. The explanation seemed reasonable enough, and I had already developed a little feel for angles, and I was more interested in making the masse shot from "The Hustler," which is shown in the back of Willie's book.

Joe Tucker's new take on this old method is designed to get you involved and keep you involved. For full immersion, you will need to get a special cue ball and object ball set that's made by Aramith, shown in **Diagram 3.** The balls come packaged with a booklet of instructions and drills and two disks, shown in **Diagram** 4, to help illustrate shots. The disks are marked like the balls, with angles marked from 0 to 9 to the left and right for cut angles from 0 to 90 degrees. It's called the "Aiming by the Numbers Method" and should be available at better billiard retailers everywhere.

How does the system work? First, consider a corner-pocket shot with the object ball and cue ball in any position. You rotate the object ball to align the 0-9 numbers so that the 9s are nearest the side cushions, and facing away from the pocket. The cue ball is rotated so its 9s also face the side rails, and the numbers face the end with the corner pocket you're going for. It took me a little while to convince myself that this always works out.

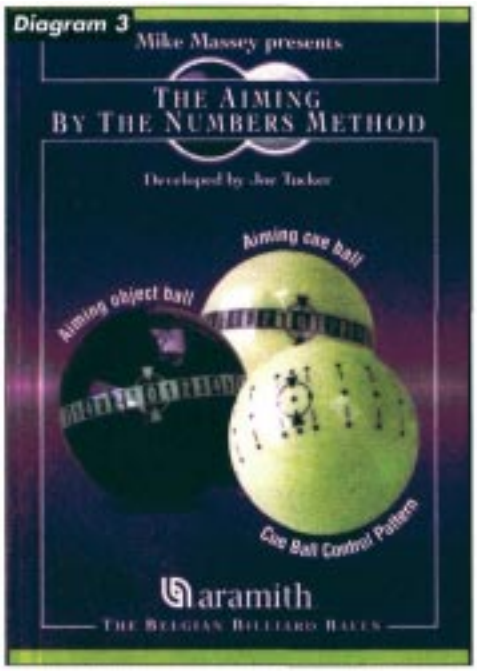
Now for the amazing part. Look on the object ball for which number is farthest from the pocket. Suppose that's the 3 (which means 30 degrees — the angle of the shot relative to the long cushion). All you have to do is make the 3 on the cue ball contact the 3 on the object ball.

Where did the parallel lines go? They are actual-

ly still there, but with the numbers on the balls, you don't have to visualize them. If you must, draw a line from the object ball to the pocket, and through the 3 in this example. Draw another line from the center of the cue ball through its corresponding 3. Because the balls are numbered the way they are, these two lines are guaranteed to be parallel.

Note that the numbers (0-9) don't tell you the angle of the cut — they just tell you the angle of the parallel lines in the Mosconi and Byrne diagrams. You can actually calculate the cut angle by subtracting the normal number and the 0-9 number that your stick is aligned with on the cue ball.

The booklet that comes with the balls also includes extensive drills to work on each of the major angles. Note that the object-ball aiming number is determined by its position alone, and not at all by the cue ball. This is very different from fractional-ball aiming. This means that you can figure out the object-ball number from the diamond on the opposite side cushion from the intended pocket, using the straight line from pocket to object ball to diamond. The booklet gives the diamond locations that correspond to the object-ball numbers, and if you invest a little time in memorizing these, you can pick out the object-ball number very quickly. Or, you can just use the two pop-out diagrams in the booklet, which illustrate all the diamond intersections.



For side-pocket shots, the system is modified some, but works in much the same way. I think the whole package is the clearest, most complete explanation of any aiming system available. Joe Tucker is also developing a more extensive workout book as well as a training DVD. Look for them soon. Bank shots are included.

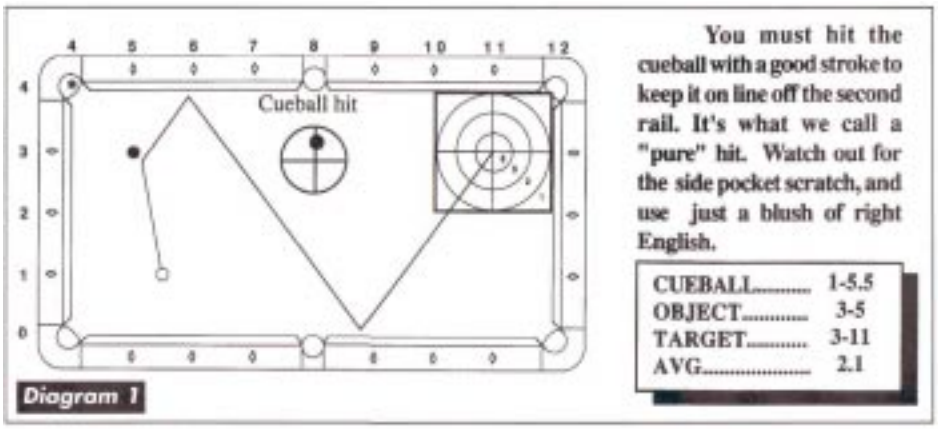
Bob Jewett

Target Pool, Revived

Take a new look at this out-of-print training system.

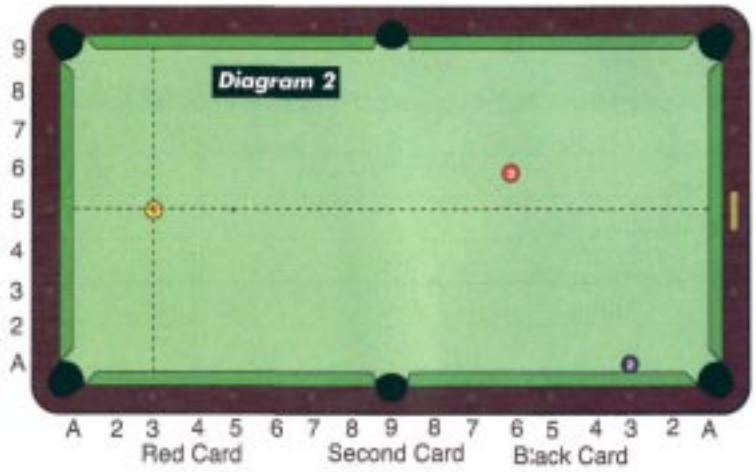
Back in 1992, a very useful learning tool called Target Pool came on the scene. It was developed by Don Wilkie and pro player Kim Davenport. The idea is to shoot a specific set of shots for position, and to land the cue ball as close as possible to the center of the target. The main items in the kit are a booklet which describes the shots and the system of scoring, and two bull's-eye targets made of thin fabric — one for the open table and one that is cut in half for a target against the cushion.

There are a dozen "courses" to play listed in the booklet, with 10 shots to try for each course, and a par score based on Kim's score. A typical shot is shown in **Diagram 1,** from "Course 6 — Getting to the End of the Table." The bull's-eye target is shown drawn to scale. The required hit on the cue ball and other suggestions are given for each shot, and you can see Kim's average score to try to shoot for. This particular shot requires you to go two cushions (side-side) for the position.



The shots range from easy ones that Kim averages 5 on, to one monster shot that requires the cue ball to jump off the first cushion and then go three more rails to the other end of the table with a par score of 0.7. Unfortunately, Target Pool seems to be out of production now.

In researching this column, I discovered that a group at the University of Aalborg in Denmark developed a computerized instruction system based on Target Pool. "The Automated Pool Trainer" had a screen to display the shot, a speech synthesizer to give instructions, a speech-recognition system that could listen to the student, and a video camera to check on ball placement and for instant replay. A laser-pointer system showed where on the real table to place the balls and target, as well as the required path of the cue ball to the target. The screen was also used to show the text of the recent instructions that the system had given verbally in case the student wasn't listening at the time. If you want to learn more about the project, see http://cpk.auc.dk/education/IMM/pooltrainer/. The Web site includes a video of the system in action. The surface of the pool table becomes a big touch-screen display for control — lit by the laser system — and it shows you your score for the shot after the cue ball stops rolling.



I don't think pool instructors need to fear for their jobs just yet. Below is a low-cost alternative that will set you back the price of a deck of playing cards.

The idea is to generate a series of shots that will take you all over the table. Rather than limit the choice to a fixed set, this system will create pretty much every shot you might run into. You will draw cards to determine the positions of the object ball and target. The cue ball will be in hand, and if you don't feel challenged enough by a shot, move the cue ball to someplace inconvenient. Or, you can try to play the easy position perfectly.

How to get from playing cards to a position on the table is shown in **Diagram 2.** It uses a grid system like the one from Target Pool, modified to work well with cards. Deal cards from the shuffled deck, putting any face card (K-Q-J) aside until you get a non-face card (ace through 9). That determines how far across the table you go, in half-diamond steps. If your first card is a 5, the position will be somewhere on the centerline of the table as shown. Deal yourself more cards until you hit another non-face card. If it's a red card, start counting from the left end of the table, or from the right end for black cards. The 1 ball is at the position for a 5 followed by a red 3. The 3 ball is at 6,B6, and the 2 ball is at A,B3.

Go through this procedure twice to get the position of the object ball and the target for position. To mark the target for position, you can either leave the cards near the spot selected, or use a coin or chalk.

For the first level of difficulty, you're permitted to play the shot any way you want to

make the object ball in a pocket and put the cue ball on the target. If you don't want to be bothered with scoring, just practice the shot until you get the cue ball close to the target — say within the span of your hand, or within a ball's width, if you want to go for extreme precision.

If you run into a shot that you just can't make work, like pocketing the 2 ball in Diagram 2 and putting the cue ball where the 1 ball is, make a note of the problem and practice it separately later.

If you want to be fanatical about it, mark a ruler so that within 3 inches is five points, 6 inches three points, 9 inches for two and 12 inches for one point.

For the second level of difficulty, use the face cards that you set aside during the deal. You need to hit one cushion for each face card you've drawn. If you didn't get any face cards, you have to get from the object ball to the target without hitting a rail. If you got three face cards, you need to figure out a three-cushion path. These more complicated paths may not always be possible, but see how close you can come.

In **Diagram 3** is a shot similar to Diagram 1 generated with cards — 7, red 3 followed by 5, black ace. There were two face cards drawn, so you have to go two cushions to get to the target (marked X). Of course, there may be other paths using two cushions, such as starting the cue ball at A, and going two cushions at Al and A2. Or you could place the cue ball for a nearly straight shot and follow to the end rail and upper side cushion at B1 and B2.

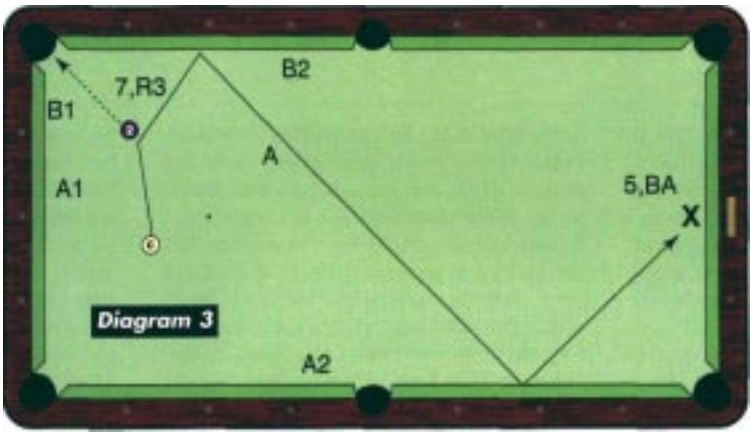


Diagram 3

If you happen to get more than three face cards in your deal, you have to bank the object ball, but you're not required to hit any cushions with the cue ball. To get good position from the bank may take a few shots. If I had to bank the ball in Diagram 3, I'd move the cue ball just a little to the left and bank the 2 cross-corner while sending the cue ball to B2 and then to the X.

While this is a good solo practice, it can also be a two-player game. Both players shoot the same shot with separate cue balls, and closest to the target wins the point. It's like horseshoes, so if you shoot second it's OK to knock your opponent away from the target. Also like horseshoes, if neither player is within a certain distance — a foot? — there is no score. The first player gets to choose the number of cushions but not which ones; pay no attention to the face cards. Alternate who goes first. For more excitement, it can be a multi-player game with each player getting two shots, using the two same-colored object balls as his cue balls (1-9, 2-10, etc.).

Let me know if you try this type of practice, and if you come up with any interesting modifications.

Bob Jewett

Close Quarters

Learn to beat one of Wimpy's favorite proposition shots.

[Bob Jewett is on vacation this month. What follows is a reprint of a classic Jewett column from August J 993. — Ed.]

In **a** past issue *[July 1993]*, I described a system for aiming when the cue ball is close to the object ball. This time, I want to suggest some stroke techniques that will help you avoid hitting the cue ball a second time when the object ball is near. These techniques will be especially valuable in pool's finesse games, 14.1 and one-pocket.

Shot **1** in **Diagram 1** is a proposition bet that I've heard was a favorite of Luther Lassiter. The cue ball and the 1 ball are on opposite sides of the headstring and a quarter-inch apart. The goal is to make the 1 ball hit the end rail without the cue going over the line. You must use a level stroke.

First, see how short a stroke you can develop. Start with the cue ball four inches back. Hitting the end rail should be easy, and if you use draw, the cue ball should come back without any forward motion after contacting the 1. Move the cue ball gradually closer to the 1 ball. I find that by the time they are half an inch apart, my arm hurts from the unaccustomed effort of suddenly stopping the cue stick. Try this drill on a table now.

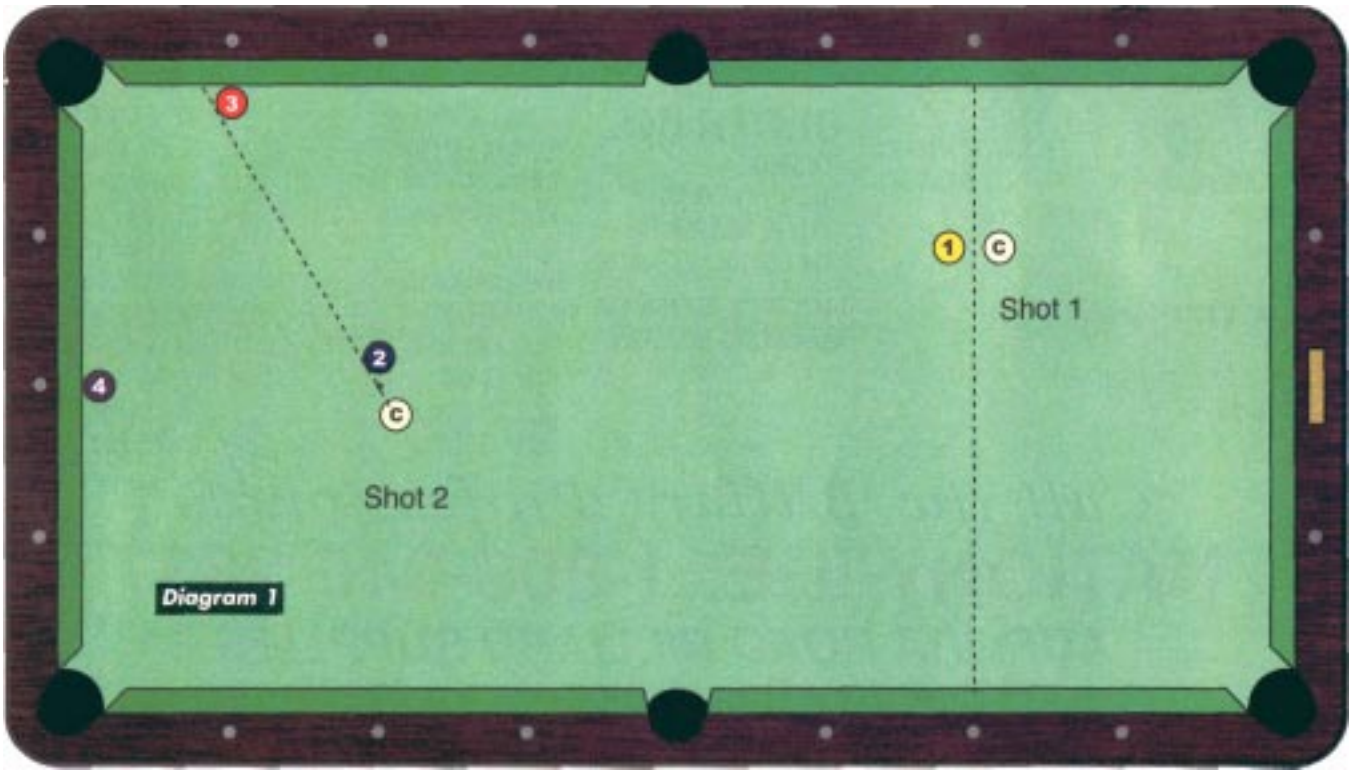
At this point, your arm should be sore, you have developed a special stroke for very close shots, you've grown to hate the sound and feel of a double hit, and you're ready to bet that the shot's impossible when the balls are only a quarter-inch apart.

Now for the trick.

Place the balls for Shot 1, make a firm closed bridge with a little draw, and with the tip about half an inch from the cue ball. Let the back end of the cue stick rest on the rail. Without moving the stick, slide your grip hand up until your knuckle is pressed against the outside edge of the rail, and take a very firm grip on the cue. Take a short backswing, keeping the stick rubbing on the rail. Your hand will hit the rail and stop the cue quickly enough to avoid a double hit. You may need to adjust the tip-to-ball starting distance, depending on the springiness of your knuckles and how hard you're willing to hit the rail. Old-fashioned square rails give a better stop than modern rails that slope away from the cushion.

The bad news: This shot is not generally useful, unless the cue ball is the right distance from the rail. The good news: There's another technique that can be used in many close situations. For Shot 1, you can make the 1 ball hit the far rail twice and still not drive the cue ball over the line.

I first saw this technique when Rene Vingerhoedt, the great Belgian billiard fancy-shot artist, gave an exhibition in the room where I was just beginning to learn the game. He first shot standard artistic billiard shots. He then announced that he was going to change to his masse cue for the second half of the show, but first he would shoot the "Spanish Dance." He placed the balls just like Shot 1, and took a tremendous stroke, smashing the cue ball into the red ball. The red took off at a million miles an hour, but the cue ball just sat where it started, spinning and wobbling — that was the "dance" part. Vingerhoedt got out his case, took his cue apart, and screwed his masse cue together. The cue ball was still dancing.



How did he do that? With a technique that is well-known in Europe but still a mystery to most players in the United States. It's called a whipping stroke. It's rather difficult, so let's start with something simpler that gives some feeling for the shot without having to master the strange whipping motion.

In Shot 2, the idea is to find how close the cue ball can be to the object ball on a half-ball cut and still avoid a double hit. The 2 ball is placed so it would be touching a ball on the spot, and the 3 and 4 are placed on the diamonds. The 3 ball is there simply to help you place the cue ball on the proper line. Aim through the center of the cue ball at the edge of the 2 ball and slightly into the edge of the 3. Neglecting throw, the 2 ball will be driven straight across the table, and the cue ball, if cued on the equator, will hit the 4 ball.

Practice this shot with a normal follow-through, moving the cue ball closer and closer to the 2 ball until a double hit occurs and the cue ball hits the end rail on the far (high) side of the 4 ball. Next, try the same progression using extreme-right English on the cue ball. You'll probably find that the cue ball can start much closer to the object ball because it starts moving to the left just after collision, which makes room for the stick to pass. If you use draw with the English, you should be able to land the cue ball on the near (low) side of the 4. If the draw takes quickly enough, this technique could be used for the proposition in Shot 1.

Finally try the shot with outside or left English. This will result in a double hit even when the balls are an inch or more apart, because the cue ball will be moving into the path of the stick after the collision with the 2 ball.

Try the same setup for a fuller shot on the 2 ball, and you should get similar results; right English will help you avoid the foul.

The whipping stroke uses a similar idea, but it is mostly the stick that's moved to avoid the second hit. Instead of using a straight follow-through, the cue is swerved to the outside of the shot during the final stroke.

In Shot 1, set up for a lot of right English with the cue stick aimed toward the 4 ball. On the back swing, swerve the butt away from you (if you're right-handed) and on the forward stroke, swerve back, so that at the end of the shot, the cue stick is pointed toward the 3 ball. While swerving the cue, keep your bridge stationary.

This outside-in motion is difficult to master, since it goes against the standard ideal straight follow-through. It's not easy to have the tip come back to just the right place on the cue ball after having been pulled clear to the other side of the cue ball. And adding object-ball accuracy to this forceful shot will be even tougher.

Once you've got the timing down, you'll be able to shoot straight toward the 1 ball in Shot 1, leaving the cue ball spinning in place. With a little draw beside the English, you can bring the cue ball straight back to the end rail. Best of all, you'll have the stroke technique to avoid all forms of double hits.

There's one more facet to this shot — whip without English. The purpose of swerving the cue stick is to get it away from where the cue ball is going to stop. Swerve down is nearly as good as swerve to the side. Aim straight at the 1 ball, starting near the center. On the final stroke, raise the butt of the cue so the tip dips down to the cloth after hitting the cue ball with draw. The needed stroke is very short, as in the first drill, since the cue ball will be drawing back soon after the hit and you need to give it room.

Don't be discouraged if you can't get the action right away. It took me 25 years to get a reasonable understanding and feel for the shot after I first saw it in 1966. If you can find an instructor who knows this shot, take a lesson.

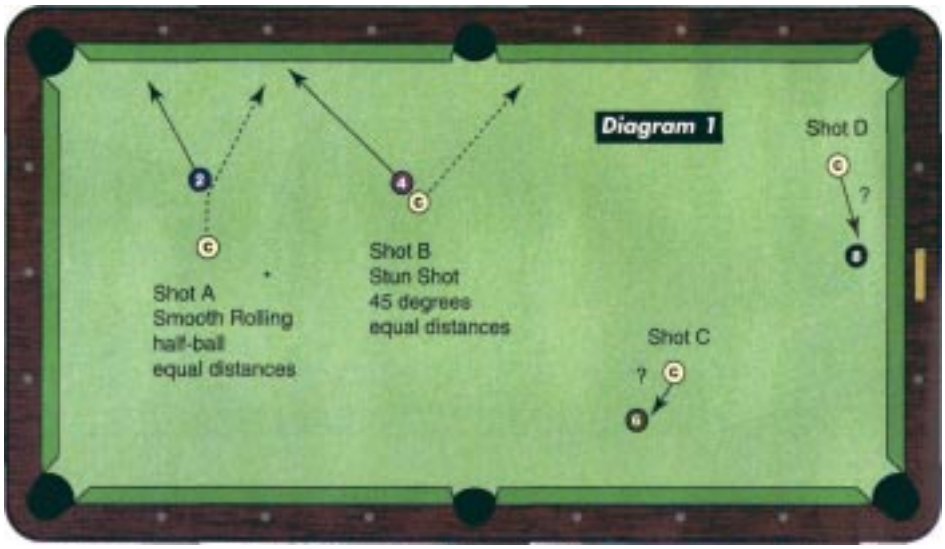
Bob Jewett

Taking A Lesson

Did you learn anything?

I just got back from vacation, part of which involved taking some billiard lessons. This reminded me of what it was like to be a student. To be a good student takes as much effort as to be an instructor.

When I was first learning to play at the student union at Cal Berkeley, there were few books or instructors available. It was 1965, Mosconi's second book had just come out, and Hoppe's book was still available and had been for 25 years. If you compare those two to the many books published just in the last five years, you can get some idea of difficulty of self-instruction back then.



We sort of learned from each other, but we didn't know much, so we couldn't learn much. I was impressed by players who regularly ran five or six at straight pool. Rumors of a run of 40 at some frat house were dismissed as unbelievable, or drunken bragging.

The nearest people known to give lessons were half an hour away in "The City." Jimmy Lee would show you about carom billiards if he liked you, and for a price Tugboat Whaley would pull out his stack of notebooks on pool and let you in on some secrets. I wish now that I had taken that trip more often. Whaley is mentioned briefly and dismissively in Mosconi's biography, which is ironic since Mosconi seems never to have shared his deeper knowledge of the game with anyone. It's too bad that Willie never became a teacher.

Fast forward about 20 years, to California Billiards in San Jose. It was one of the nicest pool halls in the country, with a tournament room that had five tables and theater seating on two sides. They had tables for carom, pool and snooker. Bud Harris, a former U.S. three-cushion champion, was the resident carom expert. He was a careful player, a student of Welker Cochran, and he gave lessons. I signed up.

Bud took me to a quiet table, and the lesson began. About five minutes in, he let me in on the first secret: You can change the amount of spin on the ball by the firmness of the grip hand. I was incredulous, and insisted on doing the experiment. With a finger-tip grip and then with a white-knuckle grip, I shot the cue ball straight into the cushion with the same speed and tip offset. The cue ball, as I had expected, angled off the cushion along identical paths for the two cases. The lesson ended.

Its a little unsettling to be told that the bridges taught to you by Hoppe and Mosconi were wrong, but they were.

Of course, both Bud and I made a mistake. As an instructor, he had cast his ideas in stone, and could not accept that any of them might be wrong. As a student, I made the larger mistake. Bud had much to teach. Some of it was B.S., of course, but I could have sorted that out later. The loss was mine.

You may want to try the experiment for yourself. With the cue ball on the head spot, shoot straight along the headstring to the side cushion with maximum left or right side and play the shot with a loose and tight grip. I'm not going to tell you which one Bud thought should get more spin. There are now camps on both sides for spin maximization — the "tight-grippers" and the "loose-grippers." Let me know how your test comes out.

Karma. Fifteen years later — about 2000 — I find myself on the other side of the table. I have a class of three instructor-candidates who want to learn to teach pool. I think it's important for them to be able to demonstrate the fundamentals of stance and stroke, including a basic shooting sequence. Part of the basic sequence is to take some warm-up strokes and then stop with the cue tip near the cue ball. One of the candidates would not stop the tip any closer than about two inches from the cue ball. He was not willing, even after repeated requests and explanations of why it was a good idea to address the cue ball closely, to bring his tip any closer to the ball. He would not explain why he was unable to bring the tip any closer.

I suppose that lesson should have ended then, too. I was clearly not able to reach the student. If you have suggestions on what I could have done, I'd be glad to hear them. The student himself gave me some suggestions, including that I should get

out of instruction. It was one of the strangest experiences I've ever had at a pool table.

Last month, I was in Vienna to visit the Weingartner Billiard Museum. I had asked Heinrich Weingartner if there was someone who might be willing to show me a little about the "small" carom games, such as straight rail and balkline. The perfect host, Heinrich arranged for the European balkline champion, Arnim Kahofer, to meet me, and we had a very productive seven hours of lessons. Arnim is a thoughtful, thorough, and friendly instructor, and of course he is a master of the games he teaches.

Almost the first thing he said was that my bridge was wrong. It's a little unsettling to be told that the bridges taught to you by Hoppe and Mosconi were wrong, but they were. Since Hoppe's day, the Europeans seem to have invented a new bridge that lets you precisely position the tip for close draw shots. It looks weird, and I had seen it before on another European champion, but had dismissed it as a pointless idiosyncrasy of the shooter. I now understand the method to the apparent madness.

During the lessons there was even a brief mention of the tightness of the grip affecting spin, and I made a note to myself to look into it later.

While most of the techniques and drills we covered are more useful to billiards than to pool, there was one that should help your pool safety play. For the shots shown in **Diagram 1,** the idea is to start with an object ball somewhat away from the cushion and the cue ball farther out, at some angle. The goal is to hit the ball and leave both the cue ball and the object ball frozen to the cushion. No pocket is involved at this point. To succeed, you have to learn how full to hit the object ball in each case.

There is some theory here. In the case of Shot A, both the cue ball and object ball need to travel about the same distance to get to the rail. If you make a half-ball hit on the right side of the object ball with a smoothly rolling cue ball, the object ball will be cut 30 degrees to the left and the cue ball will be deflected roughly 30 degrees to the right. The theory of a half-ball hit in this case says the cue ball and object ball will travel the same distance.

In Shot B, the cue ball is very close to the object ball and they are angled at 45 degrees to the cushion. If you play the shot with stun — no draw or follow on the cue ball when it hits the object ball — and cut the ball 45 degrees, theory says that the balls should split at 90 degrees and travel the same distance. Does theory hold up? Give it a try.

Try other angles as well. I think you'll be surprised by some of them — I was. Besides safety possibilities, knowing the "equal travel" hit for various positions should also help your position play.

I think that, as a student, it's important to ask yourself some questions both immediately after a lesson and when you have had a chance to make the lesson part of your game:

- What was the main idea covered?
- Is it correct?
- What will I do differently now?
- Has my game improved?

If you find yourself answering "Don't remember," "Can't tell," "Not much," and "What was that lesson about, again?" maybe the lesson was not successful. (But let's not try to assign blame for the failure.) I think the most important of these is "What will I do differently now?" If a lesson doesn't change how you play, it was useless. Since my trip to Vienna, I've spent a lot of time on the table doing things I had never done before, and now I feel like I'm beginning to learn about close caroms.

Bob Jewett

Different Strokes

It takes all kinds.

Recently in the Internet discussion groups, there have been several conversations about what stroke to use for various shots. Somebody made a statement about there being only three or five strokes. That got me to thinking, and I started a list.

First, I think we need to define what a stroke is and what separates one stroke from another. Saying that someone has a "sweet," "smooth" or "flashy" stroke may look good in a non-technical article, but it doesn't convey any real information. I'll define a stroke as the sequence of motions from addressing the cue ball until the stroking arm stops moving.

Are different strokes necessary? Yes, there are situations on the table where you really need a different physical approach to the shot. In addition, there may be strokes used simply to act as a memory aid without any real physical purpose. See if you can tell them apart.

What I will call the standard stroke — many players use it — is fairly simple. After some preliminary fiddling or warm-ups, the cue tip is stopped very close to the cue ball — this is "addressing" the cue ball — and a final check of the line is made. The stroke then consists of drawing the cue back until the ferrule is at the bridge hand, bringing it forward through the cue ball at the "address" point, and coasting to a stop with the tip six inches or so beyond the point of contact with the cue ball.

There are two common forms of this standard stroke, one in which the elbow remains stationary and one in which the elbow is stationary until the end of the stroke, when it drops about the thickness of the upper arm — four or five inches. The former is generally for softer shots, and the latter for power shots, such as drawing or following the length of the table.

The first form of the standard stroke which I described above is the classic pendulum stroke. The forearm moves like a pendulum, with the elbow fixed and the forearm swinging. Many instructors feel that it is the easiest and most consistent way to hit a ball. The second form I described, where the elbow drops at the end, is a natural development as the speed of the shot increases. With more power, the stick naturally comes forward more at the end of the shot. As the grip hand comes forward, the forearm closes on the biceps, and it is more comfortable to let the elbow drop a little. This drop should happen after tip contact, so it doesn't affect how much draw or follow you get.

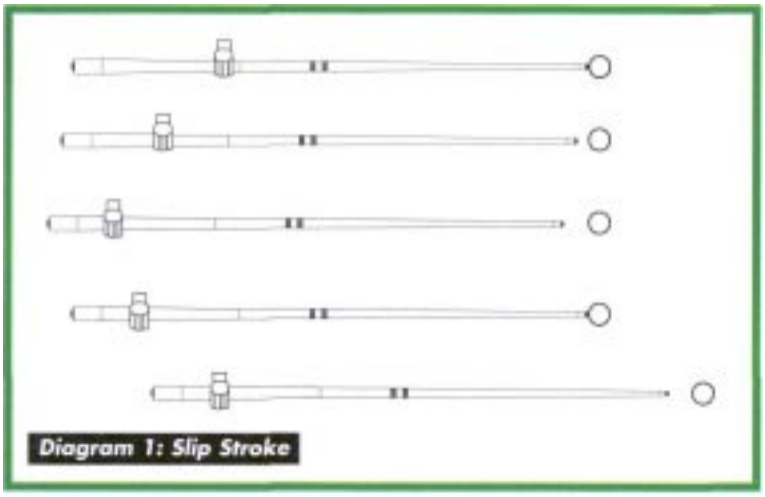


Diagram 1: Slip Stroke

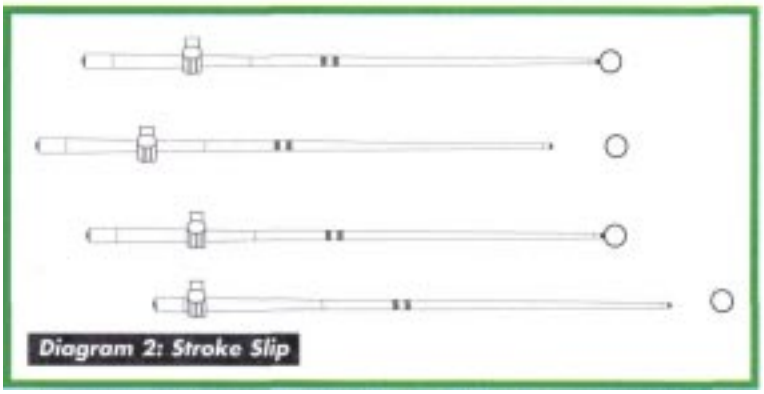


Diagram 2: Stroke Slip

The next stroke I'd like to describe is what I call the "piston" stroke, in which the cue stick moves not like a pendulum, which naturally has a curve to its motion, but like a piston, with the tip's motion travelling along a straight line. This requires a more complicated arm motion, with the elbow moving down and up and down to keep the stick on a fixed line. This might seem like a minor variation, but the required physical motion is very different from the standard stroke. Few players use this stroke, but some of them are champions.

A third stroke is what 1 call the "rail banger." In this, the elbow drops a lot. The rail, if it happens to be in the right place, will stop the elbow's descent with a loud "whack." The tip ends up in the air, and the knuckles sometimes end up bloody. For more details about the mechanics involved with these various strokes and some field observations, see my February and March 2004 columns in *BD*.

Based on the above (somewhat biased) descriptions, which of these strokes is needed for good play?

A stroke that has come into play relatively recently is the power break, used in 9-ball. On a table with a tight rack, a relatively soft break will almost always pocket a ball, but with a bad triangle or cloth pocked with craters, you can get better results if you crank up the speed, getting more of your body into the shot. If your upper body is moving forward at a couple of miles per hour when the stick hits the cue ball, you get significantly more energy into the ball, assuming you still can maintain control.

I saw one match in which the breaker followed through so far that the cue tip came to a halt beyond the center of the table. He was breaking well, and the cue ball was hopping back from the 1 ball and stopping

in the middle of the table. On one break, the cue tip actually hit the cue ball in mid flight over the center spot, a feat which required perfect follow-through and a perfect hit on the rack. His opponent didn't notice the aerial foul.

In both forms of the standard stroke that I've described, the cue tip is brought back to the bridge hand before striking the cue ball. In the "poke stroke," it is only brought back part way, and the follow-through is usually shorter. Among the top players, Allen Hopkins is known for using this abbreviated motion. It is often described as ugly, but here's something to consider: About 10 years ago, a laser that strapped onto the cue stick, named the Laser Shark, was being marketed at a trade show. It was very good at showing any side-to-side wobble in the mechanics. The company reported that the only pro player to show negligible wobble was Allen Hopkins.

Do you want to play like Willie Mosconi? Then you have to use the slip stroke, because he did. As shown in **Diagram 1,** during the backstroke, the hand slips back on the cue stick, then it grips the stick and the stick is brought forward as usual. Former U.S. carom champion Allen Gilbert also uses this stroke. Note that it is almost exclusively pool players who use the slip stroke, as carom players nearly always use rubber wraps which prevent any slippage, and snooker players grip their sticks at the end of the butt, and if there were any slippage, the stick would drop onto the table.

There can be some variation in the exact timing of the slip. The tip has to move back from the cue ball and that can occur before, during or after the slip. Can you see how a slip stroke might be useful? Try it to see what it feels like.

A different kind of slip stroke is the "stroke slip," in which the stick is released during the forward motion and sort of thrown through the ball. Mechanically, this can get a longer straight follow-through without dropping the elbow. This is shown in **Diagram 2.** Can you make the motion work?

One method of squirt compensation, which I call "aim-and-pivot," deserves its own stroke category, although the defining motion takes place before the shot, and it can be combined with the above stroke motions. The idea is to aim a shot with no sidespin, then pivot the cue stick at the bridge hand, and then stroke through along the new line. For left English, for example, you would line up through the center of the cue ball, and while the tip is near the ball, move your back hand to the right until the tip is out on the ball for the amount of sidespin you want. Then you make the normal stroke, using one of the above techniques or one described below. If all works well, the angle the stick pivots through is the same as the angle that the cue ball squirts away from the line of the stick.

If the stick has fairly low squirt, or for some other reason the pivot point is not at your bridge, the pivot needs to be around a different point. One Internet poster says that his pivot point is about halfway between his two hands, so to use aim-and-pivot he puts half of the English on by moving his bridge hand to the correct side and the other half by moving his back hand.

A related stroke motion is what I call the "aim-and-swoop" stroke. This is like the aim-and-pivot, except it always pivots at the bridge, and the pivoting motion is part of the final stroke. That is, the cue ball is addressed in the center without sidespin, then the cue stick is brought back and through as the backhand is moved to the side to achieve sidespin. The tip is still moving somewhat to the side as it hits the cue ball. Some believe they can get extra spin on the cue ball this way.

In my next column, I'll cover another dozen or so strokes. In the meantime, sort out for yourself which of the above are useful to you.

Bob Jewett

Different Strokes, Part 2

Here are a dozen more motions, from the essential to the esoteric.

Last month, I described 11 different strokes. Briefly, they were: the standard pendulum; the pendulum with biceps relief at the end; the piston; the rail banger; the full-body power break; the poke; the slip stroke; the stroke slip, in which the stick is released before impact; the aim-and-pivot; the two-handed pivot, which is a kind of squirt compensation for low-squirt sticks; and the aim-and-swoop. You may know some of these by other names. For example, the technique of "backhand English" involves either aim-and-pivot or aim-and-swoop, depending on whom you learned the term from.

Remember that I defined a "stroke" as the sequence of motions from addressing the cue ball until the stroking arm stops moving.

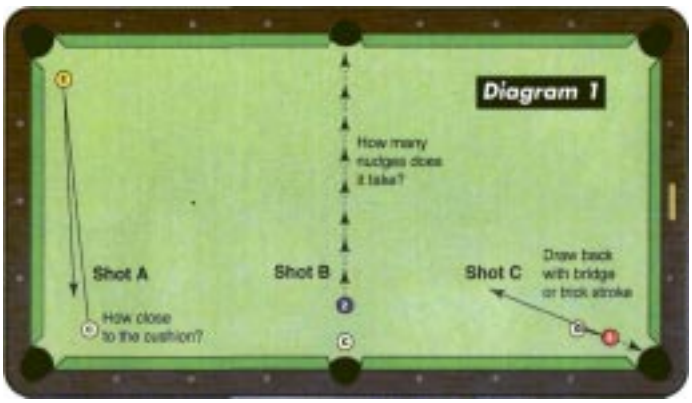
Here are another dozen strokes — some essential and some just bizarre.

The sidearm stroke is usually seen in players who learned to play at an early age. Instead of the forearm hanging straight down from the elbow, it is held out to the side with the hand away from the body. Willie Hoppe — who started earning his entire family's living through billiards at the age of 7 — was one player with this affliction. In modern times, you need look no further than Keith McCready, who got into trouble in junior high for asking his coach to hold onto his horse-choking bankroll. Young players have to get the stick up to the table, and it's often done by raising the hand up level with the elbow. Bud Harris told me that Welker Cochran also started side-armed, but converted to a perfect pendulum when he got enough height.

There are times when you need to raise your arm, perhaps to clear obstacles on your side of the cue ball. Do you do it with a sidearm stroke? How straight can you stroke with one?

An alternative way to achieve some elevation is to maintain a pendulum arm position but to raise the shoulder and elbow by standing up higher, which I'll call the high-arm position. One fault I've noticed in players, including myself, is that they tend to go up on their toes to get height. Usually that's not necessary, and a flat-footed stance will get you high enough with more stability. An additional technique I've seen used in some positions is to press the hip against the side of the table, or even to put a leg up on the table, if you're that flexible.

Shot A in **Diagram 1** is a drill to practice moderate elevation with accurate aiming. The goal is to shoot the object ball straight in and draw the cue ball back to where it starts.



Begin with the cue ball several ball diameters from the cushion — very easy. Make the shot tougher and tougher by moving the cue ball nearer to the cushion. Keep track of your progress toward the rail with a coin or an object ball. As the cue ball gets closer, your arm will have to raise. How high can you rise and keep a pendulum position? Stay flat-footed? Aim well?

The high-arm stroke is also used for some jump shots, but for even more elevation, many players move to the dart grip. The forearm is nearly vertical, or at least in a vertical plane, with the hand up. For a right-handed player, the thumb is on the left side of the butt with the index finger and maybe the middle finger on the right side of the butt. The big advantage of this, over using sidearm and a regular grip, is that it's much easier to keep the stick on the correct line for aiming.

Masse shots also require some kind of raised-arm position. For the nearly vertical shots, many players use a normal grip and bring the forearm up above the shoulder. Many carom players — half- or nearly full masse shots are common at both three-cushion and the small games — use a dart grip most of the time. Some use a grip you've probably never seen. Make a V with your index and middle fingers with the back of your hand up to the ceiling and your palm down. Stick the vertical cue stick between those two fingers and grip with the sides of them. It may help to curl the fingers so more surface area is on the stick. This transforms the V-grip into the "eagle claw." The resulting motion feels a lot more like throwing than the typical stroke.

Speaking of carom billiards, there are several special techniques that were developed on the pocketless table for close-ball situations. One is what I call the "tap stroke," which is used when the balls are very close together and a minimum amount of precise motion is needed on the cue ball. The tap is made without a backstroke at all, like tapping a key on a keyboard. You don't need a running start to press a key or to drive a billiard ball less than an inch. It's hard to get used to if you rarely play softly.

Shot B in the diagram is a drill to practice your soft shots. Start the cue ball in the jaws of a side pocket and an object ball about six inches from it, straight toward the opposite side pocket. The goal is to take as many shots as possible to sink the ball in the opposite side, leaving the cue ball and object ball in position for each subsequent shot. You lose if you fail to hit the object ball or double-hit the cue ball. Ten strokes is poor, 20 is fair, 30 is good, and 40 or more is excellent. Once you get to 30 regularly, try challenging a friend. It is not fair to play to hit the side of the object ball, just brushing the edge; you must play more or less straight at the ball, moving it straight toward the pocket. Using the thin-hit technique, a hundred shots is not hard.

Another technique from carom for close hits is the "palm slap." Holding the stick loosely, just slap the butt up against your palm. This gets a little forward motion on the stick and can make very soft to medium-soft hits.

In the August issue (which was a reprint of a 1993 article), I described two other ways to avoid hitting a close ball, but with a lot more power. One is the "table stop," in which the grip hand is positioned so that it will hit the

edge of the table just before the tip hits the ball, and the springiness of your abused knuckles stops the stick before a second hit. This is usually not useful in normal play.

A second way described in August was with what is called a "whipping stroke," in which the second hit is avoided by getting the shaft off to the side of the cue ball. Some of these shots may be fouls, some are certainly fouls, but some are with only one contact of stick to ball. This would be a good subject for further study with high-speed video, and it was covered briefly by the Jacksonville Project, but it's hard to be sure whether extra contacts did or did not occur.

Another special technique for getting good power into a close ball is the "cramp stroke." Move the grip hand far, far forward. Do this by getting into position with the tip near the cue ball, and move your grip as far forward as you can possibly move it while in stroking position — my hand goes to nearly the joint of my cue. Now when you stroke, your arm can't follow through, because, at the moment of impact, your arm is horizontal and your elbow, unless it dislocates, will stop further forward motion. It takes more than a few shots to get comfortable with this grip, but I find it a very reliable way to hit a close ball with power.

You may have gotten the impression that I don't recommend using a sidearm stroke if you can avoid it, and the main reason is that it's hard to keep the stick straight on the line of the shot. For shots with the mechanical bridge, a different kind of sidearm is a recommended technique. The stick is held near the end of the butt with a dart-like grip, the fingers on top and the thumb below. The forearm is horizontal, with the elbow at the same height as the hand, and perpendicular to the stick at the moment of impact. In theory, this is a kind of pendulum turned on its side, and the stick is moving in a straight line when the tip hits the ball. When was the last time you practiced with the crutch? Would you rather eat broken glass? Start counting the number of times that you miss shots due to stretching or shooting opposite-handed, and when you get to 10, go to the practice table. In **Shot** C, the balls are on the wrong side of the table for a normal bridge, and you have to draw the cue ball back, first one diamond, then two, and finally back to the end cushion. Can you do it with a bridge? Try some angles with sidespin and some follow shots as well.

There is a novelty stroke from Jerry Briesath that Robert Byrne described in these pages some time ago which you can use to avoid bridge work. Suppose you have Shot C and there is no bridge and your left-handed shots are nonexistent and you just have to get back to the end rail, and you can't shoot behind your back (which is a stroke I haven't mentioned yet). Put the cue stick in position flat on the table, reach forward as far as you can with your left hand and lift the tip off the table just a little. Rather than a normal stroke, which would be real hard with the butt of the stick resting on the cloth, jam the heel of your right hand into the stick's bumper, driving the tip into the bottom of the ball. Jerry can draw the cue ball the length of the table.

A kind of stroke that has been specifically forbidden is the "drop" or "lift." Suppose you have an object ball a hair from the rail and the cue ball straight out from the object ball but only a peppercorn away. What to do? One clever person came up with this: Place the stick so it's pointed to shoot the cue ball straight at the object ball. Stand by the rail so the stick is also pointed at you and you can look down from above the shot. Move the stick forward a little so the tip is barely under the edge of the cue ball. Pull the stick straight up, hitting the cue ball with a thin, glancing blow. I defy you to get a single hit any other way in this position while shooting straight at the object ball. A wrinkle is to hold the stick above the cue ball and just let it drop. Be ready for an intense discussion of the rules if you try this in a game.

Another illegal stroke technique is the intentional miscue. This can be useful to get out of double hits, to jump over balls, or to make certain impossible shots, probably by double-hitting the cue ball with the side of the shaft.

Yet another illegal stroke is the push shot. I'm not talking about double hits, which are a separate subject. In a push shot, the tip pushes rather than strikes the cue ball and contact is maintained for a much longer time than in a normal shot. There are some interesting push-shot trick shots. An instructor from my area used to teach them to be used in games. Start with the tip very nearly on the cue ball and then gradually accelerate with no backstroke at all. It's sort of an extended tap stroke.

Finally, there is the "scoop stroke," which I finally understood only a few months ago, thanks to fellow columnist Dave Alciatore, although I had seen it in print a few decades ago. To execute a scoop-stroke jump shot, place the stick on the table and then slide it along on the cloth to the base of the ball. The stick must be on the cloth for the shot to work. Contrary to my previous thinking, no miscue is required on the shot, although one may happen. By miscue, I mean slipping of the tip on the ball. The cue ball gets into the air because the table helps to push it up as the tip is wedged between ball and cloth. Another illegal mode.

Did you think there were just one or two strokes? Now you know of a couple dozen. Fortunately, only about a third of them are needed in play and worth practicing. If you have any other strokes that should be added to the list, please let me know.

Bob Jewett

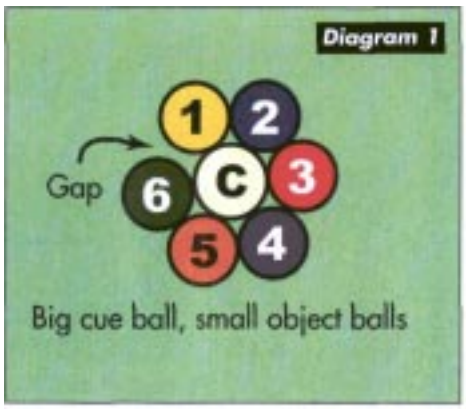
Wrong Size, Wrong Shape

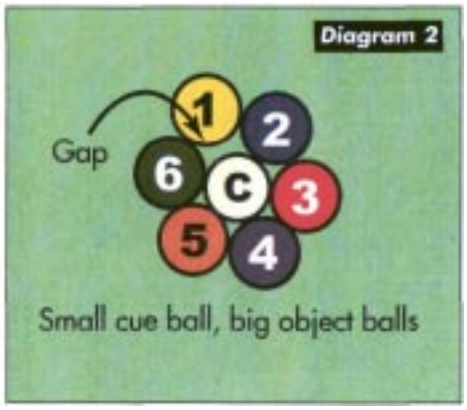
You should probably have that looked at.

Recently on the Internet discussion group rec.sport.billiard, Pat Johnson of Chicago mentioned a problem he had with his new cue ball. When he put the cue ball on the table and surrounded it with six used object balls from the poolhall, he couldn't get all the balls to freeze. There would be gaps between the object balls, and if he moved the balls around so there was only one gap, it was 3/32nd of an inch, as shown in **Diagram 1.** This seemed to show that the pool balls were smaller than the cue ball. Pat's question was: How much smaller are the object balls?

I made a quick guess that if you divided the gap by 6, the diameters of the object balls would be smaller than the cue ball by that amount, or l/64th of an inch. It turns out that I was off by a factor of two. Two other participants in the newsgroup, Jim (who goes by the user name "JAL") from Indiana and David Hood from Colorado correctly pointed out that the ratio is about 3, so Pat's cue ball was a whole l/32nd of an inch larger than the object balls he was trying to play with.

By a coincidence, just after this online discussion, one of the players in the 14.1 league I play in brought his new cue ball to use in his match. I showed the two players how much of a gap the cue ball caused between the surrounding balls, and it looked to be 1/8 of an inch. We then tried putting the house cue ball in the middle of the cluster, and we got a different type of gap. It was between the frozen object balls and the cue ball, and it was nearly as large as the gap illustrated in **Diagram 2.**





Amazingly enough, according to Jim's and David's analyses, you can find the difference between the cue ball's and object balls' diameters again by dividing the gap by 3, even though the gap is made in a very different way. For this example, the house cue ball was smaller by 1 /24 of an inch.

Is 1/24 of an inch enough to worry about? It depends. The difference in size has a corresponding difference in weight, and that will make the cue ball rebound off the object ball differently. If you have only a vague idea of where the cue ball is supposed to go on any particular shot, the difference will not be noticed, but the better your position play becomes, the more such discrepancies will bother you.

The better your position play becomes, the more the discrepancies will bother you.

Let's take an example of a draw shot with the small cue ball. If a normal ball is 6 ounces, the small cue ball is only 5.67 ounces. (This is calculated from the cube of the ratio of the two diameters, if you want to try a different case yourself.) Suppose you are making a shot where, if you start the cue ball with near-maximum draw, it might arrive with about half of that after rubbing on the cloth on the way to the object ball, and you would get two feet of draw. On the same shot, the smaller cue ball will get about 43 percent more draw and come back three feet, just from being that small amount lighter.

Now suppose the poolhall buys new object balls, but keeps the old cue ball. That would roughly double the relative differences in diameters and weights, and for the example draw shot I just described, the cue ball would come back twice as far (four feet) as a standard cue ball against a standard object ball. If you instead try to follow with the light cue ball, you will be similarly surprised when the ball goes forward only 64 percent as far as you were expecting. So three diamonds-length of attempted follow ends up a whole diamond short.

How do these measurements compare to the equipment specifications in the Billiard Congress of America rule book? Balls are supposed to be 2.25 inches in diameter within a tolerance of +/-0.005 inches. (Typical high-quality new balls are much more exact than that.) Assuming that the middle ball in the cluster is the correct size, this means that the gap when you attempt to freeze six balls around it can be no more than 0.015 inches, which is about 1/64 of an inch, or the thickness of a business card.

So far, we've been assuming that the object balls are all the same size. If a ball has to be replaced, this will not be true. The object balls we measured above were about 1/24 inch smaller than a new ball. Suppose the 9 ball has to be replaced in that set. There's no way that you will ever get a tight rack with the new 9 ball in the center because the old, small object balls just can't stretch around it. Unfortunately, even a l/64th-inch gap — which you might see with new, in-spec balls — is large enough to make a difference in how a rack breaks.

Many years ago, before I had my first run of 50 at straight pool, I played day and night in a rec room with old, worn balls. I thought I was pretty good because I could draw the cue ball all over the table. What I didn't real-

ize, even though it was in front of me on every shot, was that the cue ball was tiny compared to the object balls, relatively speaking. With draw coming so easily and naturally, my position play and patterns evolved to where I was using draw on most shots.

Eventually, I got up enough courage and funds to make a trip to the local poolhall to try my luck in a competitive match. The cue ball there looked a little funny. It seemed big. It seemed rough, as if someone had taken sandpaper to the surface. Maybe it was a big barbox cue ball that had migrated to a regular table, or perhaps it was an old, mud break ball. In any case, it didn't draw. I was helpless. The local hotshot would miss until the last three balls, because he quickly figured out there was no way I could get position two shots in a row. I didn't have my rent money with me, so the lesson that day was worth more than the price, although it took me a while to figure out what the lesson was.

I've mentioned here before that cue balls can also be off-center or out of round. You may notice this when the ball is rolling a long way to a stop. One time it might roll a little to the left. The next, along the same path, it might roll to the right. Back when ivory was the preferred material for carom balls, this sort of behavior was fairly common, and shots were often made or missed by the little hook the ball took at the end of a low-speed shot. When a billiard ball got too oval, it had to be turned down with a special lathe to make it "true" again, and the balls became smaller and smaller.

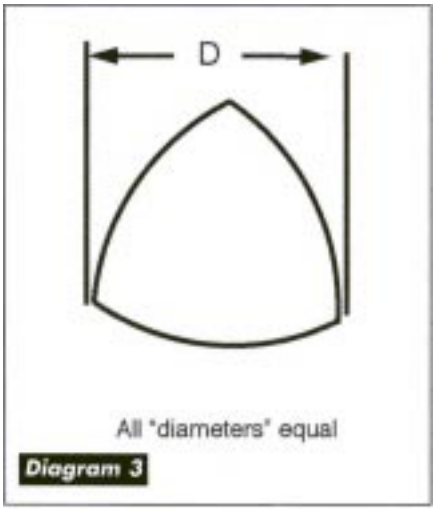


Diagram 3

Trying to test the roundness of a pool ball is far harder than testing the size. You might measure a bunch of diameters of the ball, but even if they are all the same, you can't be sure that the ball is really round. Look at the two-dimensional shape in **Diagram 3.** Measure its "diameters" or the distances across in all directions — they are all the same, but the shape is clearly not a circle. Similar weirdnesses can happen in three dimensions. One simple test is to use a perfectly circular hole just a little larger than the ball and make sure there is a constant clearance all around the ball no matter which way it's turned in the hole.

One tool I've seen in a billiard-supply store is a stand where the ball sits on three ball bearings while a feeler gauge touches the top of the ball. As you rotate the ball on the bearings, the feeler gauge indicates how many thousandths of an inch the top of the ball moves up and down. One precise technique scientists use is to measure the deviation from roundness of a bunch of "great circles" around the alleged sphere. A great circle is a circle on the surface of a sphere that has the same diameter as the sphere, dividing it into two equal hemispheres, like the equator on the Earth. Mathematical techniques allow scientists to connect the circles together to find the topography of the sphere, accurate to about 1 part in 10 million. I think for the purposes of pool, just watching for inconsistent roll-off as the ball comes to a stop is good enough.

Should you worry about all of the above? Only when your game is ready for these details, such as when you can control the roll of the cue ball to better than one diamond.