Bob Jewett

Double-Elimination Formats

Another loss isn't necessarily the player's gain.

In the past two months I've tried to convince you that round-robin or single-elimination formats are the best. This month, we'll go over what has become the standard for large tournaments in the US, the double-elimination format. I don't like the DE format myself, but it's useful to understand it if you're going to be a tournament director or even a player in one.

The basic goal behind DE is to allow every player to have more than one match; the main complaint about single-elimination is that everyone who loses in the first round only gets one match. You stay in the DE tournament until you have two losses. (Interestingly, you don't hear about tennis players clamoring for DE in tennis tournaments.) The problem is how to arrange the matches fairly, and for a reasonably speedy conclusion.

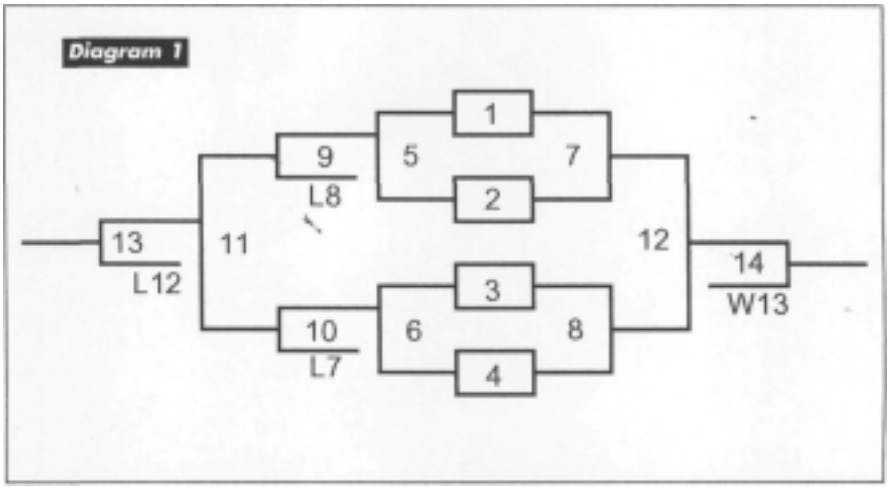
Diagram 1 shows a standard DE chart for eight players. The first matches are down the middle. Seeding and byes for the first round are done the same as for single-elimination, which was covered last month. The matches are numbered for reference.

The winners of the first round advance towards the right, while the losers move to the left. The winners' side remains simple. The losers' side is complicated by the need to make room for the later losers on the winners' side. This is shown by the appearance of L7 and L8 in matches 10 and 9, who are the losers of matches 7 and 8.

An important thing to note is that when L7 and L8 move over to the losers' side, they swap top and bottom. This is to avoid repeated matches. For example, if L7 were not swapped to the bottom, he might have to play the same person he played in match 1 or 2. While there is no way to avoid repeated matches at some point in the tournament, they should be delayed as long as possible, so that they can only occur between players who are already in the money. With eight players, you can't do better than this one swap, but with 64 or 128, things get more complicated. A good large DE chart will do at least two levels of mixing/shuffling to delay repeats.

I shudder to think of all the DE events I've played in that didn't do this shuffling, and I ended up losing twice to one player. I would have much preferred to play someone else for my second loss.

When a winner on the losers' side is finally determined, she or he comes over to play the winner of the winners' side in match 14. There are two basic ways to do this final match. In the old days, if the winners' finalist lost, then each player would have only one loss, and in keeping with the concept of DE, there would have to be another match. The potential of needing a whole extra match at the end of the tournament can really mess up scheduling, especially if it is being taped for TV. The solution that is used nearly always today is to have a single final match. Sometimes this single match is made longer to make it a better decider of who's the best.



One problem while scheduling the rounds for DE is that there are twice as many rounds on the losers' side. This means that if you play the winners through as quickly as possible, the winner of match 11 will be waiting for several rounds, getting rusty and fretting. If matches are played in the order numbered on Diagram 1, there will be fewer long waits.

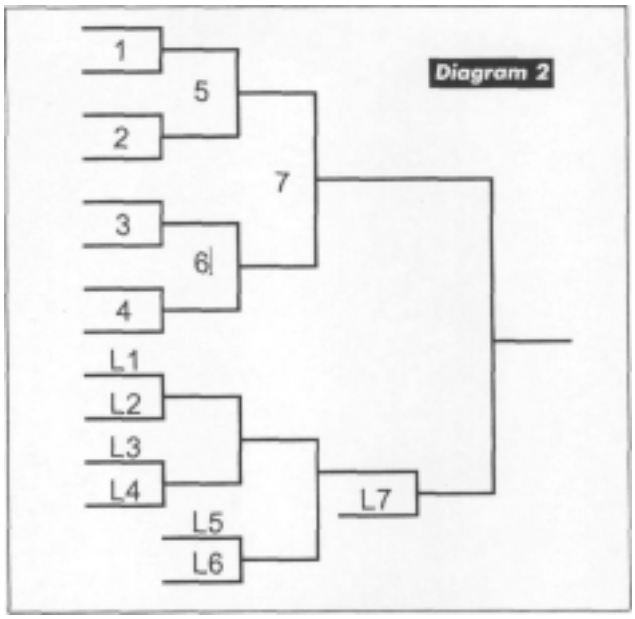
If you lose in the first round, winning the tournament will be a real challenge, since you have to win twice as many matches to get to the finals as the person who just beat you. The best example of someone who met this challenge was Jimmy Caras in the 1967 U.S. Open 14.1 tournament, who lost in the first round and came back to beat Luther Lassiter twice in the finals to win the tournament.

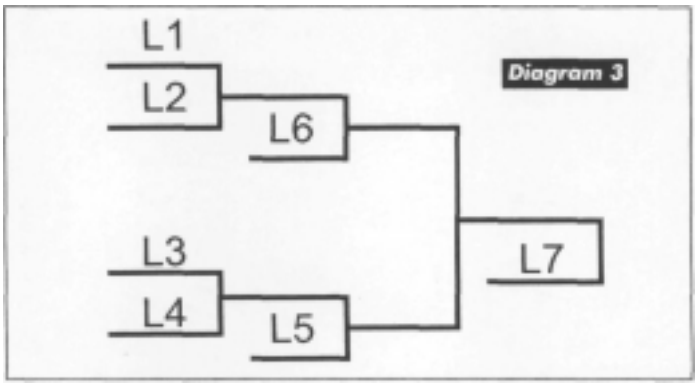
For scheduling, it's important to note that there will be nearly two matches for each player entered, and there will be about twice as many rounds as for single-elimination. Tournament spreadsheets on the Web sites mentioned before will keep track of these details for you.

An alternative DE chart is shown in **Diagram** 2. The idea here is that the losers from each round on the winners' side form their own single-elimination tournament. The winners of each mini-tournament come back together to find the overall winner of the losers' side. This chart is easier to follow and plan the schedule for than the normal DE chart.

The main problem with this system is that if the original chart has nearly 50% byes, the bracket for the losers in the first round will be very sparsely populated, and the players will have an easy ride into the money. This can be corrected by combining the first- and second-round losers into a single bracket, as shown in **Diagram 3.** It is like part of the DE chart folded over.

A final system that lets players have a second chance is the "buy-back" format. For this, you have a bunch of preliminary, small single-elimination groups. Eight players is usually a good number. The winner of each flight goes on to the main competition. The seven players who lost can re-enter the tournament. Usually they will pay another entry fee, but you could also include one re-entry in the original fee. It is possible for a player to get back in the tournament several times, depending on how much time is available and how quickly the maximum number of entries (and re-entries) is reached. I've seen one player





start five times and eventually end up with third place in the main event.

One advantage of this format is that you can start play when only some of the players are present. For example, as soon as 16 were at the site, you could draw into two groups of eight. As more players arrive, they sign up and you have flights with a mixture of new and re-entered players. It is best to form two groups at a time, so that no one knows exactly who will be in their flight when they sign up.

Once all the preliminary groups of eight are played out, the main event begins as a single elimination. You can use seeding so that any byes go to those players who qualified first. This encourages players to arrive early. The winners of the initial groups do have to wait before the "main" event, but they can know when that will start and schedule their time accordingly.

This "buy-back" format offers the best of double-elimination — players get as many chances as they want — and single-elimination — with the straight-forward chart and schedule. It works best in an handicapped event, since the players don't care so much whether Efren is going to be in their flight, but with the second and third chance, an initial bad draw can be overcome.

If you have a competition format you enjoy, please send it in and I'll discuss the most interesting in a future column.

Bob Jewett

8-Ball Rules

The many different versions of one of today's most common games.

Do you think you know the rules of 8-ball? Unless you check the rule book fairly often, your knowledge is likely out of date. Since an early version of the game appeared in 1925, there have been at least four major revisions and many minor modifications.

Fig. 1 is taken from page 53 of the 1925 Brunswick-Balke-Collender publication, *Rules Governing the Royal Game of Billiards.* It is quite clearly 8-ball, but it is a kinder, simpler form of the game. It is also apparently a marketing ploy, since it requires a special set of balls to play it.

A main theme running through the history of 8-ball is the method of choosing groups. In 1925, if you only made one kind of ball on the break, that was what you got. If you made both kinds, you chose. If neither, your opponent presumably chose before his shot, but the rules are silent on this case.

Scratches had no penalty except giving your opponent ball-in-hand behind the line. In fact, it seems that scratching when making the black ball was not loss of game. The only way that you could lose early was to pocket the black before your colors were gone. Also, there was no requirement to contact your own object ball first, even when playing the black, so all combinations were fair.

The rule for a bad break was a little strange. You had to get two balls to a cushion or pocket a ball on the break, or your opponent got to break and select a group whether he pocketed a ball or not.

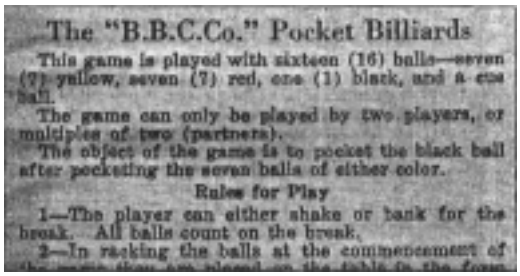
The entire 1925 rules for 8-ball are barely a page long. I wonder whether they succeeded in selling any sets of red/yellow/black balls?

In 1945, a brand-new rules publication appeared from a new organization, the Billiard Association of America. This would transform into the Billiard Congress of America in 1948, and the 1945 rule book was carried along with a slightly different cover but identical rules text through the 1963 edition.

This new version of 8-ball was both closer to and further away from the present game than B.B.C.Co. pool. Standard numbered balls were used in high and low groups. These were not referred to as "stripes and solids," perhaps because some sets of balls were not the current solid/stripe style.

The most notable change in 1945 was a special rule for the 1 and 15 balls. These had to go in the right and left-side pockets, as indicated in **Diagram 2.** Although the rule book said nothing about where those two special balls should be racked — only the eight was specified —I've played in an old-time room where the standard spots were as shown, presumably to keep them out of play at the start of the game.

If you made your special ball in a wrong pocket, it spotted up, and you went on shooting. This rule is actually quite useful to a good player who can continue to make the ball off the spot, perhaps breaking up a last cluster, and then taking a few shots to get onto the right pocket.



The "B.B.C.Co." Pocket Billiards

This game is played with sixteen (16) balls—seven (7) yellow, seven (7) red, one (1) black, and a cue ball.

The game can only be played by two players, or multiples of two (partners).

The object of the game is to pocket the black ball after pocketing the seven balls of either color.

Rules for Play

1—The player can either shake or bank for the break. All balls count on the break.

2—In racking the balls at the commencement of

Fig. 1. An early variation of 8-ball from 1925.

Choice of group, in 1945, was up to the breaker if he pocketed a ball or up to his opponent if not; balls pocketed on the break were irrelevant.

A major addition was a lot of ways to lose with the 8 ball. If you hit the 8 ball directly when playing it, then you had to drive the 8 or the cue ball to a cushion or you lost. This rule was probably mistaken for 20 years, as you would lose even if you had driven several of your opponent's balls to cushions — it had to be the 8 or the cue ball to a cushion. On the other hand, if you were hooked on the 8 ball, and you banked to hit it, you didn't need to hit any cushion afterwards. If you didn't hit the 8 at all, you lost, as well as if you scratched or made the 8 in the wrong pocket.

All combinations were allowed, except when on the 8, so the concept of "hit your own ball first" did not yet exist.

In 1925, you could make the black in some random pocket on a combination and scratch, and you still won the game — or at least that's the way the rules read.

Around 1967, the first changes to the rules in 20 years appeared, and the result was close to the current rules. The special rules for the 1 and 15 were gone, perhaps because of the growing number of coin-op tables for which it was expensive to spot balls.

Choice of group was determined on the break shot if only one kind of ball was made, or by the first person to legally pocket a ball from a chosen group. The requirement to hit your own ball was in, and if you made balls on a bad hit, you had to spot your own but not your opponent's. Slop was still allowed except on the 8.

1970 through 1974 saw only one minor change: if you didn't drive a ball to a cushion, your opponent got to take ball-in-hand in the kitchen.

In 1977 there was a substantial rewrite, and rules for "The Championship Game" expanded to five pages, largely due to many of the general rules of pool being restated in the 8-ball section. Balls jumped off the table were mentioned for the first time; they were spotted, but the shot was not a foul.

Choice of groups was rather strange. After the break, the table was still open, and then you got whatever you made more of. The rule on needing to drive the cue ball or the 8 ball to a cushion, which had been broken since 1945, was finally fixed. Until 1977, making the 8 on the break had been a loss; then it became a win, unless you scratched. The rule about calling the 8 was tightened up, so that an uncalled 8 ball was loss of game, even if you didn't pocket it.

The penalty for a foul became taking the balls in position, or taking the cue ball in hand in the kitchen. If you were on the 8, you could have it spotted and shoot a spot shot. Presumably this last wrinkle kept your opponent from surrounding the 8 ball to keep you from any shot.

The 1978 rule book had both the "Singles Championship Game" and the "Coin-Operated Championship Game," with minor differences.

1980 saw another major rewrite. In a flashback to 1925, the groups were described as either "stripes and solids" or "bi-colored," and for several years, the BCA used red/yellow/black sets in the National Championships. The corner balls on the rack were specified to be one of each group.

The required open break was now defined as four balls to a cushion; previously it was whatever the referee was comfortable with. If you failed, your opponent could shoot

from the position or rebreak. Making the 8 on the break was a win, but an optional rerack-rebreak rule was listed.

Presumably following 9-ball, three consecutive fouls was loss of game. An optional ball-in-hand, anywhere rale was listed, and these two rules together must have been very interesting — imagine being on the 8 with all of your opponent's balls still up.

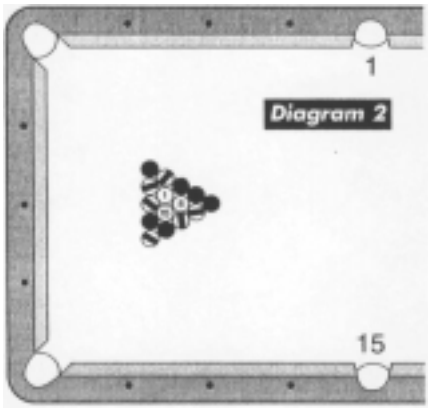
Another optional rule listed in 1980 was "last pocket." Under this rule, you had to make the 8 in the same pocket as the last of your group. An exception was that if the 8 was hanging on the lip of the wrong pocket, you could bank the cue ball three or more cushions to play it in that pocket.

In 1985, making the 8 on the break was a re-rack, but for team play, it was a win. Call-shot was introduced as an optional rule, and if you pocketed uncalled balls, they spotted up, except for your opponent's which stayed down, and on a coin-op everything would stay down. In a surprising change, calling the 8 became a "should-do" for the shooter, and it was the duty of the opponent or referee to ask for a call if none was heard.

Also in 1985, the three-foul rule was stricken, and the stalemate rale appeared. If each player had three turns with no attempt to make a ball, the game was a draw. The idea of "cue-ball fouls only" was introduced for casual play. Sadly, bicolor sets bit the dust that year.

Choice of groups changed to the first legally pocketed ball after the break. All combinations were permitted on an open table, even using the 8 ball first.

In 1986, call-shot was required to the extent that every ball and every pocket had



to be indicated. An 8 on the break gave a rerack and rebreak, or spot the 8 and play on. Jumped balls were considered a miss but not a foul, and your own balls would spot, but your opponent's would stay down.

In 1988, a scratch when playing the 8 was changed from loss of game to just a foul as long at the 8 was not pocketed. A one-minute time-limit rule was suggested, and a stalemate was redefined as six consecutive fouls (three by each player).

1992 saw "Gentlemen's Call" introduced, no longer requiring calling obvious shots. Alternate breaks became the standard; before it was loser-breaks or not specified.

In 1993, a "safety shot" was explicitly added, so that you could shoot in a ball and force your opponent to shoot from the resulting position. Jumped object balls became a foul and all were spotted.

In 1994, a special rule for "cue-ball fouls only" was added so that if you moved a near-by ball on a jump or masse shot, it was considered a foul. Stalemate got its third definition, which removed fouls as a requirement but did require exactly three object balls on the table. On an open table, you could still hit the 8 first, but it would be counted as a miss.

The year 2000 saw the last major changes, but the millennium is young. Winner-breaks is the standard, but options are listed. Hitting the 8 first on an open table is now a foul. Jumped balls no longer spot. A stalemate can occur with any number of balls on the table.

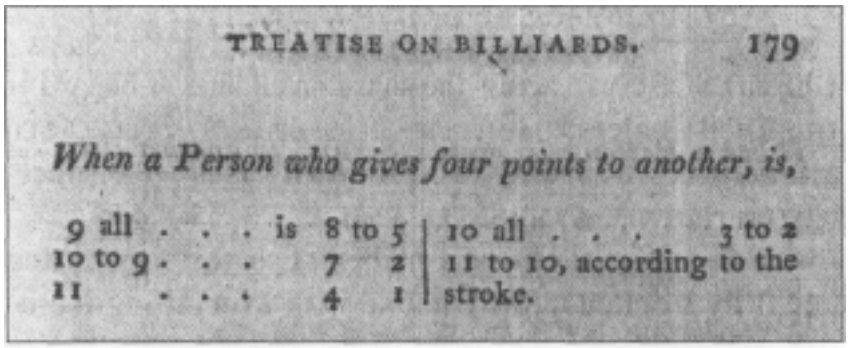
So, do you still think you know how to play 8-ball? Come on over and we can play some "B.B.C.Co." Pocket Billiards. I picked up a red/yellow/black set in the 80s — the 1980s. It takes about 30 seconds to learn the rules.

Bob Jewett

Who Wants a Spot?

Calculating your odds.

Handicapping and calculating the odds at billiards is older than cue tips — literally. **Figure 1** is a section of a book by E. White from 1807 called A *Practical Treatise on the Game of Billiards.* While he does mention chalk, leather tips were unknown to him, so he recommends roughing the wood of the point of the cue with a file before trying to apply spin such as draw.



TREATISE ON BILLIARDS. 179

When a Person who gives four points to another, is,

9 all	. . .	is	8 to 5	10 all	. . . 3 to 2
10 to 9	. . .		7 2	11 to 10, according to the	
11	. . .		4 1	stroke.	

Fig. 1. White's odds from his *A Practical Treatise on the Game of Billiards.*

White devotes a large part of the book to tables of the correct odds at billiards. Evidently the onlookers were fond of betting on the side, as the rules include a clause which forbids proposing a bet not in line with the accepted odds.

In White's day, the standard game was a sort of pocket billiards to 12 points. The odds reproduced are just for the case when someone is giving up 4 points on 12, and the weaker player has nine or 10 points. For example, if the better player is ahead 10-9, the correct odds are 7-2 in his favor, according to White. The odds are complicated because most shots score multiple points in that game.

White goes on through many tables of specific odds on all possible scores with all possible handicaps in games to 12 points. He supports this with pages of calculations of fractions and powers and finite series. In one example, he calculates — using fractions with seventh and ninth powers — the odds as 71828 to 28172 or "very near to 23 to 9" for one possible situation.

I suspect that the modern billiard audience is just as interested in that level of detail as White's readers were in 1807, so I'll keep the arithmetic in the following to a minimum. What I'll outline is a system that allows you to do many things: estimate the relative strengths of two players who have played a match; calculate a fair game between two players if they have both played a third player but not each other; figure a fair handicap between players who have been rated; and figure the odds in a handicapped match when the spot is not quite right.

The underlying idea is that players of different abilities will score balls, points, or games at certain rates or ratios, and these can describe the relative abilities of those players with a single number. You may not agree with this idea. You might imagine a "paper, scissors, rock" situation: A beats B with better shot-making, B beats C with better safety play, and C beats A by better position and long runs. The game is multi-dimensional, but the assumption here is that players can be placed in a pecking order on a single line. I think that most of the time that assumption works pretty well.

The first thing to do is set up the ability rating scale. A simple way to state it is that if you beat me by 2:1 on score, you're 30 rating points better than I am. Suppose in turn, that Efren and Earl both beat you by a 2:1 margin. This makes them 30 points above you. We could say that they are at the top, rated at 100. That would make you a 70 and me a 40. The problem with this is that there are players whom I can beat 2:1 who beat others 2:1 who beat others 2:1 ... and the lowest player on the totem pole is rated at -70. Some players would take offense at being told that they have a negative ability rating. Fortunately, we can fix this by adding 100 to everyone's rating and everyone is back in positive territory, and the differences don't change.

How would Efren and I match up? We would be 60 rating points apart (100-40 or 200-140 after inflation), which means two steps of a 2:1 ratio of games won. This means that if we play a race-to-eight games of 9-ball, I can expect to win about 2, or 1/4 of Efren's score.

How should Efren match up with someone rated 60 points below me? In theory, he would win 16 games for each game they won — 120 points difference is four times 30, or four factors of 2. Theory and practice might diverge for this case, as any hung 9-ball would be a very costly mistake on Efren's part, relative to the same mistake in a scratch game.

Using math, which I won't go into here, you can calculate fair match-ups for any particular rating difference. **Figure 2** shows a tiny part of a complete chart. The left column is the difference in skill rating (RD for Rating Difference) of two players and the right column is the correct spot. This could be at one-pocket, and the spot would be the balls needed for game, or it could be 9-ball and the spot would be games needed for the match.

Note that the RD for an 8-6 pairing is different from the RD for a 4-3 pairing. This is the same ratio of games/points/balls, so you would expect the same rating difference, but the detailed math says that the longer match favors the better player. Similarly, a 2-1 match has an RD of 38 because in such a short match, chance plays a larger part and gives the weaker player the edge. For a 2:1 ratio, the simple explanation of the system gives an RD of 30 as mentioned above, but this really applies only to very long matches.

You could use a table like Figure 2 to establish your own player-ranking system. Suppose Earl beats you in a tournament by a score of 9-5. From the table, this means that you're 27 points below him. Of course, one match does not a career make, and you would have to average a bunch of matches together to get an accurate estimate of relative strengths.

If someone had a lot of data about

Fig. 2. Rating Difference Match

RD	Odds	RD	Odds
5.3	9-8	26.8	9-5
6.0	8-7	33.9	4-2
10.4	5-4	37.2	9-4
11.3	9-7	38.1	2-1
13.1	8-6	44.3	5-2
13.7	4-3	50.9	9-3
18.4	9-6	58.3	3-1
20.1	3-2	71.0	9-2
21.5	8-5	72.1	4-1
24.1	5-3	82.5	5-1

Fig. 3. Chances With a 9-7 Spot

RD	Chances
0	30%:70%
5	39%:61%
10	48%:52%
15	57%:43%
20	65%:35%
25	73%:27%
30	60%:40%

matches, a lot of spare time, and plenty of energy, they could establish player rankings based on long-term tournament performance using this RD technique. I think there would be considerable interest in such rankings.

Figure 2 can also suggest how to change a spot that doesn't seem quite right. Suppose you are giving someone 9-7 at one-pocket — they need to make seven balls before you make nine. You're winning consistently, so a change of spot seems in order. 8-6 is a minor adjustment, as the RD change is less than two points, while 9-6 is a seven-point change and about four times as much adjustment.

In fact, the math allows you to estimate how much change would be fair based on the percentage of wins you're recording. In **Figure 3** is a table of the expected winning percentages in a 9-7 match for various rating differences. For example, if you are winning 65% of the games even giving up that spot, your real superiority is 20 RD points, rather than the 11.3 the spot implies. Checking the table in Figure 2, you could give up 9-6 and retain a small edge, assuming the calculations have been perfect.

As long as people have struck balls with cues, they have been interested in the odds of winning. These ideas and techniques may answer some of your questions. For more details on how this system works or for more complete tables of probabilities, contact me at Jewett® sfbilliards .com.

Bob Jewett is a Billiard Congress of America Advanced-level instructor, and a partner in the San Francisco Billiard Academy, which has courses for beginners to instructors.

Bob Jewett

Outside Assistance

A little spin to help the angle?

One of **the** most-repeated maxims in pool instruction is that you should never use sidespin unless you really need it to position the cue ball. Many teachers assert that nearly all shots can be played with a hit on the vertical centerline of the cue ball; draw and follow are OK, but side is to be avoided.

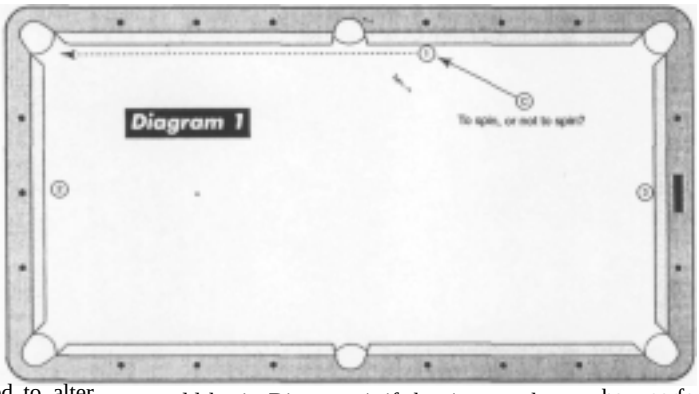
Willie Mosconi told us, "My experience has taught me that more than 85% of the shots can be accomplished by stroking the cue ball in the center of its vertical axis." He later said, "The vast majority of shots can and should be executed by stroking the cue ball at its exact center," and "Resort to English only when you are confronted with the need to alter cue- or object-ball action radically." In Diagram 1, you'll need that something special to get to either the 2 or 3.

The case against sidespin is easy to support. Squirt, swerve, throw and cling due to the spin are each impactful enough to make shots miss. If you're facing a tough shot, it would be insanity to make it harder with those factors unless the position demanded it. If you have an easy shot, you run the risk of changing a 100% proposition to a 95% chance.

On the other hand, long-time readers of this magazine may have noticed a former world champion advocating the use of outside English to help the ball into the pocket on cut shots. (Outside is right English for cuts to the left, and vice versa.) The idea is that some outside English will counteract the throw from the cue ball rubbing across the surface of the object ball during the collision. Since you can hit the object ball fuller, you will also take more of the speed off the cue ball and it will be easier to control.

Ideally, the outside English will exactly cancel the "collision-induced throw" and the cue ball will roll across the surface of the object ball without any rubbing. In response, the object ball will move away exactly along the line of centers of the balls at the instant of collision, and the ghost- or phantom-ball method of aiming — and all their equivalent systems — will be perfect.

Before we get into the details, what do you usually do? Does a shot down the rail feel better with a little outside? If you have to shoot a spot shot, do you help the angle a little with spin? A pool buddy of mine much prefers inside English on tough cut shots when position isn't a factor, as it would be in Diagram 1 if the 1 were the game ball. He doesn't follow the theory of some who claim that such spin, especially down a rail, will put enough sidespin on the object ball to make it zip into the pocket; he just finds it easier to aim with inside. He's got a point. The contact points on the cue ball and object ball are both close to the line of the cue stick, so the shot is more "compact" with all parts along your sighting line.



To analyze the problem, two basic facts are important: object-ball throw is determined by how the surface of the cue ball at the contact point is moving relative to the surface of the object ball at the instant of contact; and if the balls slide against each other during the entire contact, there is a maximum amount of throw that can be imparted to the object ball, and it is in the direction of relative motion.

The first point is critical to the use of outside English to "relieve the angle." Think about a half-ball cut shot like the one in Diagram 1. The cue ball is generally moving across the face of the 1 ball, so the 1 will be thrown towards the cushion. If some outside English is used, right english in this case, the surface of the cue ball will roll across the 1 ball without nibbing. Thus the amount of sideways rubbing, or throw, has two contributors: the general motion of the cue ball, and the sidespin on the cue ball. The tricky part is to know how much English to use. If you don't have enough, the cue ball's motion will dominate, and you will still have throw. If you have too much sidespin, the ball will be thrown in the other direction.

Is it even possible to get this last condition of "excess" outside English? Absolutely! The fuller the hit, the easier it is to do, since the cue ball's motion across the object ball is slower. On a half-ball hit, it takes only a moderate amount of spin, not even close to maximum possible tip offset on the cue ball.

So, to get cancellation of the two sources of throw, you need to balance the English against the amount of cut. This leads to the question of how perfectly this needs to be done in order to get pretty good results. This is a difficult experiment to do, as you need to control speed, angle, spin and draw/follow. You may have noticed that many of the experiments I've suggested here involve combination shots so that you can repeat the setup precisely. Studying a shot with more variables quickly becomes hard to control.

Fortunately, we already have a theoretical result. Ron Shepard, scientist at the Argonne National Laboratory in Argonne, 111., has worked out the physics of throw for a lot of different cases of spin and cut, and has made them available in a 109-page online paper you can access at www.playpool.com. The paper does have a lot of equations about all aspects of pool, and if those aren't your cup of tea, just pay special attention to the many practical questions and solutions he includes. Throw is covered around page 44.

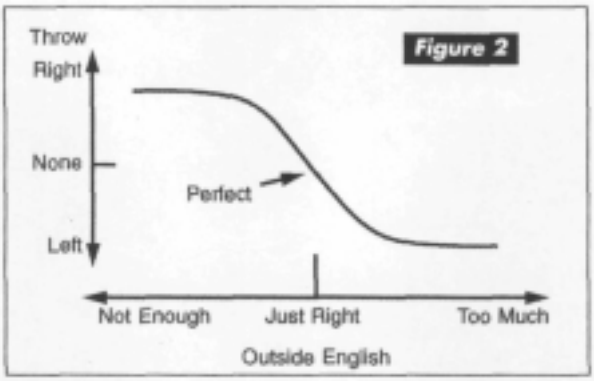
Figure 2 is adapted from Shepard's Figure 4.4. It shows the amount of throw according to the amount of outside spin for the shot shown in Diagram 1. If you have just the right amount of spin, there is no throw. If you have not enough spin, you get throw to the right; too much spin throws to the left. The interesting part is how quickly the throw changes if the spin is a little wrong. If you have between no spin and half enough, the throw is almost constant. If you have, say, between 50% too much and great steaming gobs of outside, the

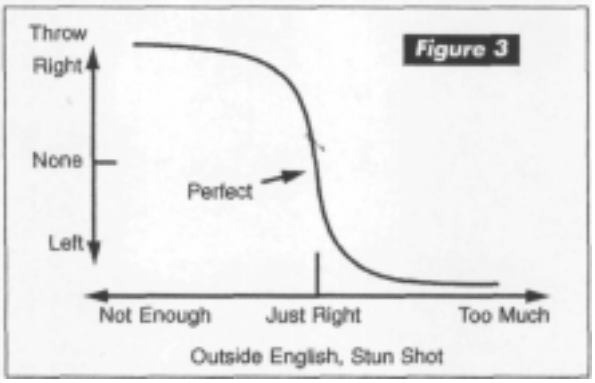
throw is again almost constant. In the middle region, around the "perfect cancellation" spot, if the English varies a little, the throw varies a lot.

This theory predicts that if you are interested in accuracy and consistency, the worst possible plan is to try for zero throw when you are cutting the object ball. Either no outside English or lots will get much more consistent object-ball paths.

What does this theory say to the people who like to use inside English? In Figure 2, their shots would be farther out to the left of the curve, and are in the region that's nearly constant throw. Providing that you can overcome the general pitfalls of using sidespin, this is a better choice than outside, generally.

The theory also has something very interesting to say about what follow and draw do when factored into the throw equation. The curve in Figure 2 is drawn for shots with moderate amounts of draw or follow. If you play the shot as a stun shot — that is, so the cue ball arrives at the object ball without draw or follow, like a stop shot — the curve in **Figure 3** applies. Note the much sharper transition between throw to the left and right. In effect, draw or follow "mellows" the effect of the English, and makes the cut angle much less sensitive to small errors in the amount of spin. Notice also that for a stun shot, you get more throw in either direction. This is related to the second major point mentioned above: the draw or follow in some sense competes with the sidespin, and makes it less effective.





This last point says something very important for a stop shot. Many of us tend to put small amounts of sidespin on the cue ball unintentionally. If we are playing a stop shot, the result is similar to Figure 3, where the horizontal axis is relabeled as "Unintended Left or Right English." It is not so easy to get exactly no English, and if you fail, there is a large penalty in throw angle. The trick, suggested by Shepard, is to make sure you have just a little draw or follow on the cue ball when it gets to the object ball. You won't get perfect stop action, but small amounts of side will be tempered by the draw or follow.

So here's my recommendation: Take Mosconi's advice, and use sidespin only when you have to. And when it comes to avoiding the effects of unwanted side, mix in a little follow or draw.

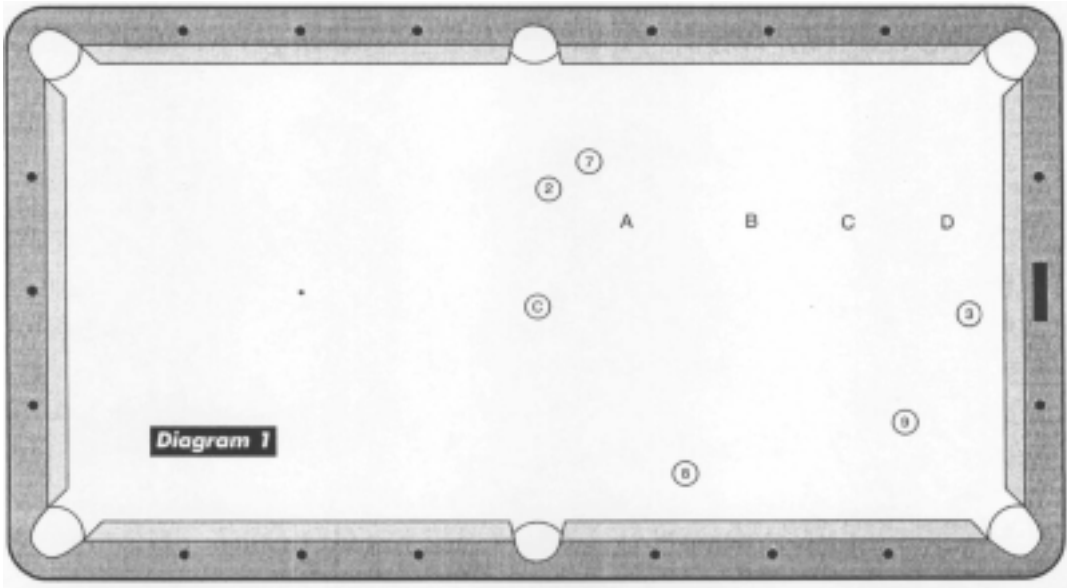
Bob Jewett

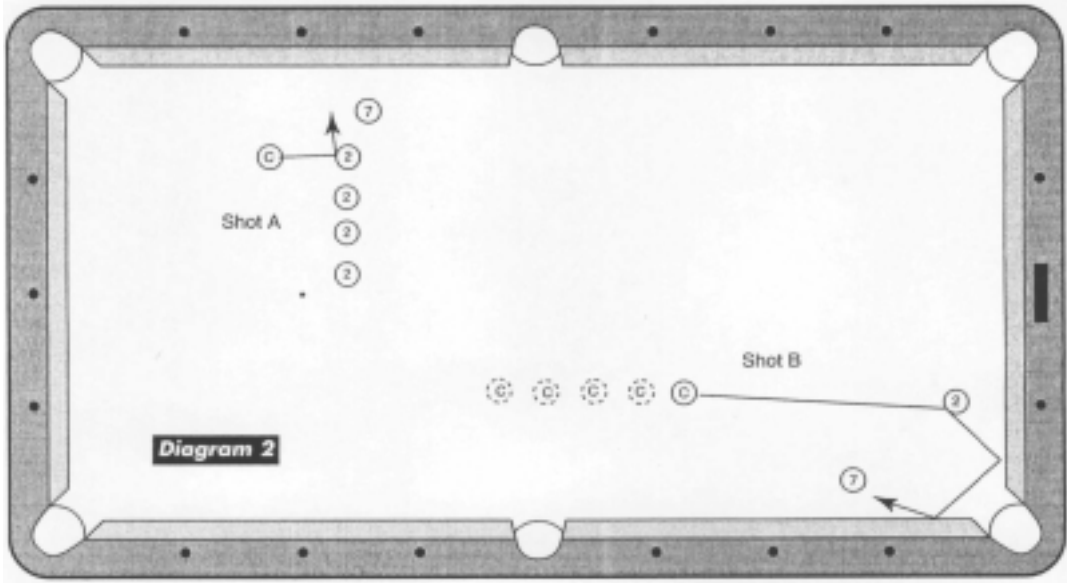
9-Ball Progress

Drills and methods for playing better 9-ball.

Do you want to play better 9-ball? Here are some drills that will help your game.

The first drill lets you track your run-out abilities. It is a form of progressive practice that I think was first proposed by Ron Shepard, the billiards-physics writer. Throw out two balls on the table, and see if you can run them in order with ball-in-hand. If you succeed, add one ball and try again. If you run out, add a fourth ball. If you fail to clear the table, subtract one from the number of balls to attempt.





Of course there will be some variation in your success rate according to how the balls happen to arrange themselves, but after twenty or so tries, you should have a pretty good idea of when you have a chance to clear the table. If you're the fanatical type, keep track of the number you get to at the end of each practice session. This will allow you to look back and see how your game is progressing.

Here are some variations on this drill. Instead of throwing the balls out, shoot a normal break shot — it's important to practice that too — and then remove the lowest balls (and a ball from any cluster) to get to the number you're trying for. Allow yourself one extra ball-in-hand in the middle of the run, so when you completely miss position, you can recover. This will bring your attention to the position shots you have trouble with, and maybe you will find alternatives. Instead of changing by a whole ball in difficulty each time, keep track of runs/misses, and adjust the number when you have a net of three in either direction.

Another very useful practice routine is "playing the ghost." The idea is that you are playing against someone who never misses, so if you miss, you lose. If your name isn't Deuel, you're allowed to take ball-in-hand after the break. Score each rack as a win for you, or as a win for the ghost if you miss. Play to 11 or so, and keep track of your scores. One variation on this theme is to take an extra ball-in-hand after your first miss or two. Another is to keep a count of balls pocketed in ten racks. Give yourself a point per ball, counting two points for the 9. A perfect score is 100. For this, you can spot the 9 if pocketed too early.

When playing the ghost, you will encounter run-stopper shots. These are a good thing, since they tell you which shots

you have to practice. An example is in **Diagram 1,** where you have left yourself too little angle on the 2 ball to move easily to the 3. Control of the cue ball requires a lot of power and a very accurate hit on the 2. Suppose you fail to get position on the 3 and you miss the resulting bank, ending your game with the ghost. Turn the shot into a progressive practice right then. Mark the positions of the cue and 2, and try to move the cue ball a few inches towards the final position, say to A (or within a few inches of A). If you can do that, try the same shot to move the cue ball to B, and so on, making the goal harder or easier as you succeed or fail with the shot. Take 10 shots at the drill, or shoot until you're satisfied with your improvement.

Note that although you missed the bank on the 3 originally, that's probably not the best shot to practice. The real mistake was not moving well from the 2 to the 3. Or was it? Maybe you could have left a better angle on the 2, so you might also practice whatever shot led to the too-shallow angle on the 2.

Not all run-stoppers will lend themselves to progressive practice; some will have a factor in the shot such as distance, which can make the shot either harder or easier. In the example above, if you want to practice the long bank, there is no good way to make it easier, and it may be that you will take a long time to reach even 50 percent on the shot. For shots like this, just play the shot several times, perhaps with the balls remaining from the rack, and go on to the next rack.

Do you ever practice your safeties? You can turn that into a competition by playing 9-ball but only scoring points when your opponent fails to make a good hit. In this game, the 9 itself is worthless. You can also use progressive practice to work on your safeties. In **Diagram 2** are two such drills. In Shot A, assume that all pockets for the 2 ball are blocked, and the best play is to nestle the cue ball behind the 7. As more and more players come equipped with jump cues, it's important to leave the cue ball not just hidden but crowded as well. The basic safety is easy to play, but it's not so easy to leave the cue ball close to the 7 and preferably frozen. I'd say that freezing the cue ball to the 7 and thereby eliminating any easy bank to the 2 is ten times better than just a run-of-the-mill snooker. The progression here is to move the 2 ball towards the center of the table. The goal is to leave the cue ball within a ball's width of the 7. The cue ball is in hand on each attempt. Of course, if you drive the 2 ball up and back down the table and leave a shot, the safety is a failure.

In Shot B, the goal is about the same, but you need to judge the action off the cushions. You still need to drive the 2 ball to the other end of the table, and you may find that some reverse sidespin (left in this case) will help kill the speed on the cue ball so it dies nicely behind the 7. For this shot, the progression is to move the cue ball farther away. Again, consider it a failure if the cue ball ends more than a ball's width from the 7. For an easier drill, just require a hook, but no close snuggling.

There are two final things you need to do to raise your game to the next level. Play in competition. Some people recommend gambling against better players to sharpen your skills, but I suspect this advice is coming from those better players. Many rooms have tournaments or leagues you can use to test yourself against other players. Next, go see great players. Watch what they do right, but also note what they could do better. While there is some pool on TV, there are lots of things you'll only see by going to a major event, and the players will appreciate the support.

So, if you want to improve your 9-ball game, practice, practice some more, compete, and watch the best.

Bob Jewett

A Challenge to Improve

Bob Jewett has a little proposition for you.

In the billiard rooms of the 1700s, you might have heard, "I bet I can shoot from this table and make a ball on that table." Propositions and challenges are a time-tested part of pool. They offer opportunities for impromptu competition and insights into parts of the game that you might normally avoid.

I've met players who dismiss these "trick shots" as useless sleight-of-hand, unworthy of their consideration. They probably pass over one of the regular gems in this magazine — Willie Jopling's column on trick shots, challenges and propositions. There is always something to learn there about how the balls work, and often something about how people work.

Here are some shots to illustrate why propositions are worthy of your consideration.

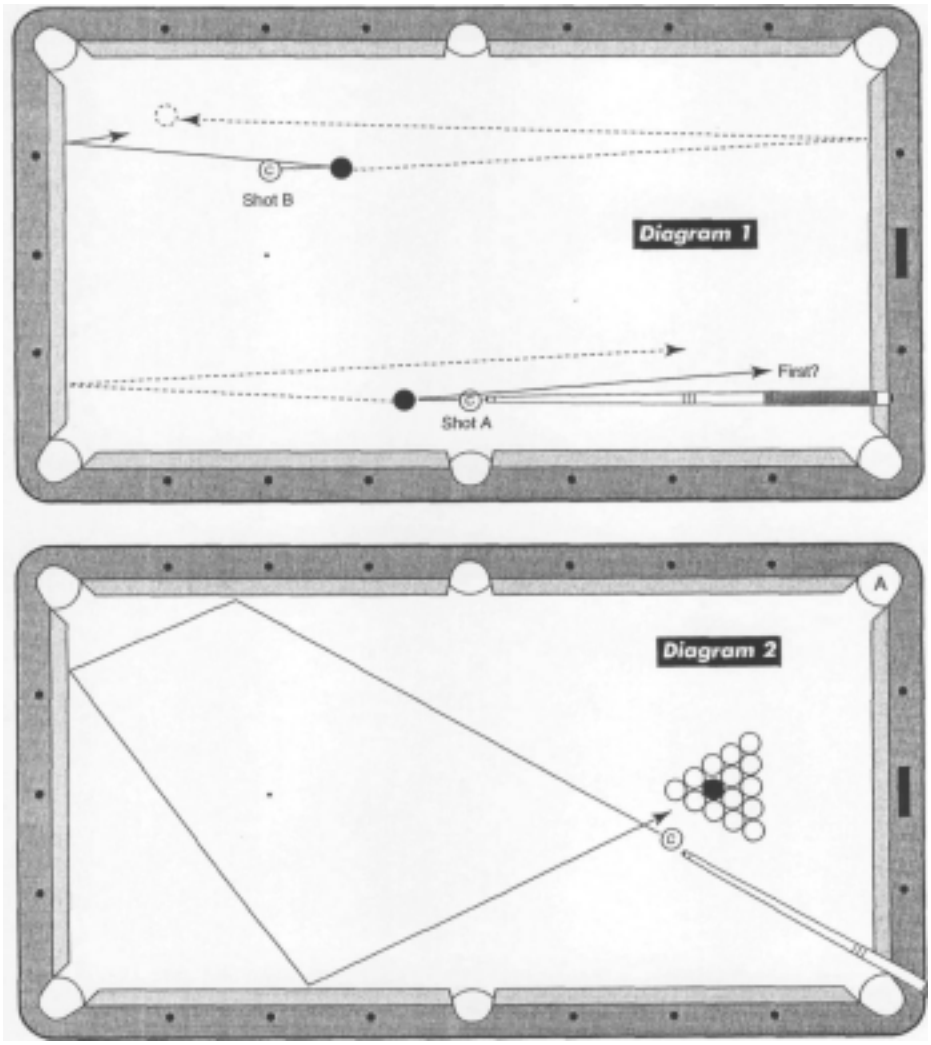


Diagram 1 shows two shots that will help improve the quality of your draw. In Shot A, the goal is shoot the object ball straight up the table and draw the cue ball back to hit the end rail before the object ball gets there. No masse shots allowed. (If you can get the cue ball back without the object ball returning, either you need to fix your table, or we should go on the road.) The challenge is to see who can move the object ball farthest up the table and still do the shot. You will probably find that a medium stroke is best.

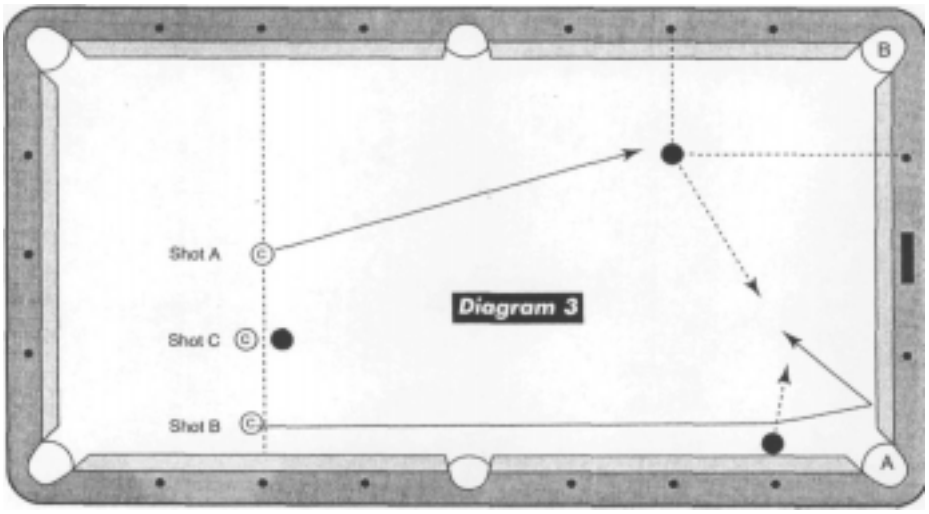
Shot B has been seen here before. It is a good test of your soft draw. Can you draw the cue ball back to the cushion without the object ball touching the same cushion? The knowledge you get from this shot seems especially useful at one pocket and straight pool. This shot depends some on the equipment — see how far from the line you can move the object ball and still make the shot. No masse.

In **Diagram 2** the goal is to shoot the cue ball three cushions (or more) and eventually pocket the 8 ball in pocket A. You can reset the cue ball after each shot. The far cushion must be the second cushion you contact. The break shot is shown. This illustrates one aspect of proposition shots — since you often repeat shots, you can find special landmarks on the table for certain shots. Note that the cue stick passes over a particular part of the corner pocket, and is pointed towards the first diamond from the opposite pocket. This works on my table, but your table may need a different starting point.

After the break shot, place the cue ball where you want, and shoot again. As a competition, try to make the black ball in fewer shots than your opponent. As a proposition, don't give the shooter more than 15 shots.

I've seen two great finger-pool artists do this proposition by hand — throwing the cue ball rather than shooting it. Cue Ball Kelly would try it in a dozen throws on a pool table. On a 6-by-12-foot snooker table, I saw Canadian Alain Robidoux try and succeed in 25 shots. The amazing thing about Robidoux's performance was that every throw improved the situation, either by moving balls out of the way or advancing the black towards the pocket.

A simpler version of this shot is to place a single object ball on the spot. Five shots is par to sink the ball in pocket A. You should quickly learn the best spin to get the most consistent path for the cue ball; I recommend that you start with equal follow



and running English — left follow for the path shown.

Diagram 3 shows three more "I bet I can and you can't" shots. Shot A is a simple cut shot. The cue ball is on the head spot and the object ball is at the intersections of the diamonds, as shown. Your goal is pocket A. When you set the shot up, it looks absolutely impossible, but you can even over-cut the ball. This is a good shot for English experiments. Does outside help you on this one, or is it better to aim with center ball?

Shot B is a handy shot to have at one-pocket. Can you bank the object ball into pocket B? Again, at first glance, it looks impossible, but with a little practice, you should be able to over-cut the shot and still get the object ball across the table. On this shot, experimenting with outside English to help may get a different result than for Shot A. You will surely note during your tests the effects of squirt, swerve and throw.

Finally, Shot C is an old friend. The goal is to make the object ball hit the foot rail without the cue ball going over the line. Mr. Jopling recently revealed a trick to make this one: run your grip hand into the rail to stop the stick. If your mark — I mean "client" — knows that trick, you can propose the next step up: make the object ball go up and down the table two more times so it hits the far cushion twice. The stroke needed is called *fouette* and is a standard part of Mike Massey's exhibitions. Studying this shot will teach you a lot about double-hit fouls and how to avoid them. It is also possible to play the one-cushion shot by moving your grip hand forward very, very far on the butt. This technique is easier on the knuckles and doesn't require a conveniently-placed rail.

I hope that Willie releases a new edition of his book of trick and proposition shots. In the meantime, review his past articles, and get a copy of Byrne's *Treasury of Trick Shots.* Some of the shots in each of these are multi-ball setups of kisses and combinations, which those pooh-poohers mentioned before will ignore, but look at each one for long enough to understand where each ball will go and why. Some of the "obvious" shots will have you scratching your head for a while.

Bob Jewett

99 Critical Points

Bob Jewett splits some important hairs.

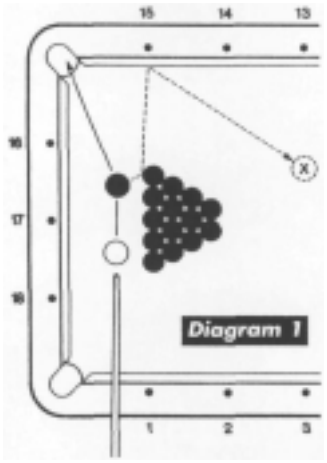
In **the May** issue was an extensive review of the top billiard instruction books. Among the cream was Ray Martin's "The 99 Critical Shots in Pool and Billiards," which was the best pool book available when it was published in 1977. While other books are now better, as a first book for beginners, "99CS" remains required reading for any serious cue student.

I have found that there are many layers to understanding. I recall when I was first learning pool from Willie Mosconi's "Winning Pocket Billiards" 40 years ago, that on each of four or five readings that were perhaps three months apart, I learned something new from each review. Part of it was that my game was developing at the same time, and Willie's help on draw shots couldn't do me much good — or really make any sense — until my arm moved more or less straight. With each new reading, more parts fit.

As my game and understanding have progressed further, I now see that there's more than one mistake in Willie's book, and some of them can seriously hold up a student's progress beyond the beginner level. It could be that in another 40 years I'll have a very different take. A sad part of this further learning is the loss of an old friend. Well, maybe not a loss, but it can hurt to see a friend in a new, clearer light that shows features you wish weren't there.

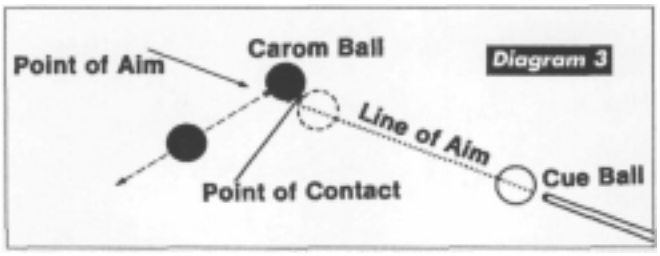
When "99CS" was reissued ten years ago, I was glad to see this classic available again for a new generation of pool fanatics, but I was not so happy to see that Ray didn't take the opportunity to update the book and fix some of "the features we wish weren't there." Here are some of the things I hope will find their way into a second edition.

The diagrams need to be fixed. Pool is a geometrical game, and scale, proportion, and accuracy are important. In **Diagram** 1 is an example straight-pool break shot taken from the book (p.141). The cue ball and object ball are larger than the pocket. Notice that the balls in the rack are smaller. It would help to show the cue applying right English, but this is shown in a separate inset about where to hit the ball.

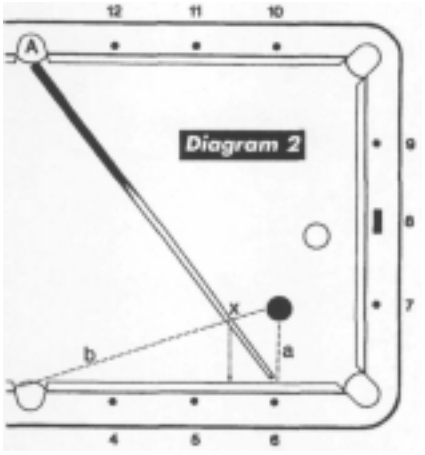


Another problem is the shading of the balls. The rack balls are supposed to be gray, but in both the original paperback and the reprint, they are very hard to tell from the black of the main object ball. In the illustrated shot, this isn't important, but other shots can only be deciphered if you can figure out which ball is very, very dark gray but not black.

The path the cue ball takes also needs to be fixed, and this applies to nearly all the diagrams in the book. The cue ball in Diagram 1 is shown leaving the object ball from the middle of the object ball, when it fact it comes from a location a ball closer to the shooter. This means that the cue ball will not hit the indicated rack ball first, but its neighbor. The details are hard to see because the balls aren't even close to the right size. Also, when the cue ball hits the rail, the contact point and turning should be shown at the rail groove, where the center of the cue ball makes its turn.



Martin doesn't have the worst diagrams in billiards. There are some carom diagrams where the balls are the size of pumpkins. Most of the time it's possible to puzzle out what Ray means, but diagrams should be clear enough that you don't have to solve a puzzle to understand them. Two examples of authors with excellent diagrams are Byrne and Capelle — open both "99CS" and one of their books and compare for yourself.



Finally, to the shot itself. The line of the stick is nearly parallel to the end rail. Willie says to use left, not right, English for this shot, and I think Willie was right. Try the shot yourself, and see which works the best for you, and then make a note in "99CS" about what you discovered.

The fundamental how-to-play section at the start of "99CS" is quite good, but could use some updates. Few people now recommend using 600-grit sandpaper to clean shafts. Modern cue papers seem to be at least twice as fine as that. The photos for bridge and stance are excellent, but the open bridge and the snooker-player stance deserve a more positive mention — just watch the top players on TV for examples.

In **Diagram 2** is the banking system that Martin explains as Shot 27. Maybe there is someone, somewhere, who actually shoots banks this way, but I doubt it. Willie shows the same system. Both of them actually have the ideal construction wrong, but the ideal construction doesn't work anyway. I think the student would be better off spending time with the mirror system, which is much easier to visualize but which Ray doesn't mention.

In my very first column for this magazine, in 1992,1 asked the reader to do an experi-

ment to find the best way to run a frozen ball down the cushion without English on the cue ball. All the experimenters found the same thing: you must land the cue ball about a quarter-inch up the cushion from the object ball. The reason, of course, is collision-induced throw; the motion of the cue ball across the object ball drags it towards the cushion. Koehler had shown the same thing in his 1989 book, "The Science of Pocket Billiards," complete with diagrams of the changes with inside and outside English. It's high time that all billiard authors expunge this myth of "hit ball and cushion at the same time."

Shot 42 of 99 shows an example of what I call the "twice as full system," in which the cue ball is blocked from the desired path by a close ball. The system as described doesn't have the geometry quite right, but more importantly, it doesn't have the cue ball frozen to the object ball, which is absolutely required for this shot to be legal and to work well.

In Diagram 3 is the carom system explained in Shot 43. Unfortunately, it doesn't even come close for a half-ball hit. The point of aim — the point on the first object ball your stick is aimed at — is the point on the first object ball that is closest to the target ball, and Martin says to play it as a stop or stun shot, with no spin on the cue ball. This is the sort of bogus system that can be debunked with a few examples. If the second object ball is at a right angle to the line of your stick, the system says to aim your stick at the edge of the first object ball. This is our old friend the half-ball hit, and the cue ball is deflected 60 degrees on the shot and not 90. Even worse, if the object ball is ahead of the right-angle line, the system says to hit the first object ball even fuller, which means you will miss the second object ball by even more.

A very interesting kiss situation is illustrated in **Diagram 4,** drawing from its appearance in both the examples on page 165 of "99CS." A ball is frozen between two others. Where does it go if struck into both of them simultaneously? You might think that it will go along one of the kiss lines (A or B), but in fact it will seem to ignore both balls and go nearly straight away from the cue ball. You could make a proposition shot from this. In "99CS," the ball is incorrectly said to go along one of the kiss lines.

Finally, I have a bone to pick about the rules listed at the back of the book. They were the official Billiards Congress of America rules in 1977 when the BCA was on Michigan Avenue in Chicago (as listed), but the BCA address has changed at least twice, and the rules a dozen times, since then. The old rules may be okay for beginners to start with, but they are likely to cause confusion among better players who try to play in tournaments. For example, in 9-ball, you are no longer permitted to push out at the start of every turn at the table — yes, people really did play like that in the last millennium.

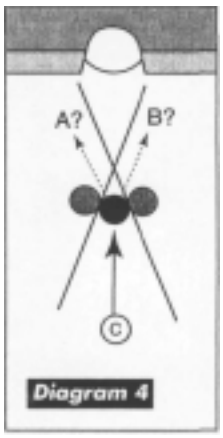


Diagram 4

The above is not an exhaustive list. As you read or re-read "99CS," or any other book about pool, be sure you do it critically. Maybe you don't have to be so tough on the author the first time through; go for comprehension of what he may have been trying to say. But if you ever hope to get past that first, superficial layer of understanding, you will need to get out your microscope and fine-toothed comb and put away your mercy.

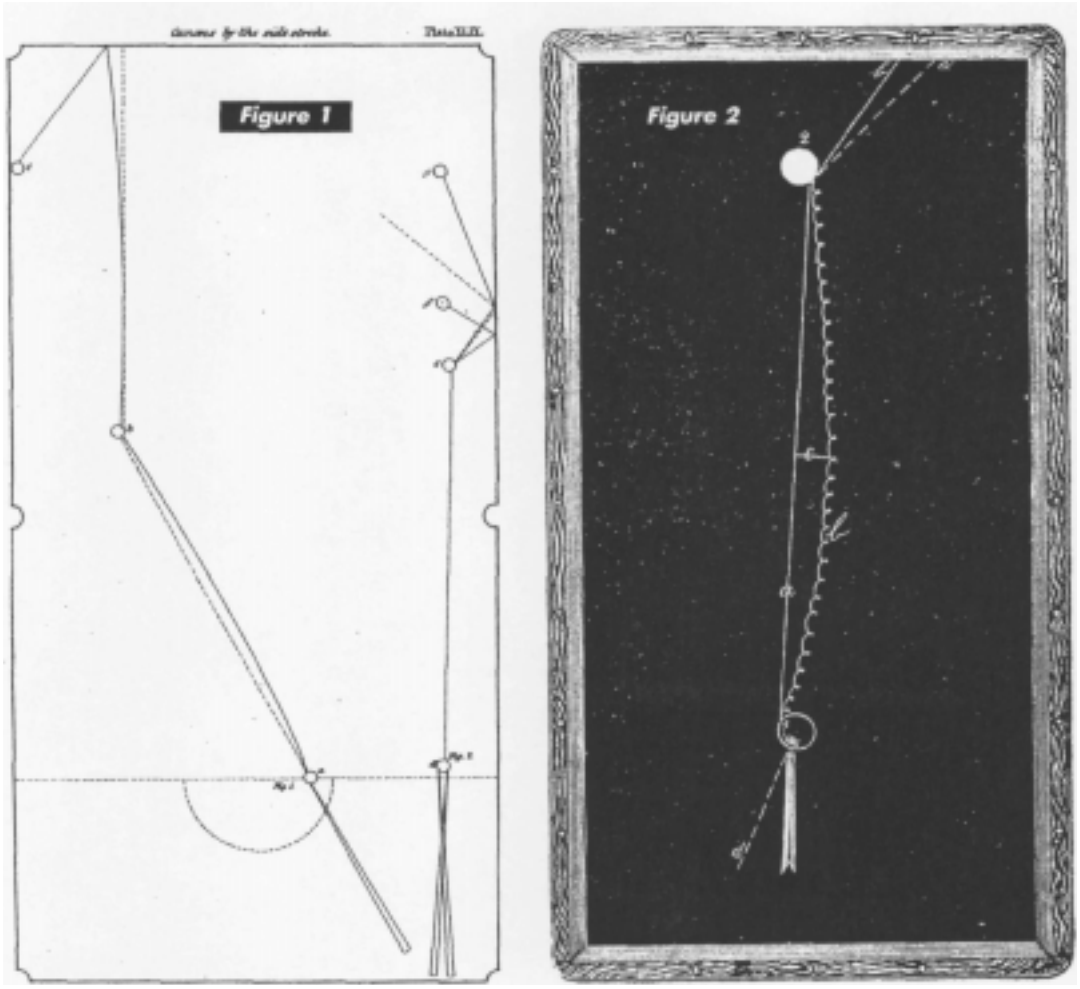
Bob Jewett

Squirt a Review

A new look at this old friend.

Squirt has been the topic here a couple of times in the past. It stirs passions among some, often because it is not well understood. Recent revelations about the mechanism that causes it have prompted me to try a more complete review. (Briefly defined, when sidespin is used, the cue ball "squirts" off somewhat to the side away from the tip. More on the definition later.)

There are some who don't believe that squirt exists, or if it does exist, they think it isn't important. When cue ball deflection — or squirt, as I prefer to call it — comes up on the Internet, one of the most common remarks of the non-believers is, "Why haven't we heard about this before, if it's so important?" Well, I looked around a little at what has been said before, and found several treasures.



In Figure 1 is a plate from *The Game of Billiards* by Edwin Kentfield, which was first published in 1839. Yes, over 160 years ago. The leather tip had been in use for only about 25 years, although the use of chalk was somewhat older. Cushions weren't yet rubber, and most table beds were not yet slate. But here we see clear demonstrations of both squirt and swerve.

The shot on the left shows how to play a billiard or carom (canon, for the British), from one ball to the other, by using heavy sidespin. The text says in part: "The dotted lines in this plate are introduced to indicate the direction the ball would take if struck in the centre; for, as it has already been observed, *the ball when struck, on its side, does not take a direct line."* [Emphasis Kentfield's.]

The shot on the right shows two different cases. When the second object ball is near, reverse or right sidespin off the cushion is needed, but running side is needed when it is farther down the table. Again, he shows the straight-line path, but notice what the cue stick does. For right English, it is pivoted to the right, while for left English, it is pivoted to the left. This shows roughly the amount of squirt compensation that Kentfield thought necessary on this kind of shot. We'll talk more about this technique later.

In Figure 2 is a plate from the American standard, *Modern Billiards,* which was published by the Brunswick-Balke-Collender Co. beginning in 1891. Shown is the path of the cue ball with extreme left sidespin. The 1908 version says: "When "English" or "twist" is applied to the cue-ball in its course, it is forced from a straight line and diverges to an extent that it will pass around a ball placed in a direct line before it. ... The dotted line d shows the direction in which the ball is forced by being struck on the side, but the ball rotating in the opposite direction to that which it is impelled, in consequence of the twist and draw imparted, aided by the resistance through friction of the nap of the cloth, serves to bring it back to the original point of aim, as shown by the curved loop-line, L, which denotes twist."

Sadly, the knowledge in *Modern Billiards* seems to have been lost in the U.S. by 1941, when Willie Hoppe's *Billiards As It Should Be Played* was published. Hoppe warns against "spineless" cues, and has a diagram of a cue ball going off at an uncertain angle while the spineless cue quivers

back and forth, but no connection is made to problems with using sidespin. Neither of Mosconi's books (1948 and 1965) describes squirt.

Figure 3 is from Joe Davis' book *How I Play Snooker*, which was first published in England in 1949. Davis dominated English cue sports — both billiards and snooker — for over 20 years. The diagram shows a ball played straight up the table with right side, and is mostly intended to warn the beginner away from English. In the text, Davis makes the point that if struck softly, the cue ball has time to recover and may cross over the original line, while if struck hard, it will not have time to return to the original line of aim.

In 1978, Robert Byrne's *Standard Book of Pool and Billiards* warns of the problem especially when shooting hard. He gave it the name of squirt, which seems to have been coined originally by a player from Napa, California named Jack Leavitt. You may see other authors call the "jumping away from the cue tip on sidespin shots phenomenon" by the name "deflection," but there are lots of kinds of deflection, and "squirt" invites less confusion. We'll see later that technically, it's the cue stick that deflects and not the cue ball.

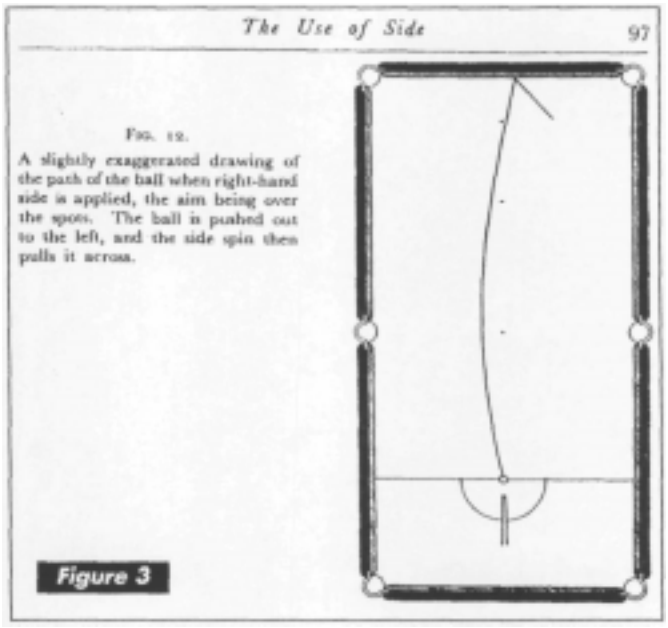

The Use of Side 97

FIG. 12.

A slightly exaggerated drawing of the path of the ball when right-hand side is applied, the aim being over the spots. The ball is pushed out to the left, and the side spin then pulls it across.

Figure 3

More recent texts have gone into more detail on squirt. Phil Capelle's *Play Your Best Pool* has four pages on the subject, including tables of experimental results and several example diagrams (pp 92-96). Ewa Mataya-Laurance's *Idiot's Guide to Pool and Billiards* has several pages on it (pp 198-200), and makes the important point that knowing squirt is present will help you make the necessary adjustments faster, even if those adjustments have to be made by feel gained through experience. She also points out that sticks vary significantly in the amount of squirt they produce, which is a factor to consider when buying a new stick or borrowing one from a friend or the wall. In *Precision Pool*, Gerry Kanov and Shari Stauch point out that most players — even top players — have only a fuzzy notion of how much squirt enters into play. For them, unconscious compensation is the way to go.

Next time, I'll go over the mechanism behind squirt and give you some suggestions on how to deal with it. In the mean time, if you know of a shot mat requires squirt — that is, could not be made with a squirt-free stick — please send it in.

Bob Jewett

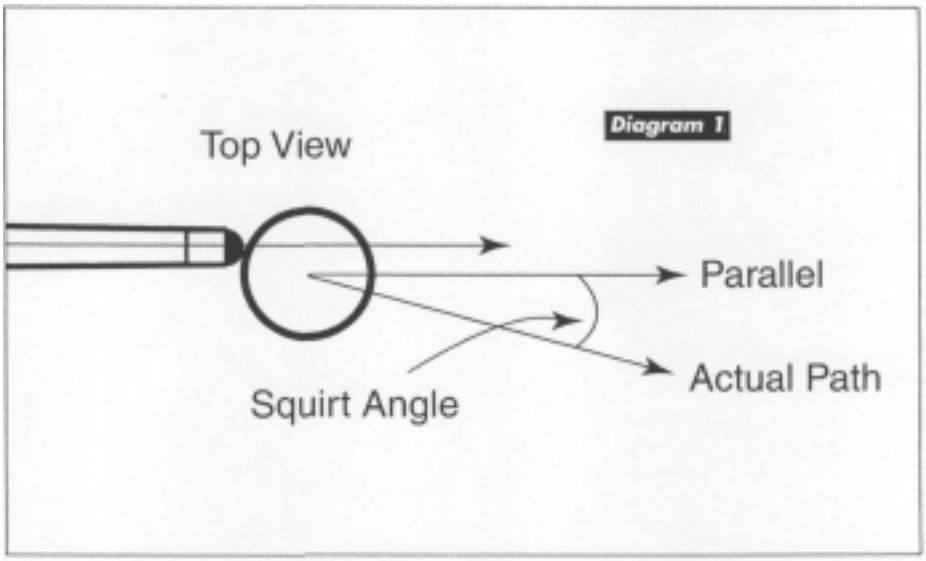
Squirt Where it Comes From

Bob Jewett continues his discussion of squirt.

In last month's column, I went over some references in pool literature about squirt, although it didn't get that name until 1978. This month we'll look at its major characteristics and the mechanism that seems to cause it.

First, let's be clear about what we mean by squirt. In **Diagram** 1 is a cue ball being hit off-center as shown from above. Rather than go along a path parallel to the axis of the cue stick, the ball starts off at an angle away from that ideal path. This angle is always away from the side of the English applied.

Although the angle shown is much larger than you will ever see on the table, the actual angle is plenty large enough to affect normal play. If you need to hit a ball on a far cushion with lots of outside English, aiming for a thin hit may get the cue ball to land full or even on the wrong side of the object ball. An attempted thin hit with inside English is likely to miss the ball completely unless you compensate for the squirt angle. In extreme cases, that angle is as large as three degrees. Note that this is not the change in the object-ball path; it is the error in the initial path of the cue ball. This means that the farther the cue ball has to travel to the target, the larger will be the total error in inches when it arrives.



Squirt has been found to vary due to many factors. The largest effect is from the amount of tip offset (side spin). As far we know, two tips of English will produce twice the squirt angle of one tip. Maybe there are small effects if the tip is not perfectly round, but this rule seems to hold fairly well. We'll see that it is the basis of one system of squirt compensation.

Another large contributor is the amount of mass in the front part of the cue stick. I've reported here before on a special shaft that Jim Buss made to demonstrate this; it had a brass rod inserted in the first five inches of the shaft. It also has tremendous squirt. In experiments reported by Predator Cues, a gram of lead tape wrapped around the ferrule increased squirt significantly. (For reference, a U.S. nickel weighs about five grams.)

Perhaps the ultimate added-weight experiment was performed by Dr. Mike Page, a university professor in Fargo, N.D. In November of 2000, he took an old stick and clamped locking pliers to the shaft at various distances from the tip. When the pliers were near the tip, the squirt was huge. As the pliers were moved back, the squirt reduced, so that with the pliers even five inches back from the tip, the stick played nearly normally.

Dr. Page also noticed a considerable change in squirt with the speed of the shot. For normal cues, this change is not clearly evident. Many people seem to notice that there is less squirt for softer shots. It may just seem that way because at slower speeds, the cue ball will have time to swerve back and cancel some of the squirt. This is an experiment that should be fairly easy to do, except that it takes a perfectly level cue stick to avoid contaminating the results. It is nearly impossible to hit the cue ball on its equator with a truly level stick.

But what, exactly, causes squirt?

While the details of the stick-ball interaction — including the main squirt-producing mechanism — seem to be obvious now, it took ultra-high-speed videos of the hit to reveal the fundamental cause of squirt. The first cue company to use such fast cameras was Meucci — well, maybe there were others, but they didn't publicize their results. Soon after Bob Meucci showed his tape at a BCA Trade Show, Predator Cues had scheduled a rental of a special camera system that works 200 times faster than normal TV cameras. Several experimenters, including myself, Mike Shamos and Jim Buss (representing the American Cuemakers Association) sublet a week of the rental in November 1998. Some of those experiments have already been reported here.

In **Diagram 2** is an illustration of what the tape showed about the tip-to-ball contact on a spin shot. At the start of this shot with left-side spin, the stick is coming straight forward and the cue ball is at rest. In the middle of the contact time — which lasts about one thousandth of a second — the tip has compressed some onto the ball, and the ball has started to move forward and has some spin, as shown by the arrows. The critical point for understanding squirt is that the tip is no longer moving straight forward. Because it doesn't slip on the ball, the tip must follow the rotation of the ball, and move to the side. At the end of the shot, the tip has uncompressed and leaves the ball. The ball has its full spin, and the stick has slowed and is moving partly sideways, away from the ball.

At this point we can apply the Law of Conservation of Momentum. At the start of the shot, nothing was moving sideways. At

the end of the shot, the stick — or at least the front part of the stick — is moving to the left. The Law requires that something must be moving to the right at least partly to cancel the momentum of the stick to the left, and that something is the cue ball.

You could say that the ball pushes the tip to the side, but it is equally correct to say that the tip pushes the ball to the side. In fact you can't have one without the other; "for every action there is an equal and opposite reaction." A physicist would say that there is a sideways force between the tip and the ball without imputing motive to either one.

With the realization that it is this "pushing the tip to the side" on spin shots that causes squirt, most or all of the phenomena are explained. When mass is added to the ferrule or front of the stick, there will be more momentum in the thing that's pushed aside by the ball, so there'll be more squirt. Similarly, more spin means more squirt because with a more eccentric hit, the stick will be moving faster to the side at the end of contact than for a more centered hit. Sadly for those of us who would like to try a squirtless stick, such an ideal now looks impossible; it would require a stick without any mass at all.

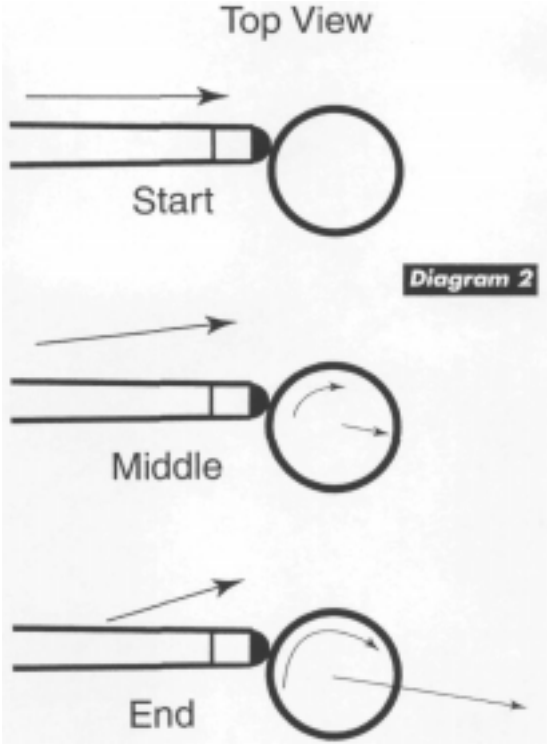


Diagram 2

Page's pliers experiment brings up an interesting question: How much of the stick is pushed aside? If you go through the numbers, if the whole stick were involved, the squirt would be much larger than observed. If moving the pliers five inches (or so) back reduces their effect, maybe it's only the first five inches of the stick that are involved. It's pretty clear that the stick must bend some during the hit, but this hasn't been measured. Ron Shepard, a researcher at Argonne National Labs and serious pool-physics fanatic, has worked out a lot of the math behind squirt, and in the end, arrives at an "effective mass" for the stick. This represents the fraction of the stick that you could say was involved if it all moved sideways together at the speed of the tip. Interestingly, this works out to be the mass in the front several inches of the stick.

A possible design path is now clear to reduce squirt: reduce the mass near the tip. Next month we'll see what has been done so far along this course, and how you can deal with whatever squirt your stick happens to have.

Bob Jewett

Squirt Continued

How to deal with it.

In the August issue, we reviewed discussions of squirt (divergence of the cue ball when using side spin) in 150 years of billiard writing. Last issue, we looked at the basic physical cause of squirt: the tip's moving to one side causes the cue ball to squirt to the other. This month we'll look at several ways of dealing with squirt.

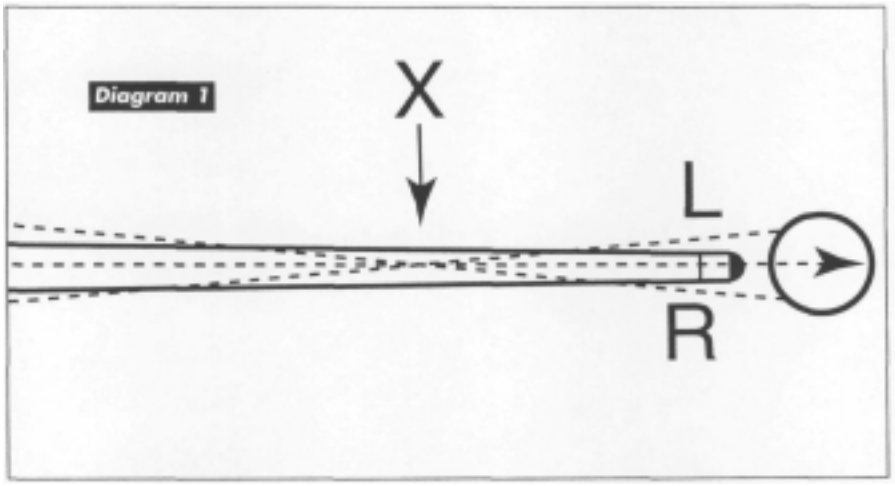
Is squirt something that has to be dealt with? If your game has not yet progressed to the point where you use side spin to position the cue ball — and most pool players will never reach that level — there's no practical reason for you to worry about it. If you do resort to English when necessary or amusing, you'll need to compensate one way or another. Many players, perhaps most, do all of their compensation unconsciously. I remember standing next to Bob Meucci while he was measuring squirt — he would call it deflection, but we've seen why that's a misnomer — at a trade show, and a top-ten pro player asked, "My cue does that?!" My conclusion is that some can reach championship levels without ever understanding the true geometry and physics happening on the table in front of them.

If you are unwilling to let your subconscious be in charge of this aspect of your game, here are several ways of coping:

The first is to reduce the amount of squirt that your stick has. The idea is that the less the cue ball diverges from the line of the stick, the less compensation you need to make. The Holy Grail here is a squirtless stick, but based on the physical analysis last month, this seems to require a shaft with no weight at all.

Two cue companies have made significant advances towards the ideal. Predator reduces the mass up front by boring a hole down the center of the shaft. This reduces the weight that causes the cue ball to move to the side. Meucci has modified the ferrule in a way that also has less mass moving to the side during impact. Traditional snooker and carom cues have less squirt than typical pool cues because of smaller shaft diameters at the tip, and shorter, lighter ferrules, which both reduce the front mass. If you have a chance, try spinning your ball with a 12mm or smaller diameter shaft fitted with a ferrule no more than half an inch long.

If your pool cue has a typical amount of squirt, there is a compensation technique that will get you close on many shots. Imagine that you want to drive the cue ball straight to the right with no spin as shown in Diagram 1 (view from above). The axis of the cue stick passes straight through the center of the cue ball along the line you want the cue ball to take. Now consider where the axis of the cue must be to drive the cue ball along the same path, but with serious left English. The axis will be along something like line L. The stick is shooting the ball off at an angle, but the squirt will bring it back to the same line as for the initial shot. The amount the stick has been angled to the left exactly matches — for this particular hypothetical stick — the angle of squirt back the other way. Of course, for right English, the angling would be just the same but in the other direction.



Now for the delicious insight. The two stick angles — for left and right English — have an intersection or common point marked X. Suppose your bridge hand was at X. You could aim with no spin, pivot the stick over to line L, stroke and shoot along that line, and the cue ball would travel along your original line straight to the right. If you wanted right English instead, you would first aim as before and then pivot to line R and shoot.

This method of compensation seems to be very old. Diagram 2 is a detail of the page shown in August from Edwin Kentfield's 1839 book. It shows two positions for the cue stick to hit the same target with either left or right English. While Kentfield doesn't stress the possibility of having your bridge hand at the common or pivot point of the two sticks, his diagram clearly suggests it.

In modern discussions, this technique goes by two self-explanatory names: "aim and pivot" and "backhand English." The standard procedure is to take a few warm-up strokes after you have pivoted over to L or R and then come straight through. This allows you to check how much side spin you have set up for. A similar technique, which we might call "aim and swoop," has you come over to L or R only on the final forward stroke, so the amount of spin is determined by how much your back hand moves to the side during the final forward motion. This sounds like it should be horribly inconsistent, but some top pros use this or even worse techniques.

How can the aim-and-pivot technique go wrong? First, the pivot point varies from stick to stick. If your stick happens to have a pivot point just at your usual bridge position, the compensation will be exact. If the stick has lots of squirt, you will need a shorter bridge; less squirt will force a longer bridge.

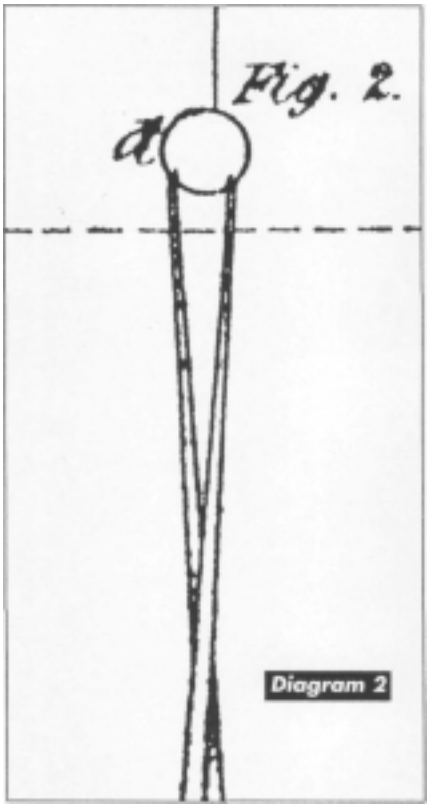
The speed of the shot is also important. As far as has been demonstrated, the squirt angle doesn't change much with the speed of the shot, but the cue-ball swerve will

change a lot with the speed — less speed, more swerve. Players sometimes confuse the two effects and think there is more squirt on fast shots. Similar confusion occurs on new, slippery cloth, which seems to have more squirt but really has less swerve than standard or worn cloth.

Does aim-and-pivot still work if you use less English? It seems to. If you pivot only half as far over as L or R but with the same bridge position, you get half as much spin and about half as much squirt. This may depend slightly on the shape of the tip. The result is that if your bridge hand is at the pivot point, the cue ball can go only along one line no matter how much left or right English you use.

This last point can be important for the selection of a break stick. If you choose one with a pivot length equal to your break bridge length, the accuracy of your hit on the rack will not be ruined by your inability to hit the cue ball in the middle at break speed.

Pivot length — the distance between your bridge hand and the cue ball for perfect squirt compensation — has quite a large range depending on how the shaft of the stick is made. Reported values range from 8 to 50 inches. You clearly must be careful in your selection if you want to use the aim-and-pivot method. On the other hand, if you're like me and want a cue with low squirt to reduce the needed compensation, and the chance for error to creep in while applying that compensation, you'll want to look for a cue with a longer pivot length.



Measuring pivot lengths is easy if not perfectly accurate — try different bridge lengths until you find one that gives good squirt compensation. As a target, try to hit an object ball full that is only a diamond or so from the cue ball; that will give swerve less chance to **corrupt** your results. Also, be sure to shoot fairly firmly, for the same reason.

Earlier in this series, I asked if there was any shot that required squirt. Rick Malm emailed to point out that if an alley formed by nearby object balls restricted your cueing to only one level line of approach to the cue ball, squirt might be required to make the shot. I do not recommend buying a variable-squirt shaft to be ready for this improbability. Rick also pointed out that on draw shots, a high-squirt cue stick should shoot the cue ball more parallel to the table, since the "vertical squirt" would tend to cancel stick elevation. This might help a little, but I think that all normal sticks don't have nearly enough squirt to get a perfectly flat shot.

Bob Jewett

Chalk Marks, Cue Marks

The devil's in the details.

My view is that the game is 85 percent physical and 10 percent mental. In the physical part, I include knowing the basic shots, seeing the shot at hand, and bringing the stick through consistently enough to pocket the ball. In the mental category, I place attitude about the game, strategy, and the ability to concentrate on the shot at hand.

You may have a different opinion of the importance of the mental side of the game, and those of you who read Bob Fancher's interesting and informative views on this may have revised your estimates recently.

If you have the physical part right, you're going to make all but two shots out of a 15-ball rack, and maybe more. There is no substitute for physical ability. This lesson can be learned from watching excellent 9-ball players try their hand at straight pool. I watched a young Cole Dickson run 80, and he may have been on the right ball with the right angle once or twice. The mental aspects of patterns and shot selection are trumped by a good eye every time.

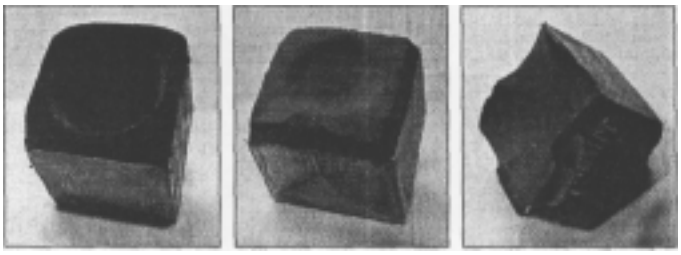
So, let's suppose that you have the physical part down well enough — see the shot, make the shot — the first 85 percent. Let's also suppose you have the mental part down, and you're in the right state of mind and you know the strategy and shots for the game you're playing — the next 10 percent. What is the remaining 5 percent? It's the fun part. It's the special knowledge or technique that will help you maybe one time in 20. It's the part I usually write about here.

Is the final 5 percent important? Not if you routinely miss 30 percent of your shots. You should be spending all of your time — or as much time as you can stand and afford — on the first 85 percent of the game. You need to fix your arm.

But if you want to play at the top level, you need to have that 5 percent ready. The top players in good form miss so rarely that a 5 percent error rate would be a disaster. I remember a match between Mike Sigel and Louie Roberts at one of Terry Stonier's tournaments in the 1980s. In 21 games of 9-ball, there was one missed ball. Sigel missed it, and lost 11-10. Luther Lassiter was asked how he could tell if he could beat someone. He would watch them play for an hour, and if they missed a ball in an hour, he knew he could beat them.

What is in that 5 percent? All the minor stuff after you get your arm to move straight and get your mind in the right place: special shots, special techniques, special strategies.

Here is a checklist of things in that 5 percent which I have covered here before:



Left to right: bad chalk, **salvaged chalk, and** correctly-worn **chalk.**

close-ball aiming and stroking; choosing the easiest shot; dealing with squirt; effects of dampness on banking and draw; speed, spin, and distance effects in banking, if bank pool is not your usual game; accurately predicting draw and follow angles; the special systems to use when balls are frozen; dealing with equipment defects; unusual safety plays; masse, swerve and jump shots; special reactions in combination shots; multi-rail position; and weird stroke techniques.

You may be saying that the above is surely more than 5 percent of the game. No, it isn't. Some of the above might come up only once in a month of play, and you're likely to play many racks in which none of them is important. Of course, if you play bank pool or one-pocket often, your arm needs to learn the right way to move to make banks for all conditions, spins and speeds. In my system, those considerations become a part of the physical aspect of the game. Similarly, if you play three-cushion billiards, multi-rail position must be made part of your nature, not something special to be used rarely. And if you play English Billiards, the precise speed and angle that gives a scratch with follow will be programmed right down into your spine and you will make those shots naturally.

These last three points make a general point: to move some of the 5 percent stuff into your 85 percent area — that is to say, to put more shots into your arm where they are natural — you would do well to branch out and play a wider variety of games.

Two other items that I put in the 5 percent group are chalking and stick rotation. Let's look at those two in more detail.

Is chalking that important? It's been argued that most shots can be played with an unchalked stick, and if you have perfect speed control, you may be able to get through a few racks without any spin at all on the cue ball. I've watched beginners at the pool hall who never chalked. When they did get a rare miscue, they simply got another stick from the wall.

Most players learn to chalk badly. They get some chalk on some parts of their tip some of the time, maybe. The most primitive chalkers belong to the Clan of the Borers. In the first picture is the result of their vile practices. Their goal seems to be to bore through the chalk to the back paper. When they are not chalking, you can recognize them by their sloped foreheads, vacant eyes, and open, drooling mouths. Surely no reader of this magazine is a member of the Borers.

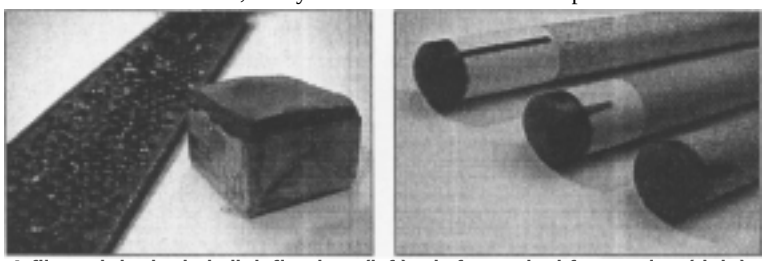
A sub-clan of the Borers is the Squeekers. The more talented Squeekers can play folk tunes with chalk on tip. Some foreigners and children may squeak the chalk out of ignorance or carelessness — correct them gently.

The problem with the Borers is that they don't cover the tip evenly with chalk. They leave caked spots and bare spots. If they ever bothered to look at the tip, they would see this and perhaps reform.

An effective way to chalk is to bring the edge of the chalk across the edge of the tip. You don't really need chalk in the exact center of the tip; you do need chalk on the part of the tip that will spin the ball. The chalk shown in the left-hand photo could be used for this, except the edge of the chalk — the rim around the bored hole — is hard and shiny from age or oil from hands. Using this chalk with the proper chalking motion will remove chalk from the tip rather than add it. This can be fixed by filing down the top of the chalk. This is

shown in the center photo, where fresh, clean chalk has been exposed. At the same time, you should wrap the chalk with cellophane tape to keep the paper from falling off.

In the right-hand photo on page 24 is my own piece of chalk that I've been using for about three months. It started out as a normal, full piece of chalk. Notice that the edges of the chalk have taken on the shape of my tip. As I bring the edge of the chalk across the edge of the tip, a lot of surface is chalked simultaneously. I do have to worry about trimming the tape and paper as the chalk wears down. If left ragged, it will take the chalk right back off. Shown in the left-hand photo on this page is the file that quickly changed the useless, bored-out, shiny chalk into good chalk.



A file and the bad chalk it fixed up (left); shafts marked for rotation (right).

Are you saying to yourself, "Bob's late with his April-fools column"? No, I'm mostly serious about this chalk thing. If you need more convincing, go to a pro tournament and look at the use patterns on the chalk, then compare it to my used chalk. Or read what Jack Koehler has to say about not sharing your chalk in his 1995 book "Upscale One-Pocket."

Many beginners never learn to spin the ball because they never learn to chalk well. They need to look at what they're doing.

Finally, here is a suggestion that you might put in the final 0.5 percent. Always shoot with your stick in the same rotation. That is, always shoot with the same side up. The players who need the most precision — snooker players — do this already. A snooker cue has a flat bevel at the end of butt, so that it looks a little like a chisel. The back hand holds the end of the butt with the "flat" always held the same way, maybe in the palm. This means that the stick will have the same rotation on every shot.

If there is any slight bend in the stick, it will always be the same way. If there is any harder or softer spot on the tip, it will always be in the same place, for example for draw. If the shaft is more flexible with or against the grain, that flexibility will always be the same way. The idea is that all of these effects will be learned and dealt with subconsciously.

Meucci Cues already has a solution for this. Their Red Dot and Black Dot shafts are marked to allow the player to choose the right rotation. The right-hand photo on this page shows the way I do it. With a permanent marker, make a sight on the ferrule just back from the tip. Always shoot with the sight up. After a little practice, it will be a natural part of your game. One advantage is that if I plan to shoot a draw shot, I only need to check for chalk on the part of the tip I use for draw.

Shown are three kinds of ferrule. From longer to shorter, they have progressively less squirt because ferrules are denser than wood. The one with the nearly invisible ferrule — about 1/16-inch long — is one I've played with for 20 years. Mike Massey has recently gone to a similarly short ferrule.

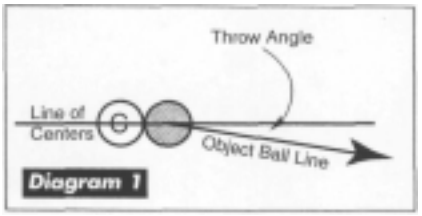
Should you worry about the final 5 percent? Only if you want to have fun or be the best. At the very least, don't be a Borer.

Bob Jewett

An Experiment in Throw

Win a year's subscription to *BD* in Bob Jewett's contest.

Readers of the instructional columns and letters of this magazine may have noticed a recent controversy about the phenomenon of throw. Its very existence, except for a very small set of shots, has been put into question. Authority has been invoked on each side.



Fortunately, this is not a matter that you have to leave to respected authority; you can decide the matter for yourself. Below I describe a simple experiment, and if you have a little spare time and a table, you can do some testing on your own. If you readers send in your results, I'll tabulate them and *Billiards Digest* will donate a one-year subscription to the two best experimenters.

First, we need to clearly understand what we mean by "throw." When the cue ball collides with an object ball, the simplest theory of aiming says that the object ball will move away from the cue ball along the line joining their centers at the instant of contact. Throw is the departure of the object ball from this ideal line due to the spin or motion of the cue ball. If throw happens on a shot, there will be an angle between the line of centers and the line the object ball takes away from the collision. In **Diagram 1,** this is drawn as an angle larger than zero.

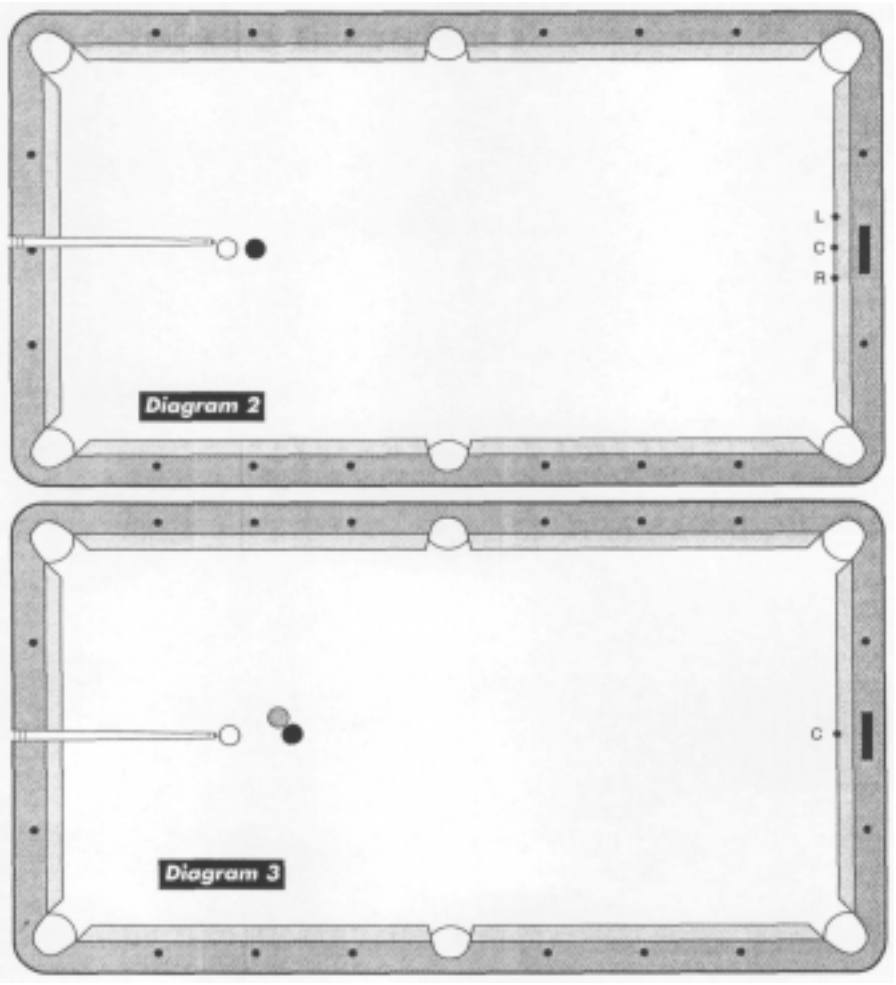
In one standard demonstration of throw, two object balls are frozen together and the combination is shot from an angle. Unless the contact point is wetted, the second object ball is always thrown, with an angle of up to six degrees. I think the result that an object ball can throw a ball it is frozen to is not questioned by any rational being, human or otherwise. But we are going to test a much tougher situation — whether the cue ball can throw the object ball.

Yes, you could argue that the cue ball is pretty much like an object ball and a collision from the cue ball is more or less like pushing a frozen object ball into another, but let's try to do the real thing and see what happens.

The difficulty — and the challenge of designing the experiment — is in knowing the line of centers of the cue ball and object ball at the instant of collision. Taking a belt and suspenders approach, here are two different methods to measure the angle — if any — of cue ball/object ball throw.

In **Diagram** 2 is a very simple shot. The object ball is on the head spot, and the cue ball is straight towards the head cushion and an inch or so away. The balls are close together so that we know the line of centers well. A problem with testing for throw is that the results can be polluted by both squirt and swerve. Having the object ball close to the cue ball reduces both factors. In addition, to make sure the cue ball does not have time to swerve, you must play the shot just firmly enough to drive the object ball to the foot cushion and back to the head cushion. This also reduces the effect of table slope.

To make sure the balls are in the same position every time, either use some donut-shaped paper reinforcements or tap the balls firmly into place. To get a reference line, shoot a shot with no spin on the cue ball. Place chalk or some other marker on the rail to indicate the center position. Shoot a few more shots to see if you have a consistent reference. At this point, you could estimate how much random variation you have just for your center-ball shots. It

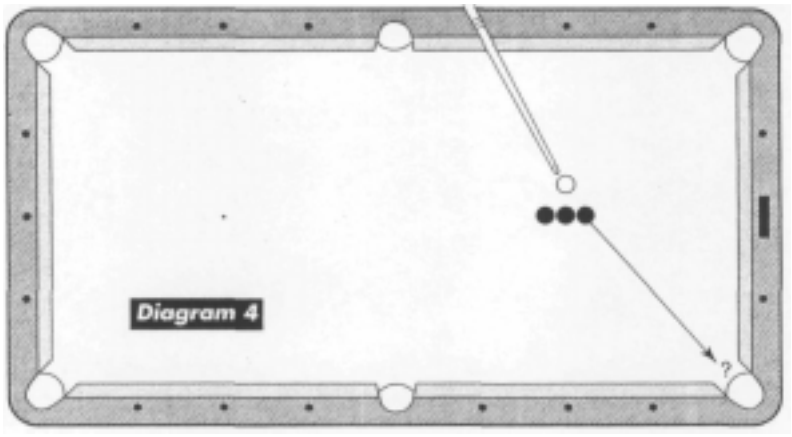


should be less than half an inch, if you set up consistently. This spread should be part of your report.

Now set up the shot again. Shoot the shot with left English and no follow or draw; hit the cue ball right on its equator. Make sure your stick is as level as possible and pointed straight up the table, parallel to the center line. Note where the ball hits the foot cushion and mark it. Shoot several more times and check how accurate your mark is and how consistent your shots are. If the mark is not the same as for the center-ball shot, note whether it is to the left or right and by how much. Next, do the same for right English. For extra credit, note where the object ball hits the head rail.

It may be that you will double-hit the cue ball because it is so close to the object ball. This may be distracting, but it shouldn't change the path of the object ball, which will be long gone by the time the tip hits the cue ball a second time.

In **Diagram 3** is a second way to do the experiment. Place an object ball on the head spot as before. Now freeze the cue ball to it pointed straight down the middle of the table. Freeze a third ball to both of them, and then move the cue ball back as shown. The test is to see how far to the right the object ball can be brought by using side spin on the cue ball. The added ball keeps you from cheating by simply cutting the ball to the right.



For this test, you may — due to less than perfect aim and stroke — hit the blocking ball first, which will keep you from getting the object ball maximally to the right. Shoot the shot ten times, and only record the result that is farthest to the right for each of right, left and no side spin. On this test, the position of the object balls is critical, so you will definitely need some positioning aid.

This setup comes up in normal play, and happens often at one-pocket when multiple balls have been spotted, as in **Diagram 4.** Can you make the back ball of two spotted balls straight into a corner pocket? If not, how about for three balls? Does spin on the cue ball help?

Write up your results and either mail them to me in care of this magazine [122 S. Michigan Ave., Suite 1506, Chicago IL 60603], or e-mail them to Jewett® sfbilliards.com. For bonus points, note whether the balls are old or new, clean or dirty, and what kind of cloth you are playing on.

One last point to ponder: Physics predicts an interesting connection between throw and transferred spin on the object ball. Because throw is caused by tangential or sideways force, if the object ball is thrown, it must also have acquired side spin in the collision. Conversely, if the object ball has side spin after the collision, it must have been thrown.