How Tough is Tough?

by BOB JEWETT

DOES A LONG, straight shot require more accuracy than a shorter thin cut? Is a bank or a cut easier? The answer is partly individual; you might love thin cut shots but dread long shots. Such preferences aside, simple geometry can be used to assign a difficulty factor to each shot and allow an objective comparison.

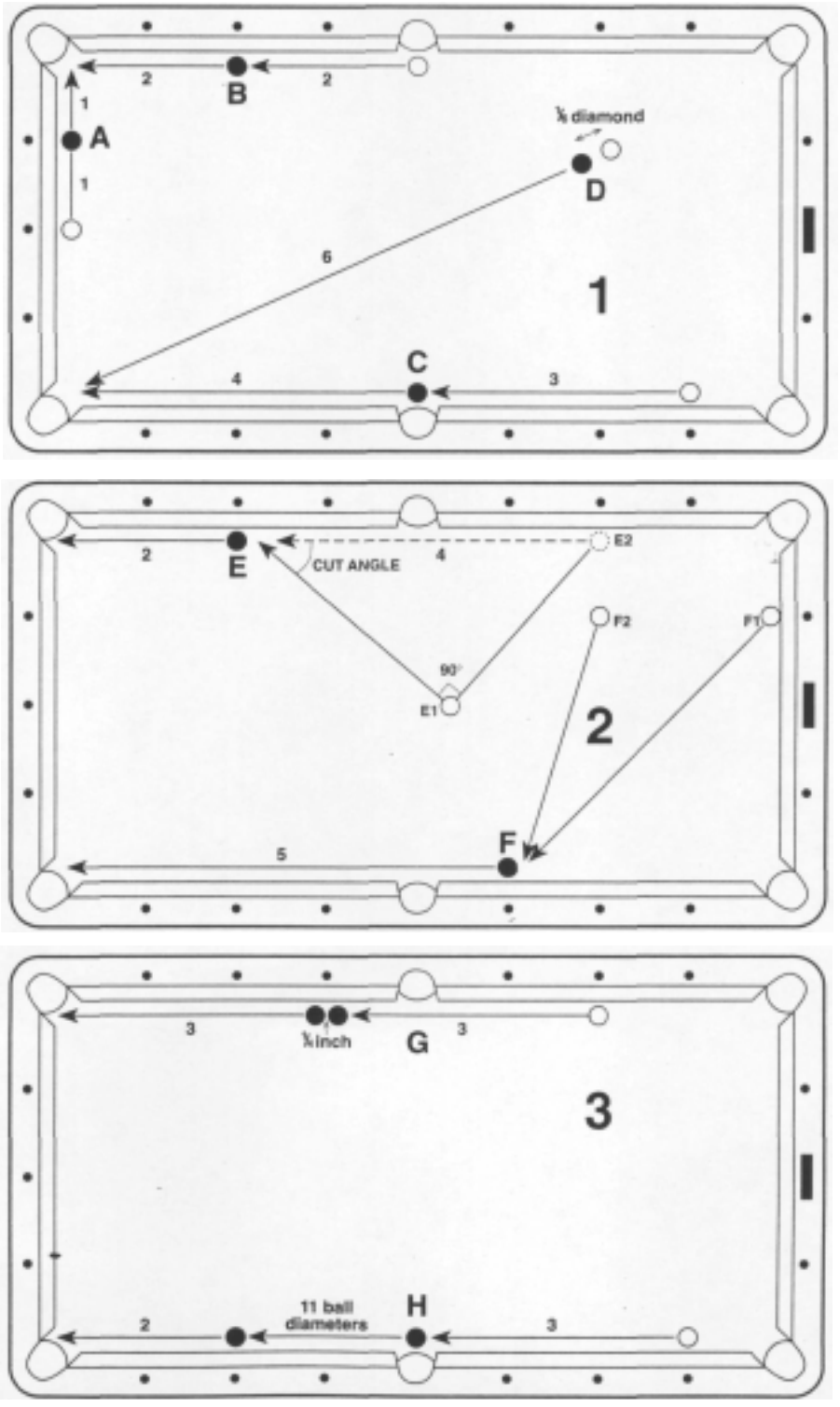
The basic difficulty of a shot is determined by two distances: how far the cue ball travels to the object ball and how far the object ball travels to the pocket. Let's measure these distances in diamonds. The difficulty on a straight shot is found by multiplying these two distances together.

Figure 1 has several examples. Shot A has each distance equal to one, so its difficulty is 1 = 1 x 1. Shot B has each distance equal to two for a difficulty of four. C, at 12 (3 x 4), starts to be tough enough you might look for another shot or safety.

This difficulty number tells you directly how accurate your mechanics have to be on the shot. Let's assume that your bridge hand is placed perfectly, and all the error is in where your grip hand is at the instant of tip-to-ball impact. Using similar triangles, typical pocket size, and average wing span, it turns out that the total "window" for your back hand to come through is just one over the difficulty factor, with the answer in inches. Shot C is a 12, so the window is only a twelfth of an inch wide, or a twenty-fourth of an inch to either side of perfect. The margin on shot A is much more comfortable: one inch total or half an inch to either side.

Shot D, with the cue ball only a ball diameter (about a sixth of a diamond) from the object ball is only a "one" but it looks a lot tougher. It illustrates the point that even though the total shot might be long, if either distance is very short, the shot is easy. The hardest shot for a given total length is when the object ball is about half way between the cue ball and the pocket, as in C.

How does a cut influence the difficulty of the shot? There is a simple way to construct the equivalent straight — in shot. In Shot E, draw the line from the cue ball to the object ball (El-E). Through the cue



ball, draw a line perpendicular to E1-E, and extend it until it meets the extended path of the object ball at E2. Shooting from E2 requires the same precision as from E1. The difficulty is 8 = 4 x 2.

Shots F1 and F2 are more difficult cuts. With graph paper or using the geometry of similar triangles, we can find that F1 has a difficulty of 30 while F2 is a 50.

Combinations are another complication that is easy to include in the calculation. Multiply the three lengths of travel together, but measure one of them in ball diameters. For example, in Shot G, the distance between the two object balls is only a quarter inch or a ninth of a ball diameter. That makes the shot a "one" (3 x 3 x ^{1}A = 1). Shot H, on the other hand, has the middle distance equal to 11 ball diameters (two diamonds) for a difficulty of 66. Combinations should be avoided unless one of the distances is small.

For bank shots or kick shots, just remember that the distance to use is the total length traveled by the cue or object ball. Not included are the effects of side spin (planned or accidental) and other facets of ball-rail interaction, which are sure to make the shot harder.

For most of the shots shown, the balls have been in positions that are easy to calculate. Real situations will either need a tape measure and a T-square or a little practice at guesstimation. Getting the distances within half a diamond is close enough for most purposes.

Besides allowing you to choose the easiest shot from several options, the difficulty factor is useful to measure position play and shot making ability. During a match, note the difficulty of each of your opponent's shots and note the ones he misses. Does he leave himself a lot of 2s and 3s, or is he stabbing at 15s and 20s? Does he usually miss anything tougher than a 10? Leave him 15s.

I recorded shot difficulties in seven matches at the 1976 World Open 14.1 Championships (the one in Asbury Park with the hurricane). Players like Mizerak, Crane, Rempe, Sigel and Fleming had average shots between 3.5 and 4. The best one-game average I recorded was 3.43 by Larry Lisciotti, who went on to win the tournament. If you want to measure yourself against this standard, videotape yourself in a match or train a practice buddy in difficulty estimation.

Test Time — The Answers

by BOB JEWETT

IN LAST DECEMBER'S issue, there was a quiz. Based on the questions to be used in the BCA's Instructor Certification Test, it really was a test of the test. Ten readers from four countries submitted answers. But before we announce the three winners of free subscriptions, here are a few answers — some of them mine and some supplied by the guinea pigs.

1. When a shot is played with side spin, several important effects are noticeable and may cause the shot to fail if not included in the planning for the shot. Name three of those effects, describe them and how you demonstrate them to students.

A: Squirt/deflection. At the moment the stick hits the ball, the cue ball moves away from tip, almost like a minor miscue. This can be demonstrated by placing the cue ball on the head spot, freezing an object ball to the far end rail, and using extreme English to hit rail first and play the object ball along the rail to the far corner pocket. If played fast with a level stick, the aim is to the wrong side of the object ball with a squirty stick.

Curve/swerve. The cue ball will curve on the way to the object ball. This is accentuated by shooting slow, with draw, plenty of English, and a slightly elevated stick. If the first demo is repeated with this stroke, the cue ball can land on the opposite side of the object ball.

Throw. When the cue ball contacts the object ball, the object ball doesn't travel along the line of centers (the line joining the centers of the two balls at the instant of contact), but moves to the side opposite the English. Place the cue ball about a ball diameter from an object ball and lined up to miss a far corner pocket by about half a diamond. Play straight at the object ball, but with English way out on the equator. The cue ball should stop in place, spinning, while the object ball will either find the hole or miss by a diamond.

Two other minor factors to consider on English shots are "cling" (or "skid") and miscues.

7. What conditions are necessary for the cue ball to stop dead at the instant it hits an object ball?

8. What additional condition is necessary for a stop shot (for the cue ball to remain in position after the instant of impact)?

9. Give three common things that cause the cue ball not to stop dead on a stop shot.

A: Judging from the submitted answers, these questions need to be worded more clearly. Question 9 asks only about the instant of the collision, and the requirements are that the cue ball hit the object ball squarely, and that the balls be of the same weight and of good elasticity, like new cast phenolic pool balls. For a stop shot, which concerns what the cue ball does after the instant of contact, the requirement of no follow or draw is added, and of course this probably means that the cue ball started with some draw. Common reasons that stop shots fail are that there is some cut angle, or some follow or draw, or the cue ball is in the air, or the cue ball is either light or heavy, or, as in the case of ivory, the balls are inelastic.

10. Describe the "ghost" or "phantom" ball aiming system.

11. What other systems give equivalent aiming lines?

12. For roughly what length of shot is the simple phantom ball system too inaccurate on a half-ball cut shot?

A: In the "phantom ball" system, you picture the "future" cue ball at the instant it contacts the object ball, with their line of centers going to the center of the pocket. Shoot to make the present cue ball take the place of that future cue ball. (As an aid to visualization, you can have an accomplice temporarily place an object ball in the place of the phantom cue ball.)

Other aiming systems that are equivalent — that would have you shoot the cue ball to exactly the same place but with different ways of seeing the shot — include the "inch and an eighth" system, where the target is one ball radius in front of the object ball, the parallel lines system in Mosconi's book "Winning Pocket Billiards", and the contact point system in the instruction section of the BCA Rule Book.

While these systems will get the ball somewhere close to the pocket, for shots of some length their neglect of throw renders them too inaccurate to pocket the ball. Question 12 asks at what length of shot does the system fail if it is executed with perfect accuracy and mechanics. The surprising answer is that even with generous pockets, the system starts failing for shots only a diamond and a half from the pocket.

16. In damp conditions or on dirty cloth, draw dissipates rapidly. Why?

A: About half of the respondents got this exactly backwards, saying that such conditions reduce friction. In fact, dirt, such as powder from chalk, and humidity *increase* the friction between the ball and the cloth, causing the draw to be rubbed off faster.

Here's a quick experiment you can try: wax the cue ball. I once asked a friend if he could make a length-of-the-table stop shot on old cloth. He kept drawing the cue ball back to the middle of the table until he realized that the secretly waxed cue ball was making the felt play like slippery new. Wax also helps when you're practicing masse shots on old cloth.

17. Describe aiming a half-ball shot. Neglecting throw, what is the cut angle for a half-ball shot?

A: This question tripped up most of those who tried it. They got the description right: the axis of the cue stick points through the center of the cue ball directly to the edge of the object ball. But they said it is a 45-degree cut when it is 30 degrees. (Imagine all three balls touching in a triangle, and recall isosceles triangles from high school geometry.) Including friction, the cut angle is slightly less than 30 degrees.

22. Approximately what fraction of pool balls are not within tolerance?

A: The allowed variation is five thousandths of an inch, and most pool balls fail. They're mostly OK fresh from the factory, but wear down in play and are illegally small within a year or two. This is most noticeable for the cue ball, which gets much more wear than any object ball. The common symptom is great draw but lousy follow, because the cue ball bounces back from the larger, heavier object balls.

The last half of the test was on the rules and their interpretation. Most people seem to get their rules by word of mouth, maybe from the old geezers down at Murphy's Bar. There are books on the rules of pool, and the one for this test was the *BCA Rules*

and Records Book. The rules have been in a state of flux for the last 20 years or so. The good news is that the BCA and the World Pool-Billiard Association have agreed to a five-year moratorium on significant changes. If you get a copy now, you'll be set into the next millennium.

30. Is a miscue a foul?

A: Maybe. On a jump shot any miscue is a foul, even if the other requirements of the shot are met. On other shots, miscues are not fouls, unless maybe the ferrule touches the cue ball on the miscue.

43. While playing a bank shot, the player places the chalk where he wants to hit on the rail, then shoots. Is that a foul?

A: This is slightly a trick question. In the *1993 Rule Book,* it was only forbidden by the general sanction against using equipment in an unusual manner. **In** the ***1994*** *Rule Book,* there is Rule 3.42, which reads in part, "Illegal Marking. If a player intentionally marks the table in any way... he has fouled."

And now for the judging. It was difficult to select the winners, since there were several sets of excellent answers, and it came down to the best extra credit questions. The winners were from three different countries. An outstanding set of answers was from Victor Maduro of Panama. Perhaps Victor should have been disqualified as a professional, since he co-authored *Bola 9,* an excellent book that covers a lot more than 9-ball. The other sets of winning answers were from Daniel Artiano of San Diego and Andy McLeod in Great Britain.

If you would like a list of the 53 questions with answers or at least pointers to where you can find the answers, send a large double-stan*ped envelope, or just three stamps, to Bob Jewett, 962 Stony Hill Road, Redwood City CA, 94061. Allow two weeks for delivery. If you have any more questions that would be good for the Instructor Certification Test, please send those too.

in a previous issue, I described "An Experiment in Curve," in which the goal was to make an object ball curve. No one submitted results, thus the prizes are unclaimed. After hours of experimentation myself, and discussion with experts in the field, I have come to the conclusion that it is not possible to make an object ball curve significantly. (See the original column for the restrictions.) If you have gotten the shot to work, let me know and I'll do my best to make you rich and famous.

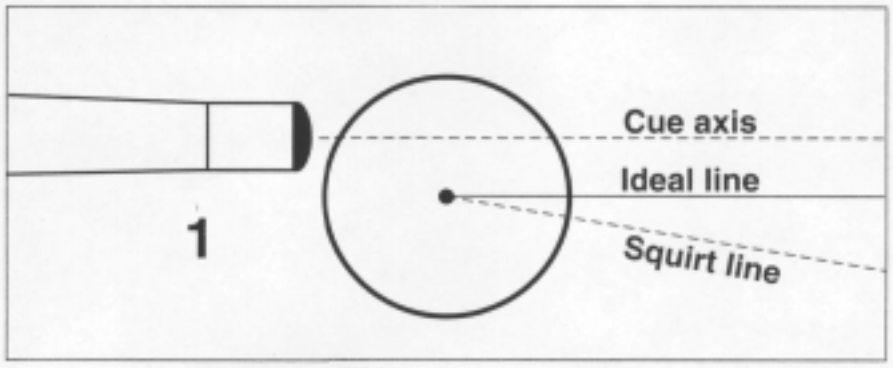
Bob Jewett is a Western Regional Director of the U.S. Billiard Association, and was the 1975 Intercollegiate Champion at 14.1.

Squirt Testing

by BOB JEWETT

IF YOU'RE A new player, this column may keep you from crippling your game permanently. If you're a veteran, it may show you why English shots have been so tough to master.

First the definition: when a cue ball is struck with side spin, the initial path is often assumed to be parallel to the axis of the cue stick. Instead, the cue ball starts off at an angle to the ideal line. That deviation or deflection from the ideal is called "squirt." See Figure 1.



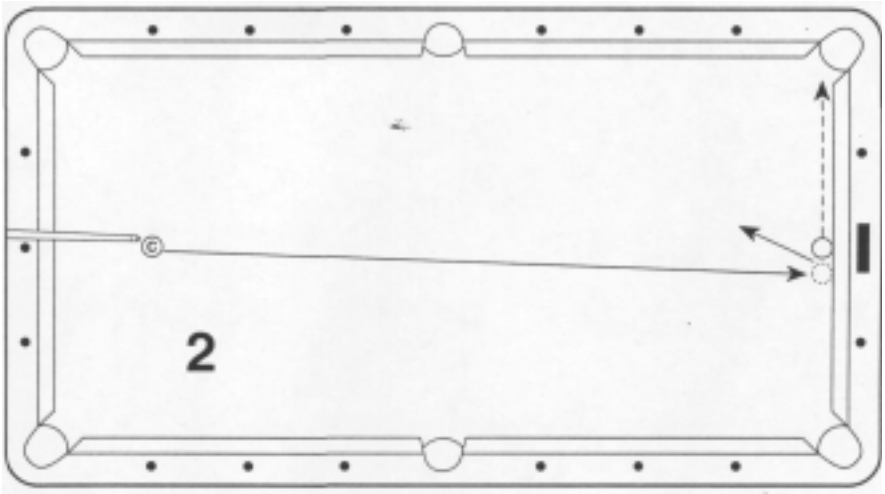
Squirt is the single most important characteristic of a cue stick. Less is better. More squirt means more aiming compensation on any shot with side spin. It is remarkable that many good players are unaware of the existence of squirt.

The amount of squirt depends mostly on the cue stick and the amount of English. Sometimes it appears as if a softer hit has less squirt, but this can be explained by the curve of the cue ball back towards the ideal line, due to spin on the ball. If the shot is played slowly enough, and with just a little cue elevation, it's possible to get the two effects to cancel. At any rate, more English gives more squirt.

Squirt also varies tremendously with the type of cue stick used, and most of the variation is from the shaft. All sticks I've seen have significant squirt, more than enough to cause a miss if not compensated for. The worst can deflect more than a ball and a half in a table length of travel. If side spin is an important part of your game, accurate compensation for squirt is a must for consistency.

Because I'm an engineer, as soon as I'm told a phenomenon exists, I want to measure it. It's hard to put a gauge on deflection, and no one is selling a squirtometer, but the following test will allow you to compare cues under extreme English conditions. There are several steps, each of which must be followed carefully. If you're not a "detail" person capable of careful observation, skip past this part.

Place the cue ball on the head spot.



Shoot along the main axis of the table over the foot spot to the middle of the foot rail with extreme left English, with the tip contacting the cue ball on the equator. You should be able to hit the left side rail near the side pocket. Remember to chalk. Play the shot with enough speed, so that the cue will hit the far rail a second time.

Once you are comfortable and consistent with spinning the ball that much, place an object ball frozen to the middle of the foot rail. Shoot the same extreme left English shot, trying to hit on the rail just barely to the right of the object ball and then spin into the ball. Hit correctly, the object ball will be pocketed in the corner. See Figure 2. If you miss the object ball entirely, the cue ball should still hit near the side pocket. Be sure on the final stroke that the stick comes straight through the cue ball without any curving to either side.

Now, note (or have a friend note) where your cue stick points on shots when the object ball is pocketed. If the stick points somewhere toward the object ball, it's pretty good. If the stick points to the wrong side of the object ball's origin (left side, from your viewpoint), it has too much squirt (deflection) to be usable. It is unlikely that the line of the stick will be parallel to the desired path of the cue ball. If that's the result you get, you're probably ignoring one of the cueing instructions above. If several cues are available, compare them.

If you do the squirt measurements, please drop me a note in care of this magazine. I'd like to know the amount of squirt and what kind of cue you are using.

Now that you know how important squirt is on spin shots, and are able to measure it at least crudely, I bet you'd like to know

what causes it. So would I. There are people who claim to understand squirt, but I've never seen an adequate explanation of why it occurs or what's necessary to minimize it. There are no clear causes or cures, but here are some additional observations that may suggest further experiments to you and things to seek or avoid:

I figured that a stiffer shaft would help, so I glued a tip to a solid aluminum rod with a %-inch diameter. The result was about three times more squirt than with any normal cue.

Jim Buss, a cue maker in Houston, sent me some special shafts with brass inserts in the first four inches, presumably increasing the stiffness there. These have almost as much squirt as the solid rod, and make an excellent demonstration of one of the perils of English for new students.

Joel Lehman, a fellow pool instructor from Oakland, got a 63-inch cue to match his height. It had a fairly flexible shaft and unusable squirt and had to be cut down.

Cues with small tips and tapers that start increasing near the tip are often more than twice as good as so-called "pro" taper shafts, which start with a larger diameter tip and stay that same diameter for the first 12 inches or so from the ferrule. Some cue makers offer a taper between the two. nearly cylindrical for the first six to eight inches, before the major flare starts building out to the joint. The idea is to give most of the ease of stroke of the cylindrical taper, yet maintain reasonable accuracy when using sidespin.

An aiming technique has been developed to achieve approximate compensation. It is an old technique that I call "aim and pivot." First aim the shot without English; for example, a full ball hit on an object ball two diamonds away. Now, without moving your bridge hand, pivot the stick to hit the cue ball with side spin, and shoot firmly. With luck, you'll hit the object ball full. A little thought will convince you that the pivoting is in the right direction to compensate for the squirt. Unfortunately, the amount of compensation depends on the length of your bridge, which will have to vary from six to 20 inches, depending on the stick. Another factor is the speed of the shot, since a slow shot allows the cue ball to curve back towards the ideal path.

There is only one way to avoid squirt completely, and that is to stay on the cue ball's vertical axis. Most players prefer to use English, at least occasionally. If you're one of them, you've got to learn to compensate for squirt.

Bob Jewett is an engineer at Hewlett Packard and a former ACU-I straight-pool champion.

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TECH TALK

Bytes & Billiards

by BOB JEWETT

COMPUTERS ARE EVERYWHERE these days. They started their invasion of pool halls as fancy cash registers, a position they have strengthened by evolving into indispensable accountants with graphical displays, programmable rate schedules, and more features than we old-time card stampers can understand. They are now advancing on the pool world on several other fronts.

The Information Super Highway has been much in the news, usually in the future tense. For more than 30,000 pool, snooker and billiard fans, it is already a main source of information about cue sports. A sort of electronic bulletin board going by the name "alt.sport.pool" flashes billiard news, questions and answers around the world at the speed of light.

Access to this paper-less magazine is free for many people with computer accounts at schools or at companies that connect to the "Internet." There are also commercial services which provide a connection to anyone with a suitable home computer. For a few dollars a month, you can exchange messages not only with billiard nuts, but also with aficionados of scuba diving, cactus raising, and several thousand other interests.

The pool discussion group has far more readers than writers. In the past month, 80 authors have put fingers to keyboard to generate 300 messages on such diverse topics as Earl Strickland's break shot, the proposed rewrite of snooker rules by the WPBSA, "Willie Hoppe" cue sticks and Panamanian 10-ball. Rules and playing techniques spark very fervent discussions, and the intensity with which some people expound their beliefs can be startling to the uninitiated. While most contributors are from the United States, you will also see comments from Belgium, India, Poland, South Africa, and over a dozen other countries.

Not only is pool being discussed across the network, it is being played! Sven Davies of the United States and **Jari** Kokko of Finland have organized a team competition called Internet Equal Offense. At a designated time, each of several five-player teams, perhaps from different continents, goes to their home pool hall and connects to a local computer center by modem. A connection is made through the Internet to a computer in Finland that runs a Scoreboard program. As each member of each team plays an inning of equal offense, the score is forwarded to Finland and immediately appears on the screens at all the tournament sites.

(Equal offense is played like straight pool and scored like bowling, so face-to-face competition is not necessary. The maximum score in an inning is 20 points, and each player gets ten innings. See the BCA rule book for the details.)

To date there have been four tournaments, at about four-month intervals. The most recent competition was in May with teams entered from Finland, Utah and California. The Californians were victorious in their IEO debut with a combined score of 542 out of a maximum of 1000. The September tourney will include a team from Iowa City that is rumored to be very strong.

If you are interested in participating in a future IEO event, send electronic mail to:

jari.kokko@hut.fi or
stdavies@blue.weeg.uiowa.edu.

If you don't have e-mail yet, send me a note and I'll forward you some more information on that old-fashioned medium, paper.

If you are already connected to the Internet, and know about the interactive information-grabbing program Mosaic, you should try connecting to the computer tky.hut.fi in Finland. The connection point is http://www.tky.hut.fi/~sbo/. It has several documents on line including a round-by-round commentary on the 1994 Embassy World Professional Snooker Championships.

Next time, I'll compare several pool and billiard simulator programs. Some of them have developed beyond mere toys and are realistic enough to be valuable learning aids.

Bob Jewett is an engineer at Hewlett-Packard, and a former ACU-I billiard champion. He can be contacted directly at his Internet address: jewett@hpl.hp.com.

Bytes and Billiards II

by BOB JEWETT

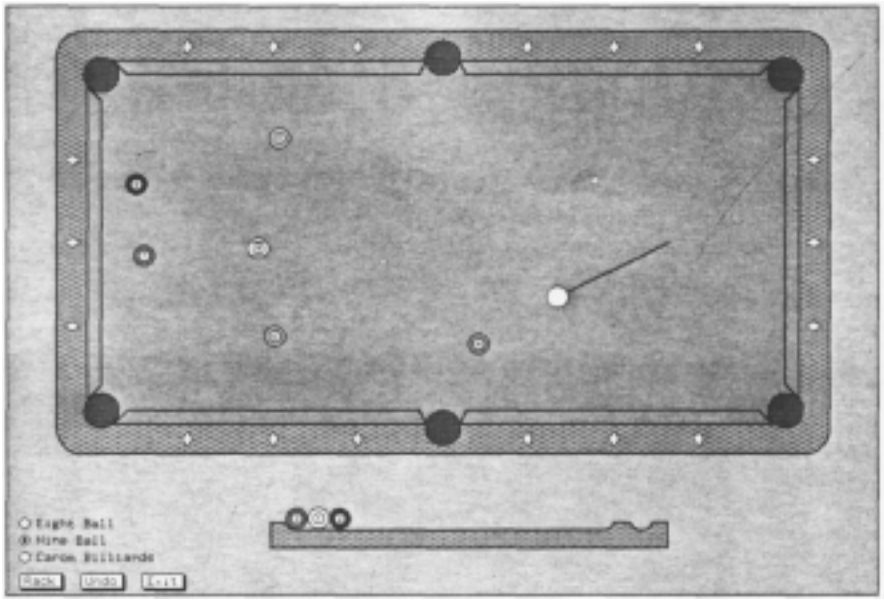
WILL THE COMPUTER screen replace the baize-covered table as the preferred venue for billiard competition? The idea is not as far-fetched as some might hope — look how quickly chess-playing computers have surpassed all but a handful of human players. Computer networks already flash scores between equal offense competitors on different continents.

High-resolution computer graphics combined with the amazing computing power found even in many home computers have already resulted in some entertaining and educational programs. In this column, I'll describe two quite different programs that simulate colored spheres on green cloth. In a future column, I'll review the features of a dozen or so programs now available for personal computers.

The guts of any pool program is the part that calculates the paths of the balls when set in motion by the cue stick. None of the programs available take into account all the minor details, but some are complete enough to have masse and jump shots. Others omit basics like side spin — such a program might be fun, but you can't learn much about banking when all the balls reflect perfectly from the rails. Especially important are the mechanics of aiming and choosing speed and English. This aspect is as important as the physics content.

The diagram shows the screen for the program Xpool by Charles Bulkeley, that runs on Unix workstations with X11 Windows. A game of 9-ball is in progress. To shoot the 4 in the side, the mouse has been clicked to create the line coming out of the cue ball. This line represents the cue stick. A shorter line gives a softer shot. The mouse is adjusted until the speed and angle look right, then the button is released to shoot.

Some other features of Xpool are visible in the figure. The pocketed balls below the table can be spotted by clicking on them, and any ball can be repositioned with the mouse. If you don't like the way a shot came out, you can "undo" it and try again. Eight-ball and carom billiards are also available.



Xpool lacks several important features. There is no spin — no English, no draw, no follow. The balls move like hockey pucks and rebound perfectly from the rails. The aiming method is crude; attempted thin hits often miss the object ball. Even with these faults, Xpool is reasonably entertaining; just don't expect to learn much about real pool from it.

There is another billiard program called Xpool. This second Xpool comes in a version for the Microsoft Windows platform called Winpool. The two Xpool's and Winpool are "shareware," which means that the author requests a donation.

For serious students of the game, the program Carom Simulator for Microsoft DOS systems is far more realistic. A fairly new product, it was being demonstrated at the 1994 BCA Trade Show by Hans de Jager, a world-class Artistic Billiards player. As the name of the program suggests, the table won't have pockets. What you will get are calibrated numerical settings for speed, aim, spin and elevation.

Aim is set in two ways. First there is a phantom cue ball that is set on the table anywhere along the line of aim. The exact location is shown numerically to allow very fine adjustment. A separate small aiming window shows the "tip's eye view" of the overlap of the cue ball on the object ball with calibration marks.

Spin is set by moving a small blue dot around on the cue ball in the aiming window. A numerical readout shows how eccentric the hit is, both up/down and right/left, and if you exceed the safe limit of spin, the computer beeps at you, signaling an impending miscue.

Elevation is set by rotating a small cue stick in the aiming window. A slider with a numerical readout sets the speed.

One very nice feature of the the program is its ability to save table positions to be recalled by the name of the shot. The installation includes all the shots from the Artistic Billiard competition and an automatic mode that demonstrates each shot, showing power draws, jumps, masses and kiss-backs.

A "try again" feature makes it easy to explore variations. A little more speed might lengthen an angle on one shot, while adding draw and English to another might avoid a kiss. The high quality of the simulation and the precise control of the parameters make the results useful.

The bad news is that Carom Simulator costs real money — $149 list. Write to European Billiard Products, 1406 Sycamore Drive, Simi Valley, CA, 93065 for more information.

Bob Jewett (Internet: jewett@hpl.hp.com) is a former ACU-1 billiard champion and is now an engineer at Hewlett-Packard.