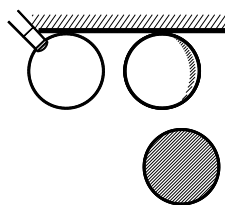
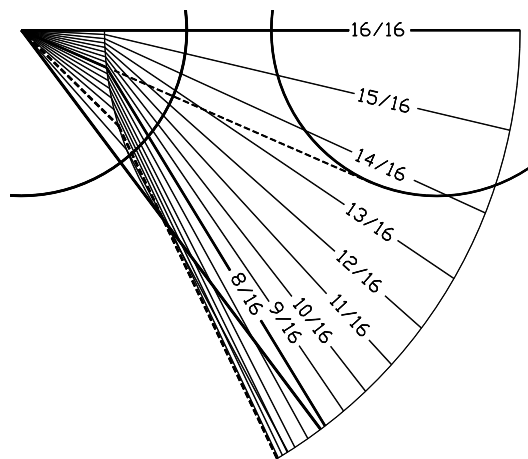


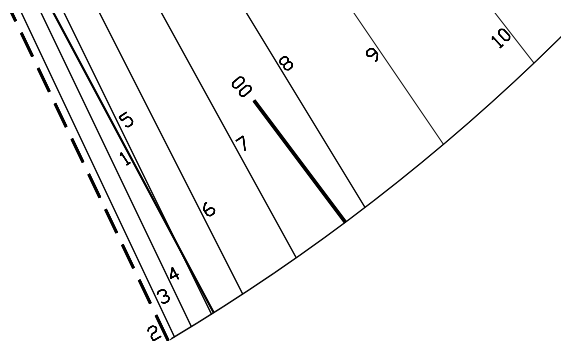
# SHORTSIGHTED CANNONS



**SHORTSIGHTED 1** The qball iz a ¼ ball from the yellow. The question iz.... Which aim on yellow gives the widest angle? Most players would elect to aim a thick half-ball on yellow (9/16ths), koz they think that this gives them the widest deflection angle for their long-range loozers. But, the contact giving the widest deflexion-angle for this short-range cannon iz 2/16ths.



**SHORTSIGHTED 2** Here iz the qball's theoretical deflexion for each of 17 contacts on yellow, ie from 0/16ths to 16/16ths. Shown, the half-ball (8/16) contact gives a wider angle than the thick half-ball (9/16). The widest angle (bottom broken line) belongs to the 2/16ths contact.



**SHORTSIGHTED 3** We hav zoomed in. The widest angle (broken line) belongs to the 2/16ths contact. In fact, the widest angle iz enjoyed by an 8.5/64ths contact. And all contacts finer than half-ball giv a wider angle than the half-ball angle. The 00 iz the line for 0/16ths, ie a near miss. This must be hard to believe for a dyed-in-the-wool loozer. She thinks that the largest deviation angle iz the thick half-ball, & that all other contacts giv a thinner deviation angle. This might be correct, depending on how u define deviation angle. It's nearly all explained in a later section called MAXIMUM DEFLEXION ANGLE. The following extract iz interesting.

*I know that up to now we hav mainly been talking about Maximum Deflexion Angles, but the angles are of little interest. What are of interest are the Maximum Deflexion Contacts giving the Maximum Deflexion Angles. When u aim u aim for a contact, eg half-ball, it iz the contact that iz meeningful to a player. The Maximum Deflexion Contacts were az follows.*

| Range to third ball | Zero  | ½ ball  | 1 ball  | 2 ball  | 4m    |
|---------------------|-------|---------|---------|---------|-------|
| Separation ¼ ball   | 8/64  | 8.9/64  | 9.5/64  | 10/64   | 11/64 |
| Separation ½ ball   | 10/64 | 12.6/64 | 16.9/64 | 19/64   | 21/64 |
| Separation 1 ball   | 12/64 | 20.9/64 | 22/64   | 23/64   | 24/64 |
| Separation 2 ball   | 16/64 | 22.8/64 | 24.3/64 | 25.2/64 | 27/64 |
| Separation 4 ball   | 20/64 | 24/64   | 25.6/64 | 26.7/64 | 29/64 |

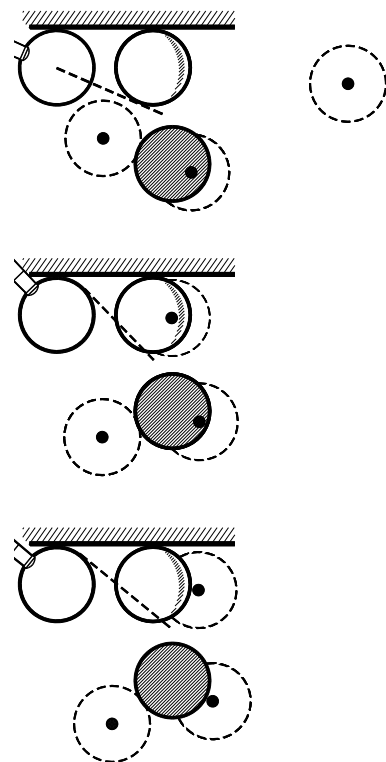
*Az karn't be seen, when the separation between qbball & yellow iz not large, the old red-ball player's thick half-ball iz worse than useless. A thick half-ball would be getting a lot less Deflexion Angle, not more. None of the above contacts giving maximum Deflexion Angle came within a bull's roar of 32/64 (half-ball), not even for a range of 4000mm (a large billiard table iz only 3600mm long). For a separation (distance between qbball & yellow) of a ½ ball & a range (distance between yellow & red) of ½ a ball, which would be commonplace in a run of nursery cannonz, the maximum Deflexion Angle iz obtained with a 12.6/64 contact, which iz below a quarter-ball (16/64), & miles below a half-ball (32/64).*

## WHICH AIM GIVS WIDEST

**SHORTSIGHTED 4 HALF-BALL** Here iz what happens in Deflexion 1 when we hit the yellow half-ball (32/64). The leev iz very bad (broken ballz). The leev for a thick half-ball (say 36/64) would hav been even worse.

**SHORTSIGHTED 5 EIGHTH-BALL** Here we hav hit the yellow an eighth ball (8/64ths), ie the contact giving the maximum deflexion angle. The leev iz ok-ish. (Actually, according to the chart, between 8/64 & 8.9/64 givs the maximum).

**SHORTSIGHTED 6 QUARTER-BALL** But (az shown) the best rezult & leev iz gotten by hitting the yellow a quarter-ball (16/64) az shown. A quarter-ball duznt giv the widest deflexion angle but in this instance it more than makes up for this by bumping the yellow to good pozzy further east. Nothings ever simple, iz it. Funny stuff for us red-ball players. We have a lot to unlearn. In reality, here in 6, u might uze some swerv, & get a better pozzy (not shown).



## WHICH AIM GIVS NARROWEST

**SHORTSIGHTED 7 SHORT-SIGHTED** And this deflexion angle paradox kan work the other way. Here in 7 we need a narrow deflexion angle to score the cannon.

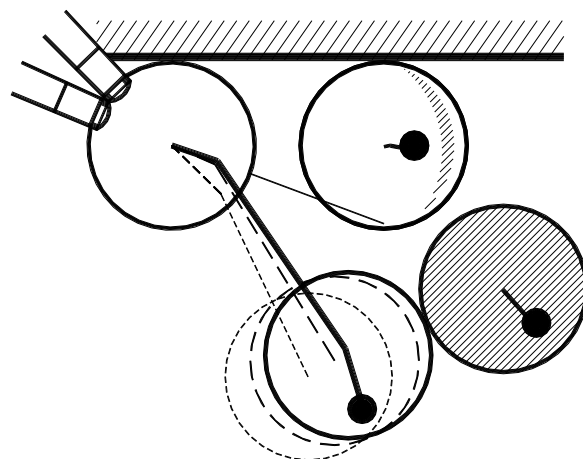
**THICK 1/2 BALL** Az shown the cannon iz possible if we hit the yellow a thick half-ball. The qball contacts the red az shown by the solid ball. Here, for simplicity, we ignore the fact that the red iz actually bumped out a little by the yellow before the cannon iz made.

**HALF BALL** The first broken ball shows the rezult of hitting the yellow half-ball. Az shown, the qball would miss the red.

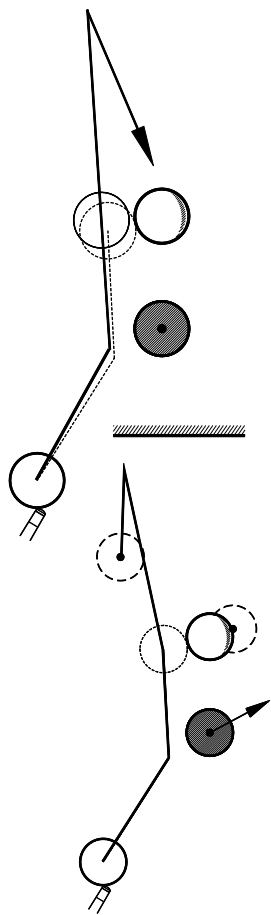
**QUARTER BALL** The dotty ball shows the rezult of hitting the yellow a quarter-ball. Az shown the qball would miss the red by a mile.

**OPTICAL ILLUZION** Most players would feel that a thick half-ball would hav no chance of making the cannon. This iz an optical illuzion stemming from years of playing medium-range & long-range loozers. We all judge deflexion angles from the outside of the yellow, but in fact the qball always starts its journey from a point inside the yellow, uzually well inside. Even for the thinnest contacts, the qball starts its journey inside the edge of the yellow.

**SHORT SIGHTED** There iz one more effect happening here. Koz of the close-range, the aim moovs further around a large amount for each 1/16th increment of contact. The deviation angle for each 1/16th increment of contact iz the same anywhere on the table, & for all ranges. But, when u compare one contact with another u havta add (or subtract) the extra angle due to the different line of aim. At longer ranges it makes little difference, but at very short-range it makes all the difference. See what i meen? Geza Gazdag would say that the qball iz short-sighted. This kums in usefull when playing ThickAlongs. This iz explained in a later section.... MAXIMUM DEFLEXION ANGLE.



## RELOADING YELLOW



**SHORTSIGHTED 8A** Here we have a promising floating-yellow pozzy. We play a cushion-cannon with rhs (az shown) to bump the yellow closer to the spot to re-load the yellow. But if u kan see too much of the yellow then this stroke iz risky, u might accidentally touch the yellow on the way past (not shown), in which case the qball might stop just west of the yellow (not shown), giving a cover for the pot-red. If u are worryd about the accidental touch on yellow, u might play a thick run-throo red (not shown), landing softly full on yellow, & wait for a better pozzy to re-load the yellow later. U decide to try the cushion cannon, to re-load the yellow. Being a red-ball player, u are tempted to aim a thick half-ball on red, to make sure u don't touch yellow on the way past. But, a thick half-ball will actually make sure u touch the silly looking yellow, this iz shown by the broken line & broken ball. Koz, in the pozzy shown in 8A, the maximum deflexion angle iz gotten from a 3/8th contact on red, shown by the solid line & solid ball. Hard to believe iznt it? The closer-in the qball then the more the need for care.

**SHORTSIGHTED 8B** The best option iz to play thick half-ball on red, slower, to push the yellow a little east az shown. This eastern pozzy iz better for a big floating-yellow break, & its better for a nursery-gather too. While we are uzing Krappamyths, better uze check-side. Clark McConachy launched this form of floating-white on the public in 1925 (but with the white east of the spot). Macka called it a moovment of 10. Somehow Murt thort that Murt invented the moovment-of-ten. Not so, unless it woz Murt who showed it to Macka.

## ANGLES & CONTACTS

There are lots of angles & contacts that we could talk about in a billiard ball impact, which i don't really want to koz things get complicated enuff az it iz, but praps it will help to hav a good squiz at the territory. There are no standard names for angles etc, anyone kan uze any name they wish. I looked at deviation angle, deflection angle, deflexion angle, divergence angle, diverzion angle etc. The following angles contacts & names might kum up. **SEPARATION** the distance between the qball & the first object-ball. **RANGE** the distance that the qball needz to travel to reach the second object-ball after hitting the first object-ball. **THE CONTACT ANGLE** this iz the angle of the line joining the center of the qball & the center of the object-ball during impact, the angle being mezured from the pre-impact line of travel of the qball. **THE INITIAL CONTACT ANGLE** when the qball first touches the stationary object-ball, which for a half-ball aim would be  $30^\circ$ . **THE FINAL CONTACT ANGLE** when the qball last touches the object-ball, which for a half-ball aim could be say  $31^\circ$ , the object-ball at this time having its maximum velocity. **THE AVERAGE CONTACT ANGLE** the ave of the initial & final contact angles, which for the above half-ball contact would be  $30.5^\circ$ . **THE EFFECTIVE CONTACT ANGLE** this iz possibly the same az the average contact angle, it iz the angle the object-ball would travel at if there were no ball-to-ball friktion. **THE DEVIATION ANGLE** being the angle between the qball's pre-impakt & post-impakt lines of travel. Earlyer we mentioned 5 tyeps of deviation angle. **THE INITIAL DEVIATION ANGLE** the deviation angle at the instant that impact ends. It iz the largest deviation angle for that particular impact event, ie before initial swerv starts. For the above half-ball contact it would potentially be  $59.5^\circ$ , but in fact it would be say  $56.75^\circ$  due to the fact that impacts are not Perfiktly Elastic. **PERFIKTLY ELASTIC** I apologize for uzing this silly name, unfortunately it haz found widespread use & no doubt it haz allready led to many stuff-ups. Teachers tell skoolkids that if an impact iz perfiktly elastik there iz zero energy loss, which iz ok. But it creates a false pikture in a kid'z mind. Imagin a ball bouncing off a wall, befor it hits the wall the ball iz floating happily throo the air, all of its muscles are very still & relaxed. After it bounces off, the ball's length & width are changing continuously, & not necessarily in phase, its muscles are anything but still &

relaxed, there iz lots of momentum trapped in this ringing. And, no matter how elastik a ball etc might be, u kan never eliminate some of such ringing, even if the ball iz perfiktly elastik. Or put another way, u might be able to make a ball that iz nearly perfiktly elastik, but u will never get very close to making an impakt that iz nearly perfiktly elastic, hence the use of the word elastik iz bad for bizzness, the bizzness of teaching kids. Why not uze terms like **COEFFICIENT OF IMPAKT**, **COMPOSIT COEFFICIENT OF IMPAKT**, **COEFFICIENT OF BALL-BOUNCE**. **THE FINAL DEVIATION ANGLE** the deviation angle the qball would hav if it never stopped, ie at infinity, or more simply the line of travel of the qball after skidding stops ie after the initial swerv ends. This iz Hemming's deviation angle. **THE AIM ANGLE** the angle between the aim-line (the pre-impact line of travel of the qball) & the ball-to-ball-line (the line joining the centers of qball & object-ball before the shot). The aim angle iz fixed for any one impact. It will be larger for wider contacts on the red, & larger when the qball iz closer to the object-ball, it iz zero when aiming full-ball on the object-ball. **THE DEFLEXION ANGLE** the Deviation Angle plus Aim Angle. It uzually dekreeces az the range inkreeces, if the qball haz topspin. **THE MAXIMUM DEFLEXION CONTACT** the contact on red that will giv the largest Deflexion Angle u kan get for the shot facing you. It iz always (xcept for extreme forcers) in the range zero to a thick half-ball, ie 0/64ths to say 35/64ths. Az uzual we are ignoring screw & side, & the extra width u get if u belt the ball really really hard. **THE MAXIMUM DEFLEXION ANGLE** the Deflexion Angle u get when the contact iz the maximum deflexion contact.

## DEVIATION ANGLES

The next problem iz that we havtahav some sort of accurate deviation angles to start with, to help calculate the theoretical Deflexion Angles. **SKOOLKID** We could do a skoolkid type of analysis. We could calculate theoretical deviation angles uzing conservation of whatever uzing zero losses or whatever, ie zero impact loss, zero friktion loss, zero skidding friktion loss, zero curve, zero swerv. **ARITHMETICALLY TREATED** Actually, i reckon that our skoolkid would hav mission impossible. That's why i am doing it the eezy & accurate way, the Billiards Arithmetically Treated way. **MIDSPOT LOOZERS** Anyhow, i already have my old deviation angle rezults that i mentioned earlyer, for midSpot loozers, so the eezy way out iz to uze theze rezults. The Deflexion Angles are only going to be for soft shots, so i reckon my deviation angles will be ok. They wouldn't be any good for high-speed short-range shots, they would under-estimate the curved contributions. But, at slow speed, i reckon that the curved bits i had for the long loozers would be near'nuff in proportion to the curved bits uget for soft shots. I could add that the deviation angles for slowish shots would be larger koz the stun-throo iz less %wize than at the higher speeds that i uzed in the center-spot tests (stun-throo iz the qballs speed after a stun-impact, ie when the qball haz no initial topspin, it iz about 1% at nursery cannon speeds & about 3% at center-spot loozer speeds). And larger koz the ball-to-ball friktion (slippage actually) losses at low speed are larger due to the larger impact times. This iz complicated, but it iz the topspin energy that suffers most, hence a larger deviation angle, the ball-to-ball slippage energy loss at nursery cannon speeds iz about 5% of total pre-impact energy & at center-spot loozer speeds it iz about 2%, i always try to uze momentum for all my calculations & rarely havta uze energy but here i had no choice. **NAPKURV** But, az we are mainly talking about cannons on the top-cushion, the deviation angle would also be diminished, diminished by the napkurv due to the induced rhs (balls travelling against the nap kurv left if having rhs). And diminished due to the larger % wize Janus Cloth Effect. **JANUS CLOTH EFFECT** When there iz no nap, & when there iz nap, the Janus Cloth Effect trys to make the ball kurv left if having rhs, due to the changing footprint shape etc az the ball slows, this & the earlyer stuff are all fully explained in Billiards Arithmetically Treated, & mentioned in Chapter 65 (DriftKurv). In any case, whether larger or smaller, the deviation angles would all be larger or smaller in ruffly the same proportions (i almost sed degree), so it duznt make much difference. I am happy to uze my midSpot rezults.

## MIDSPOT LOOZERS

The deviation angles i am gonna uze are the ones i mezured for loozers off the midSpot, az follows. The first column iz the contact in 64ths (16 iz quarter-ball). In the second column 0.25 iz quarter-ball. The third column iz the deviation angle (degrees).

## CALCULATION OF DEFLEXION

**DRAWINGS** The eezyst & most accurate way to do the calculations woz to do accurate drawings of the two balls (the qball & the red), showing the qball trajectory before & after hitting the red. **TRAJECTORYS** I did a trajectory for each 1/64th contact. To save time, i woz able to get away with doing only say 10 trajectory (instead of 64) for each drawing. So it's just simple geometry really. When i sed the eezyst way, i should have sed the only way, i karnt imagin anyone having the time to set up some sort of computer program to do any of this properly, u will see what i meen. **SEPARATIONS** I did five drawings, uzing AutoCAD (which duz very accurate drawings). One with the qball attacking the red from a separation of  $\frac{1}{4}$  ball, then from a  $\frac{1}{2}$  ball, then from 1 ball, then from 2 balls, & lastly from 4 balls. I woz only interested in the maximum trajectory for each of the five cases, so this made things eezyer. But not az eezy az u might think. Koz, there's one more little problem with Deflexion Angles. **RANGE** The maximum Deflexion Angle for any one separation depends not only on the separation to the red, it also depends on the range to the yellow. And this iz not koz of the strength of the shot, we all know that strength affects the angle koz of the larger kurv. No, the drawings deal with soft shots with almost zero kurv. **GAIN** It's like this.... one part of the reason(s) iz that when u change your aim from say half-ball to say quarter-ball, u immediately gain a few mm of width in your shot due to the new contact point on the red. Know what i meen? The size of the gain iz of no real use, but i will giv it here just to emphasis my point. Theze are the gains u get by re-aiming from half-ball to quarter-ball.

|            |                    |                    |        |        |
|------------|--------------------|--------------------|--------|--------|
| Separation | $\frac{1}{4}$ ball | $\frac{1}{2}$ ball | 1 ball | 2 ball |
| Gain       | 1.38mm             | 2.27mm             | 3.35mm | 4.43mm |

**HALF BALL** The other part of the reason(s) iz that contacts less than half-ball always giv a narrower deviation angle. So, let's compare a half-ball trajectory to a quarter-ball trajectory. **QUARTER BALL** The quarter-ball trajectory haz a wider contact on the red, but haz a narrower deviation angle. The half-ball trajectory haz a narrower contact on red, but haz a wider deviation angle. **CROSSING TRAJECTORYS** Somewhere down the range the two trajectory might cross. Whether they cross depends on the initial separation between the qball & red. For a small (quarter-ball) separation theze two trajectory do not cross, but for a two-ball separation they do cross. This meens that before the crossing-point the quarter-ball contact givz the wider Deflexion Angle, but after the xing point the half-ball contact givs the wider rezult. **CONTACTS** So, i drew accurate trajectory for each 1/64th contact. Then i inspected the trajectory to see which trajectory (& contact) gave the widest Deflexion Angles at varyus ranges, viz Zero, quarter-ball, half-ball, one ball, two balls, & four balls. **EXAMPLE** Take a hypothetical example. Say that in one drawing, a 7/64th contact iz the winner at zero range (1mm), & a 12/64th contact iz the winner at long range (4000mm). **DAY IN THE SUN** U will find that in this drawing 8/64ths, 9/64ths, 10/64ths, & 11/64ths contacts all have their day in the sun, somewhere in between, & in that order.

## MAXIMUM DEFLEXION CONTACTS

I know that up to now we hav mainly been talking about Maximum Deflexion Angles, but now that i hav got the rezults i am not going to givem to you, koz the angles are of little interest. What are of interest are the Maximum Deflexion Contacts giving the Maximum Deflexion Angles. When u aim u aim for a contact, eg half-ball, it iz the contact that iz meeningful to a player. **CONTACTS** The Maximum Deflexion Contacts were az follows. Theze are partly theoretical, koz they are based on drawings of the balls & trajectory. But they are also partly empirical, koz the deviation angles i uzed

in the drawings are based on actual measurements (albeit for longer range loozers hit at medium pace). Here they are, hav a good look koz a lot of effort & a little thinking went into theze.

| Range to third ball | Zero  | ½ ball  | 1 ball  | 2 ball  | 4m    |
|---------------------|-------|---------|---------|---------|-------|
| Separation ¼ ball   | 8/64  | 8.9/64  | 9.5/64  | 10/64   | 11/64 |
| Separation ½ ball   | 10/64 | 12.6/64 | 16.9/64 | 19/64   | 21/64 |
| Separation 1 ball   | 12/64 | 20.9/64 | 22/64   | 23/64   | 24/64 |
| Separation 2 ball   | 16/64 | 22.8/64 | 24.3/64 | 25.2/64 | 27/64 |
| Separation 4 ball   | 20/64 | 24/64   | 25.6/64 | 26.7/64 | 29/64 |

**THICK HALF BALL** Az karnt be seen, when the separation between qball & first object-ball iz not large, the old red-ball player's thick half-ball iz worse than useless. A thick half-ball would be getting a lot less Deflexion Angle, not more. None of the above contacts giving maximum Deflexion Angle came within a bull's roar of 32/64 (half-ball), not even for a range of 4000mm (a large billiard table iz only 3600mm long). When i say a range of 4000mm i meen when the trajectory for a soft shot iz extended out to a distance of 4000mm, a real shot would have to be hit hardish to get to 4000mm & so would have a wider initial curve & so a wider Deflexion Angle. **QUARTER BALL** For a separation of a ½ ball & a range of ½ a ball, which would be commonplace in a run of nursery cannons, the maximum Deflexion Angle iz obtained with a 12.6/64 contact, which iz below a quarter-ball (16/64), & miles below a half-ball (32/64). **TRICKY** Actually, this contact (12.6/64) for this separation (1/2 ball) & this range (1/2 ball), takes the prize for trickyness. If u look at the graph of theze rezults this point iz comparatively lower than all the others, it looks like a mistake, but it's not, i triple checked my drawing etc, all the points look lowish but this one iz super-low alltho it's not obvious from just looking at the above table. **NURSERYYS** And this (1/2 ball) iz the separation & range u get most of the time when u are nursing. So, if u wanna maximize the Deflexion Angle aim less than quarter-ball.

## SIDE-SPIN

**WARNING** A word of warning about side-spin. Its worth repeating what my other articles say about side-spin. Side spin duz not affect deviation angles very much (so Riso Levi got something right after all). **CHECK-SIDE** reduces the deviation angle just a bit, & running-side just a very little bit, both a lot less than what the old red-ball player thinks. Here i am referring to half-ball contacts & contacts not far off half-ball. Check-side & running-side kan have a substantial effect at contacts much thicker than half-ball, but little at a half-ball & almost zero at quarter-ball (see other articles). **SWERV** What the old red-ball player duzn't realize iz that when she plays a long shot with lots of side she uzually gets a lot of swerv (due to the masse effect of hitting downish) & a lot of kurv (due to the effect of the nap), & swerv & kurv do not affect deviation angle, but they do affect Deflexion Angle (& i kan add that deviation angle affects Deflexion Angle). Swerv/Kurv changes the attack angle of the qball onto the red, & hence changes the Deflexion Angle, but it duz nothing to the deviation angle. What this means iz that if u want to increase or decrease the Deflexion Angle when playing short range cannons at nurseryys or at tott, its no good relying on side-spin if the contact iz a half-ball or less (it might be ok if the contact iz much thicker than half-ball). So, u havta raize the butt of the cue & make sure u get some swerv (u won't get any nap-kurv at short range). **SHORT RANGE SWERV** In fact that iz one good thing about short-range shots, it iz so eezy to get a lot of swerv, softly & reliably. This iz unlike long range shots where u karnt afford to try to get much swerv (its too inaccurate) & u havta rely on napkurv which iz very little & then only if u are shooting up the table (with the nap). **RAIZE THE BUTT** What this means iz that when u are playing nurseryys or tott get used to raizing the butt of the cue, to change Deflexion Angle, it will reward u heaps. And don't try to do the impossible by uzing side to change the Deflexion Angle for half-ball or quarter-ball contacts, it will stuff u up heaps. **MAXIMUM DEFLEXION ANGLE** But the main outkum of this article iz that the thick half-ball rarely givs u the maximum Deflexion Angle... when the qball iz close to the first object-ball the maximum might kum from a quarter-ball contact or even less. So its back to our nurseryys & tott & let's see how we go this time.