Back to the Future?

"Or, how did we get here, and where are we?"

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Once again, we hear the thundering roar of a firearm, see the belching cloud of sulphurous smoke and hear the telltale metallic "ding' of a selected target being scored as a hit. Yes, the description of a black powder shooter at a Cowboy Action Shooting event. With the growth of Cowboy Action shooting has come resurgence for authenticity and, for some, a real identification with what was 'real' in the 1870's. That means Black Powder and real lead bullets with soft lube that will work. For others it is merely having the right stuff for the best performance in their smokeless loads. But, how is it that we are finally experiencing, and enjoying 'back to history'?

First there were rocks, then big sticks to survive and protect early man. Then the ingenuity evolved to combining sticks and rocks and we had spears, lances and weighted clubs. Ingenuity progressed to the extension of man's arm to provide more leverage with the Atyl-Atyl, and following that development was the idea of compound leverage of a string attached to both ends of a pliable stick and the refinement of the spear to act as a projectile. The bow and arrow was born, and lasted for quite some time in the history of man's quest for improved survival and defense.

Then, like all great steps in evolution, came the accidental discovery of new technology. The invention of gunpowder! There then came a new era in power and extension in the form of the chemical propulsion of a projectile to even greater distances. Although the process was not always consistent, accurate or safe, it continued in its development until the day someone realized a fitted projectile was better than the stones, rocks and other fauna that was currently being stuffed on top of the powder. Thus was born the cannon and a new chapter in siege warfare began. Over the years, more creative genius refined the cannon to affect better consistency, accuracy and safety. In the process the refinements of fit, alignment, axis, riflings and sights were added. The predecessor of what we have come to know as the "rifle".

This firearm passed through many iterations from fused-stationary, fused hand-held, matchlock, wheellock, flintlock, to percussion cap ignition all the way to the self-contained cartridge, as we know it today. Obviously, there have been improvements in material and design, but the basic premise of a fit projectile powered by chemical action remains. From here, how do we get to the resurgence of the black powder Cowboy Action shooter, you might ask. Well, it was with the "improvements" in the material and chemical actions that spelled the demise of proper blackpowder shooting. At the turn of the twentieth century there came the revolution in propellants to the shift to what was called “smokeless” powder. These propellants generated much higher heat and pressures and the basic lead bullet was not able to hold a seal and maintain spherical integrity down the bore. With the higher pressures and hotter temperatures the two simple symptoms of lead fouling and inaccuracy marked the death knell for soft lead bullets. The revolution adapted, and refined the concept of “patched” bullets from simple paper patches to hardened gilding, to “gas checks” to what we presently know and the jacketed bullet. Any of you who hunt are more than familiar with the variety in claims for jackets that either explodes on contact for prairie dogs to those that merely expand to twice bore size for elephant and African Buffalo. But, that is for the other magazines to cover. How did we get back to the proper ammunition for today’s shooting?

First we need to quickly carry the evolution of jacketed and harder bullets through to its end. During the period from about 1901 until today the quest for shooters has been a bullet that will withstand smokeless pressures and heat and still perform on whatever target is selected. For game hunting it was easy, alloy jackets that met the need. For target shooting it was different. The target shooter wanted inexpensive bullets because there was a lot of shooting and economy was a serious measure of enjoyment. Jacketed bullets were not cheap, lead was. Second the bullet had to perform to standards in energy, which required higher velocity to achieve. Higher velocities translated to higher chamber pressures and temperatures, a standard soft lead could not readily tolerate. So, the quest for harder alloys began. The quest ultimately arrived to where we are today with advertisements proclaiming Brinnel hardness from 16 to 25 as the magic alloy to meet velocities that match jacketed bullets. Well, if you are a serious competitor outside Cowboy Action these are fine. They hold up under the higher pressures, meet accuracy criteria, minimize fouling *at those pressures and velocities*, and meet the energy standards for the respective sport or game. Added to the quest for the appropriate alloy was the less noticeable transition to the shape of the bullet.

In the 1950’s there was a ground swell in availability of firearms, reloading equipment and components. Serious shooters took to reloading and continued to do so in even more numbers with the affordability of progressive reloaders capable of turning out 4 to 600 rounds per hour. This reloading was, for some, a hobby but for most a necessary evil to endure in order to enjoy the shooting. The old style softer bullet was more easily deformed in the hectic process of getting enough ammunition for the next shoot. The bullets were then mostly flat based and that too contributed to ‘kinks’ in the reloading process. The mold and bullet producers responded with the design so common today and advertised as *bevel based*. The bevel having the primary function of allowing the bullet to enter the case mouth easily and with minimal distortion while loading. This bevel base design also reduced the amount of flare, or *belling*, at the case mouth prior to seating. The result of less case flaring meant longer case life, and a more economical operation. The bevel base bullet also cast and processed easier therefore providing an economical advantage as well. But the bevel is most effective in cartridges where the bullet matches the bore properly and there is sufficient chamber pressure to obturate the harder alloy. There are several formula to determine necessary obturation with different alloys but this is not the place to attempt to introduce them. Suffice it to say the automatic, the most common handgun for competition at this time, with its closed chamber, prospered with these developments. The revolver was not so lucky.

The automatic wasn't as sensitive to obturation since most casting to bore actually swaged these harder (BHN 16 to 23) bullets to the bore rather than obturating to seal. It should be important to know that a Cowboy Action standard or low velocity load will not properly obturate with a bullet harder than about 8 to 11 Brinnel hardness, even if the bullet is at perfect bore tolerances.

So, to this point all we have seen is the result to harder, faster, and hotter. This was the environment into which Cowboy Action Shooting stepped and has been tolerating for all these past years. But, that isn't what we are about.

We in Cowboy Action Shooting are about safe, authentic, accurate and competitive shooting. Especially with black powder! Black powder does not produce the high pressures and heat of high-energy smokeless powder loads. It isn't possible with black powder and low velocity smokeless loads to properly obturate a bullet, through the cylinder then into the bore, that is harder than about 9 to 11 Brinnel Hardness. Sure, they will work, but not as effectively as a 20:1 lead to tin alloy, or softer. And, in addition, black powder requires a more appropriate lubricant to deal with the residual soot left in the bore. Coincidentally, lower velocity smokeless loads require a softer lube also.

So, where does that put us now?

We need a bullet alloyed in the 7 to 10 BHN, we need a bullet lubed for lower velocity and consequent heat and pressure, we need a bullet that was the style and standard of pre-1950, and more appropriately, a bullet like they used in the 1870's until the bigger, faster, hotter, harder rage began. Why do we need this bullet?

How about starting with a short treatise on obturation?

Obturation, according to the "The American Heritage Dictionary", Second College Edition, it means; "to close or obstruct". In the case of bullet performance obturation is translated to mean the ability to 'bump up, swell, expand or swage" into the bore to seal the gases produced during ignition and combustion or explosion in the firing chamber. For a rifle this basically means the chamber, which is protected by the cartridge case, and the expectation is that the 'closure/obstruction' material is malleable enough to maintain the 'obturation' all the way to the muzzle.

In a revolver, the closure/obturation is a necessary obstruction to first seal the gases while the bullet exits the case mouth then through the cylinder throat. At this point the obturation (bumping up, swelling, expanding) has reached the diameter of the cylinder throat and is sealing all the gas. When the bullet moves across the gap between the cylinder and the barrel the bullet is throat diameter and does not expand measurably during this period. However, upon entering the forcing cone and barrel proper, the front of the bullet is slowed down from friction in the bore and the base, still under pressure from the pressure and gases, begins to expand some more until it is completely encased by the bore, or that part of the forcing cone which matches the diameter of the bullet at that time. At this point in the bullets flight down the bore proper ‘obturation’ can only be achieved by having the proper pressure acting on the proper alloy (hardness) of the bullet. It is this continued compression of the base of the bullet that starts the squeezing process that forces the lube from the groove to lubricate the bore to minimize friction now that the bullet has obturated to form the proper seal.

There are several sources that have conducted far deeper research into this matter than we have. But the consensus appears to bear out that the correct pressure to fully obdurate a bullet to the bore reads like this; “…the approximate chamber pressure needed to fully obdurate a bullet is a factor of 1,422 times the Brinnel hardness (BHN) of the projectile…”. For example, a bullet of 19BHN would require a chamber pressure of 27,018 pounds per square inch (psi) (note that this reading is in psi, NOT CUP, Copper Units of Pressure, as are readings in most loading manuals representing chamber pressures

Most cowboy action and practice/plinking loads only develop the equivalent of about 11,000 to 16,000 cup, so you can see what relative level of obturation you are achieving by dividing the indicated chamber pressure of you current load by 1422, then examining the BHN of your bullet to see how well your loads is working, sealing. Folks, as an example, according to the most recent “Handloader” Magazine, #221 p.72, it is printed that the SAAMI, industry standard for a 44Magmun is 14,000 PSI. That means a bullet with a BH of about 9.85 is minimum for even basic obturation.

Any loss of seal due to inadequate or incomplete obturation will absolutely result in projectile deformation and, in the case of any lead alloy, erosion of the face absorbing the effects of the pressure, the base of the bullet. In the case of a bullet from a cartridge the base is not only subjected to the pressure of the expanding gases but also the heat generated by the chemicals producing the pressure (remember, lead melts near 500 degrees F). This combination of pressure and heat (pressure is a positive, heat is a negative for us here) will deform a bullet base. With the best of conditions all the deformity will be towards the equal distribution of base expansion so proper seal will occur. If we only had to deal with pressure either a plain base or bevel base bullet would probably work equally well. Although we are of the mind that even just pressure on a plain-based will seal more concentrically than any other design.

Now, why should we consider “plain-based” in this treatise? Knowing what we do from the treatise above and continuing with the addition of the heat variable, which is present during the firing process, lets examine what happens as a bullet from a revolver crosses the gap between the cylinder and the barrel. First of all the maximum pressure in a revolver is reached at this point. From here on the cylinder/barrel gap will continue to bleed off from maximum pressure until the projectile exits the muzzle. While there is maximum pressure there is also maximum heat generated on the base of the bullet. If it is a plain-base bullet the heat and pressure are evenly dissipated and as the base clears the cylinder throat both expand at perpendicular angles to the flat base and exit through the gap. Some lead is melted but since there is more pressure being exerted down the axis of the bore, it remains mostly intact on the base. (Picture a blowtorch held near the end of a soup can) With a bevel base bullet the peak pressure and heat are not only impacting the flat portion of the base but also escaping around the edge of the flat of the base across the bevel and continues to do until the bullet is completely encased in the barrel. (Picture, for exaggeration, a blowtorch held at the pointed end of a cone) This is actually eroding alloy from the bevel portion and can be seen as build up in the forcing cone and on the frame top strap. Obviously this erosion adds to leading and reduced obturation. Some weapons with unmatched cylinder/bore tolerances even leave lead residue on the cylinder pin and bottom of the frame. Some harder alloys relieve this effect but do not eliminate it. Since there is no cylinder/barrel gap in autoloaders, this phenomenon is minimized. In a revolver, it has critical impact on accuracy, fouling and durability.

Even with soft alloy plain-base bullets, if the cylinder to bore measurements aren't consistent and within tolerances, erosion and base deformation will be sufficient to reduce accuracy and contribute to leading. Now, to part two of this extremely lengthy collection of verbiage.

What this all means to us shooters.

If we want accuracy, and minimize fouling we need the softer flat-based bullets for our kind of shooting. But, more importantly we need the *right* bullet. Now '*right*' can mean any number of things to any variety of shooters. For most of us in the cowboy shooting world *right* mostly means a bullet with enough mass at velocity to get down range and affect the target appropriately. I won't bother to bring the condition of reactive and tip over targets into the dialogue, but will bring in the conditions of accuracy, dependability and safety. Knowing what we do from the previous chapters, we know that accuracy is dependent upon bullet to bore fit and seal. The only way to guarantee proper bore fit is to slug the bore. There are several methods of doing this, and any will suffice. Just do it first. Secondly, the accuracy from the bullet to bore fit can only be achieved if the bullet to cylinder throat is complementary to the bore fit. This is a pretty simple formula. The bullet of perfect bore fit (at bore to .001" oversize) must be at bore or .001" ***<u>less</u>*** than the cylinder throat. That translates to mean that your cylinders throats will need to me slugged or measured and, if necessary, honed or reamed to a dimension .001" larger than the optimum bullet diameter. Simple enough, but if this fit isn't occasioned in each of your pistols, continued side effects will prevail. These side effects are reduction in accuracy and dependability. Proper fit results in accuracy, cleaner bores and less splatter around and out the side of the cylinder gap. That only leaves safety to consider.

There have been several articles in the shooting newsletters lately about the incidents of lead "stingers" ricochets and flying fragments along the shooting line; both within the posse at a single berm and across berms to other areas of the range. I can honestly tell you that any simple experiment will demonstrate the safety of the softer lead bullet. To begin the discussion, merely picture a marshmallow and a ball bearing reacting to being thrown against your refrigerator. Need I say more? In a recent exercise at a private shooting range we intentionally fired 25 rounds of bullets with a BHN of 19 to 23 at affixed solid metallic target. We then fired the same number of rounds with a bullet of BHN around 8 to 9. Of the 19-23 BHN bullets all we found were remnants of the base of bore diameter and about 1/3 of the original length. Our impressions were that the bullet fragmented and “BubbleBeed” to parts unknown. We could find only minor flakes of the rest around the target. On the other hand, the softer, 8 to 9 BHN bullets collected quite nicely all around the target. We actually found 19 complete bullets which had “Mushroomed” to about three times bore diameter. The remainder were nickel to quarter sized flat ingots about 1/8” thick. The rest of the pieces were apparent as large flakes lying along the perpendicular axis to the target for about three feet on either side. Safer? I return to the marshmallow off the refrigerator. Where does this leave us now?

Well, I hope it leaves us all with an intention of being safer, which means we will shoot softer bullets, because they are more authentic, and if properly ‘fit’ they also add to accuracy, dependability and more fun. The fun is in the reason we all started this game I the first place; we can go “back to the future”.

Good shooting, take care, aim and squeeze fast.