When the "Tin Can" Changed History

By Dick Culver

How many of you have ever heard of lumpy metal fouling in the bore of a service rifle? If you came along in the decades starting in the 1950s, the answer is probably very few or none. To our predecessors however, metal fouling in the barrel of their favorite fowling piece was a very real problem. When progressively larger deposits of jacket metal fouling start accumulating in the bore of their rifle it became ruinous to the accuracy. How the metal fouling problem came about and how it was eventually solved is a fascinating piece of history.

Cut to a typical conversation on the Rifle Range at Guantanamo Bay Cuba circa 1908

The year was 1908 and Marines on the rifle range were cleaning the new service rifle that they had just received as a replacement for the Krag. Tempers were getting a bit frayed, and the NCOs were saying unkind things about the Army Ordnance people in particular and whatever outfit had them constantly changing rifles in general. The troops however had problems of their own.

"Hey, Sergeant McCoy, when are those clowns gonna' get their stuff in one seabag?", one of the older privates asked.

"First they issue us some kind of weird 6 mm Winchester without enough cleaning equipment. The bores were so small normal cleaning rods wouldn't fit and the ammo was so corrosive that getting the bore clean was almost impossible. In China extra cleaning stuff was almost impossible to find! Then just about the time we were getting used to pulling the bolt straight to the rear, we had to turn in our Lee Navys and draw the Krags. Now THERE was a nice rifle! I really liked the Krag, it shot well and was pretty darned accurate. Now they're copying the dadgummed Germans and they send us a new rifle to get used to! Have you felt the recoil of this beast? - Geeesch!"

"Quit grousing Johnson," said Sergeant McCoy, "Just shoot what you're issued and quit beating your gums. I'm sure nobody's interested in your opinion!"

"But Sarge, I've been tryin' to clean this darned thing, and I can't get the stuff outta' the muzzle! Is there some sort of trick to cleaning this piece?"

"Johnson, you're just using the new rifles as an excuse for your lazy fanny, now get busy and put a little more elbow grease into it!"

"Sarge, honest there's some kinda' lumps or sumptin' up next to the muzzle and no matter what I use it's no go! What do I do for inspection?"

"I'll tell you birds what you'll do! You'll have those shootin' irons clean or I'll have you scouring pots for a month, right after you make sure the heads are spotless! Now quit grousing and get to cleaning!"

Scenes like this were common to all services that were completing the issue of the "New Springfield" as the U.S. Magazine Rifle, Caliber .30 M1903 was commonly called at the time. The little lumps at the muzzle were to be a pain in the posterior of the Soldiers, Sailors and Marines for the next 13 years. Unknowingly, they were the victims of modern technology. The problem was not the rifle, but rather the ammunition. Private Johnson was soon to be introduced to a magic formula that became known as "Ammonia Dope".

A Short History Of The M1903 Rifle And Its Cartridge Development

The "New Springfield" Rifle

To appreciate Pvt. Johnson's problem, a little history is in order. During the days of the Trapdoor Springfield, metal fouling in the bore was a minor problem since the bullets were lubricated lead. Good cleaning practices using metal bore brushes would remove any offending lead particles in the bore. It wasn't until the United States adopted the Krag Rifle in 1892 that bullet jackets were placed on the service projectile.

Greater velocities and pressures generated by smokeless powder demanded that a stiff bullet jacket material be used to keep from stripping the bullet in the rifling. As long as pressures and velocities were kept to "Kragesque" levels (approximately 2000 feet per second for the Krag and 2200 feet per second for the new 220-grain M1903 Cartridge), no problems with the new ammunition occurred. The new bullet jacket material was made of a material called *"cupro-nickel"* which consisted of 60% copper and 40% nickel. Ammunition companies had found pure copper jackets to be too soft for bullets fired out of a modern smokeless powder rifle, and the nickel was added for stiffness. It was not until the introduction of the M1906 cartridge with its increased muzzle velocity that cupro-nickel metal fouling reared its ugly head.

The 1903 cartridge with 220-grain round nosed bullet

Just when the Armed Forces were getting comfortable with the 220-grain 1903 Cartridge at 2200 feet per second, a new development in Germany came to the attention of U.S. Ordnance. The Germans it would seem, had gone to a relatively light-weight bullet of "pointy" design. The pointy bullets were called "spitzers" and could be launched at a high muzzle velocity from their Mauser Rifles. The resulting ballistics gave the Germans a considerable advantage in range and accuracy over their competition. Since we were just getting started issuing the New Springfield (whose Mauser design we had copied from the Germans), it was deemed prudent to upgrade the new rifle's ammunition to match the capabilities of the rifle design. Since we had "borrowed" the design of the M1903 from the German Mauser, why not the ammunition?

The original cartridge for the "New Springfield" used the heavier 220-grain round nosed bullet described above, and it became obvious that the chamber and leade of the rifling had to be changed in the existing rifles to accommodate the new .30-'06 cartridge. The newly issued M1903 service rifles were recalled and modified to take the improved round. The barrel had to be removed and cut back .20", re-threaded, re-chambered and re-installed on the receiver. The M1903 Rifle, re-chambered to .30-'06, would serve the United States in one form or another for almost 40 years. The new load was a "ring-tailed blue whizzer" with its 150-grain projectile leaving the muzzle at 2700 feet per second. That was a truly hot load for 1906! As good as the new rifle and load were, the fast moving bullet and a contrary jacket material were at the root of Pvt. Johnson's problems.

The 1906 cartridge with 150-grain Spitzer bullet

The new cartridge became known as the Cartridge, Caliber .30 Model of 1906; hence the designation of the U.S. Service Cartridge as the *"Thirty Ought Six".* The *"Thirty"* of course was for the caliber of the round, and the *"Ought Six"* was for the year it was adopted. It's abbreviation was written; .30-'06 and for many years it was perhaps, the most well known cartridge in the world. In retrospect, the original cartridge (Model of 1903) became known as the .30-'03 to differentiate it from the newly adopted .30-'06.

Cupro-Nickel Metal Fouling Rears Its Ugly Head

Almost as soon as the *"New Springfield"* with the .30-'06 ammunition hit the rifle range, a strange phenomena occurred. The 2700 feet per second was a boon to extreme range, but velocity sometimes is a double-edged sword. It seemed that strange looking lumps began to manifest themselves near the muzzle of the rifles. These lumps proved almost impossible to remove with normal cleaning methods and materials. Vigorous scrubbing with wire brushes and solvent was to no avail! The pesky stuff got worse as you continued to fire the rifle and degraded the accuracy. It was soon discovered that the lumps consisted of small particles of cupro-nickel jacket material. The intense heat and friction generated by the 150-grain .30-'06 bullet traveling at 2700 feet per second were leaving little metallic lumps that, and much like eating bear steak that seems to grow in size the more you chew, the lumps got bigger the more rounds you fired. The initial deposits in the bore continued to gouge the subsequent projectiles fired through the bore shearing off additional deposits of metal - and the problem compounded itself.

The frustration of the NCOs inspecting the troop's rifles combined with the new interest in service rifle shooting in the National Trophy Matches became a thorn in the side of the Ordnance Department. The target shooters and the folks at Springfield finally came up with a solution, but not a particularly friendly one. They developed something called *"Ordnance Department Metal Fouling Solution"* , commonly known as "Ammonia Dope". The dope would dissolve the metal fouling alright, but it was tricky to use. The "dope" was poured into a rifle barrel with a "corked chamber". A piece of rubber tubing was placed over the muzzle to allow the dope to cover the muzzle and prevent any air getting to any metal exposed to the dope. Any contact with air would ruin the barrel within a few minutes. Needless to say, Ammonia Dope was not exactly a welcome solution to the problem, but came under the heading of "what price accuracy". If the chamber plug became dislodged while the solution was in the bore, the stuff would run down into the receiver and cause extreme rusting wherever it touched the metal. At best the dope was a nuisance and at worst, a disaster. The formula for the dope for those of you who are curious was:

Ammonia Persulphate	1 ounce
Ammonia Carbonate	200 grains
Stronger Ammonia Water (28%)	6 ounces
Water	4 ounces

The solution had to be made up fresh for each use. If the dope became "stale" it became corrosive to the barrel. After a 20-minute treatment, the solution had to be immediately poured from the bore. The bore was then dried and oiled. This treatment dissolved the metal fouling and left the bore pristine for further firing. Needless to say, the troops (and competition rifle shooters) looked for alternative methods of reducing the irritating cupro-nickel fouling.

The Use Of Grease To Cut Down On Metal Fouling

One seemingly logical approach to the problem was to reduce the friction in the barrel using lubricated bullets. The theory was that if friction was reduced, metal fouling would not form. In fact this simple solution DID work, but as it turns out, the cure was sometimes more disastrous than the kill.

Cut To The Rifle Range At Mare Island, California Circa 1919

Johnson, now a Gunnery Sergeant after 19 years and fresh back from the 5th Regiment in France, is working with some of his newly recruited rifle team members.

"Hey Gunny Johnson, why are we dipping our bullet tips in Cosmoline," asked a newly selected member of the post rifle team?

"Listen Jones, just dip the things and let me worry about it, OK," said Johnson?

"But Gunny, I just dropped my clip in the dirt and the ammo is pretty dirty," said Jones!

"Well then, wipe it off and make sure the cartridges are clean or it'll make 'em hard to extract," replied the Gunny.

"But what's the idea of greasin' the stuff," said Jones?

"Well, if you dip the bullet tips in grease, we've found that it cuts down on that darned metal fouling that collects in the muzzle, and if you want good scores, you've got to cut down on the fouling. If you let the stuff build up, it tends to screw up the accuracy, and we don't have time to use that Ammonia Dope stuff between relays. If ya' wanna' beat the Army teams, listen to what I tell ya'!"

"Hey Gunny, did you guys grease your bullets in France," asked the kid?

"Of course not," said the Gunny, "we were fighting a war, not shootin' at targets - didn't take as much precision as target shootin'!"

"When did they start greasin' the bullets," asked Jones?

"Well kid, it's sumpthin' we learned by hard experience before the war. Somebody figured that if we cut down on the friction it might cut down on the lumps that were stickin' to the bore - sure enough, it worked, been usin' it every since!"

"Gunny, where do I get one of these lil' cans to put the grease in," asked Jones?

"Easy Jones, just go make friends with the company clerk and get one of his empty typewriter ribbon cans - works just like it was made for it! Some of them civilians use some grease called *Mobilubricant* that's supposed to be a little better, but Cosmoline works fine and it's free. Not only that, but if the coach is sittin' close behind you callin' your shots rapid fire, he can pick up a little smoke trail as the bullet heads for the target! Works great for team shootin'!"

Johnson didn't know it but he was teaching a practice that was to cause the Ordnance Department lots of grief for reasons that hadn't occurred to the average shooter. They would soon learn the danger of this jackleg method of circumventing the cupro-nickel fouling problem.

Problems with Greasing the Bullets

The standard method of lubricating the bullets was to dip them in a can of either Cosmoline or some stuff called Mobilubricant. As long as the bullets were singly dipped, the results gave more or less satisfactory results, but when an entire five shot stripper clip was dipped into the grease, it became a bit messy. When loaded into the rifle for a string of rapid fire, the grease was deposited on the walls of the chamber, increasing chamber pressure. Usually the shooters got away with this but not always.

The Single Heat-Treated M1903 Receiver and How It Tied In with the Lubricated Bullet

If all the receivers had been of equal strength, everything might have gone smoothly, but an old problem with the heat-treating of the Springfield (and Rock Island) receivers became greatly magnified by the greasy ammunition and chamber problem.

It seems that until WWI, receiver forgings produced at Springfield and Rock Island were more of an art than a science. The single heat treat method of producing receiver forgings equired that the hot forged receivers be quenched in oil from a fairly high temperature (1500°). This produced an extremely hard receiver that was very strong against a slowly applied force, but was sometimes so hard that it was actually somewhat brittle. When properly head-spaced and fed excellent ammunition, relatively few problems were encountered with the rifles produced between 1903 and 1917 when using pre-war ammunition.

The exigencies of war called for increased production at Springfield and Rock Island, requiring the hiring of additional and usually inexperienced personnel. Individuals who had forged receivers using the "eyeball method" of determining the temperature of the steel billets (as opposed to utilizing pyrometers) were supplemented by new "war hires" who were essentially novices at judging forging temperatures by eye. Pyrometers were suggested, but resisted by the older artisans who feared that such new-fangled stuff would supplant their skill and put them out of a job. Increased production required by the War, along with the use of inexperienced personnel set the stage for disaster.

Ammunition was badly needed in great quantities during WWI. This demand brought a proliferation of new cartridge producing companies with little or no experience in producing small arms ammunition, sometimes resulting in a product was of questionable quality. Brass quality and hardness varied greatly, along with the quality control of annealing process on the case necks. Much of this ammunition would remain in the Depots for years after the cessation of hostilities in France. Many of these "soft case cartridges" contributed to the difficulties associated with the single heat-treated receivers.

Since no one engaged in combat was terribly worried about cupro-nickel fouling in the bore on a charge across no-man's-land, the single heat-treated receivers were more of a theoretical problem than a real one during combat use, assuming the use of quality ammunition. The combat troops were hardly interested in greasing their bullets. Springfield Armory and Rock Island Arsenal however, continued to work on the brittle receiver problem. Tests had proven that there was no reliable way to reheat-treat the older receivers, so any fix would have to be applied strictly to new production of the M1903.

The solution to the problem turned out to be a "double heat-treat" process for the newly produced receivers. The process is a bit too technical to publish in detail since this is a story of metal fouling in the rifle bore. Suffice it to say that the new receivers were forged in a manner similar to the original process, but allowed to cool in an open pan. They were then annealed at 1500° and quenched in oil. The receivers were then raised to 350° in an oil bath to reduce surface hardness and allowed to air cool. The resultant receivers had a hardness of approximately 33 to 44 Rockwell C. The problem of the brittle receiver had been solved.

Both Springfield and Rock Island arrived at essentially the same process for a double heat-treated receiver. Springfield judged that any receiver produced after serial # 800.000 produced in February 1918 would be considered to be of the double heat-treated variety. Rock Island turned out its first double heat-treated receiver, serial # 285,507, during May of 1918. Unfortunately that left over three quarters of a million Springfields with single heat-treated receivers and over one quarter of a million Rock Island Rifles still in service.

The accident statistics involving the so-called brittle receivers are a bit less intimidating if we look at the actual numbers. Recorded accidents involving the single heat-treated receivers totaled approximately 137, of which 68 had "burst receivers". At least four of these were caused by shooting a German 8mm (actually 7.92mm) in a .30 caliber bore, an act guaranteed to raise chamber pressures to a phenomenal peak. One hundred and thirty seven failures out of over a million rifles is a very small percentage indeed. Those figures taken with the fact that relatively few problems had occurred prior to 1917, would indicate that most of the later incidents can be blamed on faulty or greasy ammunition.

WWI Surplus Ammo with Increased Interest in Target Shooting Compounds the Problem

Prior to WWI, an attempt was made yearly to come up with an extremely accurate lot of ammunition to shoot the National Trophy Matches. Since the ammunition was supplied gratis to the shooters by the Army, this incurred some expense to the Government. Before the war, attendance at the Nationals had been modest, consisting mainly of Regular Service personnel and the National Guard. The war changed all that of course, as literally millions of men had been introduced to service rifle marksmanship and had grown to enjoy the sport of Service Rifle shooting. The loan of free service rifles and ammunition at Camp Perry made the pot even sweeter.

Unfortunately the war had left the Army with millions of rounds of 1906 150-grain Ball Ammunition of wartime manufacture. At least some of the surplus was of the questionable variety mentioned above, and most had been manufactured under the rush of wartime requirements. The selection of commercial ammunition specifically for the matches seemed an un-justifiable expense to a sharply reduced (and somewhat under-funded) peacetime Army. The service teams and the National Board were told to use up the surplus ammunition on hand for practice before any new stuff would be selected or manufactured. Needless to say, scores suffered somewhat with the sub-quality fodder for the M1903. In 1920 a decision was made to select the ammunition for the Nationals themselves by competitive excellence, although most of the teams would have to use the surplus ammo for practice during the year. Apparently this paid off as the first perfect score was fired in the 1000-yard Wimbledon Cup Match during the 1920 Nationals. The rifle aficionados at both Springfield Armory and within the shooting community were looking for better ammunition. They would not have long to wait.

Two things happened in 1921 that would change the complexion of rifle competition:

1) The production of the first target grade M1903 at Springfield to be known as the M1903 National Match Rifle.

2) The production of an experimental lot of ammunition at Frankford Arsenal designed to show off the new National Match Rifle and to eliminate the accuracy destroying cupro-nickel metal fouling in the bore.

While the 1920 NM Ammunition was accurate, it was still using a standard cupro-nickel jacketed bullet, although of the same 170 flat-based design as the 1921 projectile. The shooters of course, were solving the fouling problem with liberal applications of grease. Experiments at Springfield and Frankford disclosed that the 1920 NM Ammunition fired in a dry chamber gave approximately 51,000 psi, well within normal specifications. By carefully lubricating the bullet and case neck, the pressures rose to 59,000 psi. When the entire case was lubricated along with the chamber which was common (if unintended) when the cartridges were used in rapid-fire strings, the chamber pressure rose to a dangerous 71,000+ psi, the pressure normally attributed to a proof test load.

Physics and the Rifle Shooter

The inadvertently lubricated cartridge case was the worst problem as its sides were tapered. Normal ammunition forms a gas seal in the chamber due to a process known as obturation. Obturation is simply the expansion of the brass case, tightly sealing the chamber when the round is fired. This case expansion forces little fingers of brass to occupy unseen microscopic irregularities in the chamber walls. This is truly a

good thing as it seals the chamber until the gas pressure has subsided. Unsealed chambers allow gas to blow back into the receiver, possibly injuring the shooter. The greasy cartridge case in a tapered chamber had two disastrous consequences. First, grease is incompressible and will not allow the case to expand within the chamber as it was meant to do. Since the grease decreases the coefficient of friction and allows the cartridge case to slide in and out of the chamber more easily it precipitates what I call *"the watermelon seed effect".* This equates to the squeezing a fresh, wet watermelon seed between your fingers and having it squirt out into the grass. The greased, (and tapered) chamber has much the same effect on a brass cartridge case. Since the lack of compressibility of the grease prevents the case from expanding against the chamber walls and thus sealing the gas with normal obturation, the tapered case "squirts" to the rear with virtually all of the force of the combustion gasses being directed straight rearward against the bolt. When such rearward pressure is applied to the bolt in older single heat-treated receivers, exciting things are liable to happen.

The 1921 National Match Ammunition - Enter "The Tin-Can"

To make it unnecessary to apply grease to the projectile and thus inadvertently greasing the entire cartridge and chamber, Frankford decided to make a bullet that wouldn't deposit cupro-nickel fouling in the bore. The famous old time shooter and ordnance expert, Major Townsend Whelen was put in charge of the project.

It turned out the United States wasn't the only country with a cupro-nickel metal deposit problem. It seems that the French also had had such a problem with their artillery pieces. They had solved the problem by putting strips of tinfoil in their powder charges. Tin was known to eliminate the lumpy metal fouling. The question was how to stuff enough tinfoil into a small arms cartridge case to solve the rifle problem.

The Legendary "Tin-Can Ammunition"

The 21-R 1921 National Match Cartridge with 180-grain flat-based tin-plated bullet

Major Whelen solved the problem in a most ingenious way, by "tin plating" the projectile! Extensive tests demonstrated that the tin plated bullets left the bore free of fouling. The cupro-nickel metal deposits were thought to be a thing of the past.

The projectile selected for the 1921 Matches was a 170-grain, flat-based bullet with a cupro-nickel jacket that was then electroplated with tin. The headbase of the case was stamped with **FA** and **21-R**. The bullet was loaded over 48.2-grains of DuPont # 1076 giving a muzzle velocity of 2650 fps. with a chamber pressure of 48,725 p.s.i. Tests had demonstrated that the new cartridge had a mean radius of 3.00” at 600-yards and 8.52” at 1000-yards, making the “Tin-Can” ammunition one of the most accurate loads developed for the Nationals at that time.

The Fly in the Ointment

Just when the problem of the lumpy metal fouling seemed to be solved, a new problem surfaced with the tin plating. When a new lot of ammunition is produced, it is usually put under the microscope and carefully examined for any abnormalities. While checking the weight of the powder charges, it was necessary to pull a few bullets. Normal bullets pull at around 50 - 60 pounds of exerted pressure, but these puppies proved almost impossible to pull using normal methods. The effort necessary to pull the new bullets ran from between 300 to 600 pounds! Needless to say, this would raise the chamber pressure to disastrous limits.

Actual firing of the ammunition however, showed normal chamber pressures. It was finally decided that the bullets were "cold soldering" themselves into the neck of the cartridge cases. This unexpected phenomena was causing the extreme effort necessary to extract them using a bullet pulling machine. When fired however, the neck of the case would apparently expand against the neck of the chamber thus breaking the seal of the inadvertent solder job. Once broken free by case neck expansion the projectile was free to be launched without raising the chamber pressure. Everyone breathed a sigh of relief. Better that they should have considered the contrariness of the old time shooter.

If Tin is Good, Then Tin ***Plus*** Grease Must Be Better!

Knowing the propensity of shooters to use long-standing practices, classes were held at Camp Perry to educate the 1921 competitors on the characteristics of the new National Match Ammunition. They were told not to polish the frosted tin finish on the bullets as they shot more accurately when left in the issued state, and they were told that under NO circumstances should they attempt to lubricate the tin-plated bullets! Frankford and Springfield found that the incompressible grease would not allow the neck of the case to expand and release the bullet from the "cold solder job" in the neck of the case. Greasing the bullets had the potential of creating an explosive situation. Needless to say, this advice was handily ignored by many of the old time shooters. The attitude seemed to be:

"By Gawd, them high fallutin' geniuses at the Arsenal don't know nothing about shootin' - I've been greasing my bullets for years and nothing has ever happened! Who do they think they're kidding?"

Re-enter Gunnery Sergeant Johnson, Camp Perry 1921

"Hey Gunny, what's this fancy fodder they're calling "Tin-Can Ammo," asks Private Jones?

"Weren't you listenin' the other day when they were givin' us the scoop on the new ammo, Jones?"

"Well yeah, but I threw a pretty wild liberty in Sandusky the night before. Guess I was dozin' off a bit… How about translatin' some of this for me Gunny!"

"Jones, all I know is what they told us, but it sounds like they may have solved all that metal fouling stuff that's been plaguing us for so long! I know it sure shoots good!"

"Right Gunny, it sure does, but why can't we dip our bullets in the grease anymore?"

"Jones, if you sleep during the lectures again, you ain't gonna' be makin' Corporal on your second enlistment like you were figurin'! As I understand it, this stuff is tin-plated and the tin kills the metal fouling! …And if I catch you polishing the frosting off them silver "Werewolf Killers" again, I'll *guarantee* that you won't make Corporal. The Armory boys claim they shoot better when they're frosted! We need all the points we can get!"

”Aw Gunny, they sure do shine up good - what's the harm?

"I dunno' Jones, but I'm gonna' take their word for it!"

"OK, but what's wrong with dippin' our bullets in the Cosmoline like we've always done?"

"Jones, damn it, when those egg-heads from the Armory come up with something, they've usually got it figured out pretty well! I'm gonna' follow orders, and so are you!"

"OK, OK Gunny, but I saw some of them civilians next to me on the line still dippin' 'em, if it's dangerous, why are they still doin' it?"

"Heck, don't ask me, you know civilians, they NEVER get the word, but according to Springfield, someone could get hurt by greasin' 'em. If I take you back minus an eye or with one of our fancy new rifles wrecked, it'll by my fanny. I've only got a couple of more years until I retire so if I get MY fanny in a crack, I'll promise you that yours will be in the same crack! Now all you birds hit the rack, we've got a big day tomorrow. Don't forget, we've got to go down behind the butts before the shootin' starts to put a couple of fouling shots through the rifles, so get some sleep!"

Old Habits, and Human Contrariness

Human nature being what it is, many continued to lubricate the new ammunition causing several wrecked rifles. In every instance, the cause was traced to the prohibited use of grease on the ammunition. At least one projectile was found downrange with the neck of the cartridge case still firmly attached to the bullet and exhibiting rifling marks on the brass. The probable chamber pressure of that round can only be imagined.

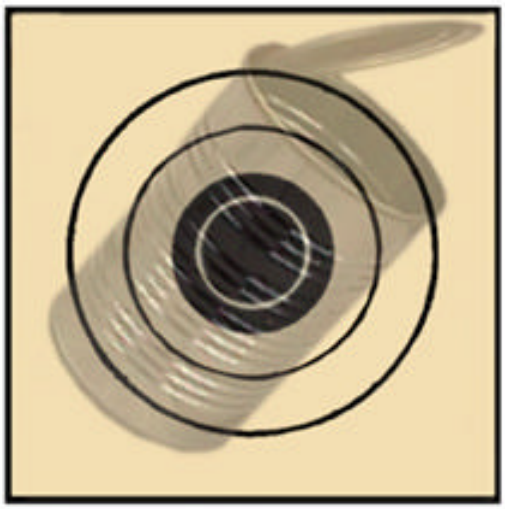
From a positive standpoint, many new records were set using the Tin-Can Ammunition and it most certainly showed off the new National Match Springfield in a positive light. The 1000 and 600-yard scores caused the addition of a "V-Ring" to the long range targets starting in 1922. Records set using the fine "Tin-Can Ammo" recorded several scores with shoot offs that recorded over 70 consecutive bulls-eyes at 1000-

yards. Ordnance now knew what the M1903 was capable of in the right hands, AND without the specter of cupro-nickel metal fouling.

The Tin-Can Ammunition had done its job and demonstrated the superior accuracy of the National Match Springfield, and that the lumpy metal fouling could be beaten. Ordnance decided that leaving the Tin-Can Ammunition in service was too risky given the inclination of the old timers to lube their bullets against all advice to the contrary. Following the 1921 Matches, the remaining stock of the great Tin-Can Ammunition was scrapped.

The ammunition companies solved the problem of the cupro-nickel fouling by 1922 without plating the bullets. Experiments with *gilding metal* as a bullet jacket material finally began to pay off. Gilding metal is simply an alloy of copper and zinc, but in the past had been considered too soft for a military bullet. However gliding metal jacket material was soon refined by Western Cartridge Company while searching for a non-fouling jacketed bullet for their 1922 Palma Ammunition. The disadvantages of straight gilding metal were overcome by adding 2% tin to the jacket. This gilding metal/tin jacket material became the famous Lubaloy Bullet Jacket. Frankford Arsenal also came up with a gilding metal jacket made of essentially the same material as Lubaloy. Frankford Arsenal's addition of a 6° boat-tail to the 1922 National Match projectile set the stage for the well-known Frankford Arsenal M1 Ball ammunition that would rule supreme in service rifle competition for many years to come.

In the end however, it was the *"Tin-Can"* that showed them the way!



The "5-V Ring" on the Long Range Target
A Legacy of the 1921 "Tin-Can" Ammunition

Acknowledgements:

Much of the information in this article is drawn from many conversations with my Dad who fired with the Marines at Camp Perry in 1921 and told me exactly how the “Cosmoline” was used to lubricate the bullets, and how the lubricated bullets actually formed a vapor trail on the way to the target. The technical aspects of the “Tin-Can” Ammunition are taken from *Hatcher’s Notebook*, Clark Campbell’s *Book of the Springfield* and other commentaries written on the subject at the time. I am especially indebted to Major Jim Land, USMC (Ret.) for the round of **21-R** “Tin-Can” Ammunition generously donated from his extensive cartridge collection. The “Tin-Can” graphic showing the loaded round, the headbase, and the separate tin-plated projectile are taken from a scan of a real “Tin-Can” round and converted into a cut-away by my long suffering Memsahib (my favorite graphic artist) who is responsible for all the outstanding graphics in this article. My thanks also to Bob Seijas for keeping me honest with his proof reading! The tin can appearing in several places was a *REAL* Chili can opened in our kitchen, stripped of its label, and photographed on our back porch.