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**BATTLEFIELD ODDITIES:  
EXPLAINING TWO MINIÉ BALLS FROM PEA RIDGE NATIONAL MILITARY PARK  
(156)**

**Don Arp, Jr.**

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*Two minié ball bullets, each with a different caliber and similar longitudinal lines were recovered at Pea Ridge National Military Park during the fieldwork conducted there in March 2001. The function of these lines was unknown. Several hypotheses were advanced to explain the markings. However, through detailed mathematic and microscope analysis, it has been determined that the lines were made by the same process and machine and may have served as a point of attachment for an experimental cartridge made of either metal, cloth, or paper. The bullets may have been part of a pre-Civil War experiment and found action in the hands of either the Federals or the Confederates, once hostilities broke out.*

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Archaeological investigations of Pea Ridge National Military Park began in March 2001 as a joint effort of the National Park Service's Midwest Archeological Center (MWAC) and the University of Arkansas Department of Anthropology. Metal detector searches were conducted in Clemon's Field and other nearby areas. These searches yielded hundreds of artifacts. Everything from shell fragments and minié balls to gun parts and uniform devices were recorded and collected. The material was taken to MWAC and processed in the laboratory under the supervision of Dr. Douglas Scott. During the processing of these artifacts, two minié balls from the Clemon's Field area stood out as being different from the other specimens recovered. Each had a series of regular lines that ran longitudinally across the skirt of the bullet. Interestingly, no other bullets similar to these are known, either from Pea Ridge or from any other Civil War battlefield. An investigation, using archaeological, forensic and historical research techniques was instigated to study the bullets and attempt to explain the function of the unusual markings.

### **Minié Balls**

Before the particulars of the bullets from Pea Ridge can be examined, it is necessary to familiarize the reader with the type of bullet known as the minié ball. The use of the term 'ball' is really a misnomer, as the minié ball is not spherical but cylindroconoidal in shape. In 1832, a captain in the British army named Norton began the invention process that resulted in the general shape and function of the projectile. However, it was a Frenchman, Claude Minié, who advanced Norton's ideas and produced the 'ball' named in his honor (Hagerman 1988:16). In 1850, the minié (also minnie) ball became an official projectile in the U.S. Army's arsenal (Weigley 2000:32).

The ball had a diameter smaller than the rifle bore it was fired from. When the powder charge exploded, the cavity in the bottom of the ball expanded, thus making contact with the rifling and causing the projectile to spin. Various methods were used to make the cavity expand. The British used an iron cup, but this was found to cause the bullet to expand to the point it became jammed in the barrel. The problem was corrected when a wooden plug was used in place of the cup. In 1857, at the Harper's Ferry Minié trials, it was discovered that a

properly designed cavity needed no foreign object to cause expansion. Therefore, the U.S. Army adopted a bullet that only had a cavity to facilitate expansion. Figure 1 illustrates the various facets, both internal and external, of a minié ball.

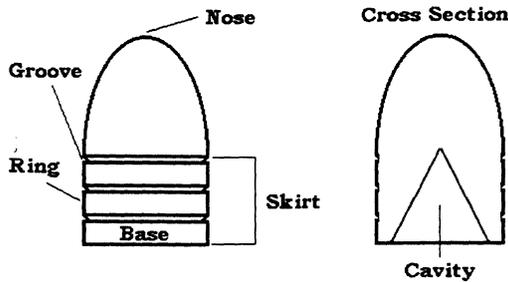


Figure 1. Minié Ball Parts.

**The Pea Ridge Bullets**

A detailed series of measurements were taken of both bullets in order to facilitate their proper identification and to support other research goals of the Pea Ridge project as a whole. Table 1 provides a summary of these measurements.

The bullets are of two different calibers: .54 and .69. Neither appears to have been fired, but the larger of the two has some deformation attributed to agricultural activity that was historically conducted in Clemon's Field, where both were found.

Early in the investigation, it became necessary to find a word that correctly described the markings found on the bullets. Terms like 'striation' and 'groove' seem obvious, but these words are already part of the nomenclature for ballistics and minié balls. At MWAC, the word 'rouletting', a term used to describe some Native American pottery designs, was used. This proved inadequate as well as it failed to describe the markings. Thus, the term *scoriation* (scoring + striation) was invented and used to refer to the bullet markings.

After the bullets were measured, the scoriations were examined under a microscope and counted. This inspection found that each bullet had scoriations with the same cross section, except that each was

in the reverse direction of the other. Figure 2 shows the cross section (nose pointed away from observer) of the scoriations from both bullets. It appears that the markings were cut with some type of half bevel blade or blades over which the bullets were rolled.

Field Specimen	2044	2097
Caliber	.69 in	.54 in
Diameter	.678 in or 17.33 mm	.528 in or 13.47 mm
Base to Nose	27.39 mm	13.17 mm
Base	2.6 mm	2.10 mm
1 <sup>st</sup> Band	2.16 mm	2.22 mm
2 <sup>nd</sup> Band	2.17 mm	1.91 mm
Top Band to Nose	17.91 mm	15.91 mm
Base Type	5	5
Cavity Type	2	2
Cavity Depth	9.15 mm	6.94 mm
Number of Scoriate Lines	76	59

Table 1. Summary of measurements taken of the Pea Ridge bullets. Base and Cavity Types are after McKee and Mason (1980).

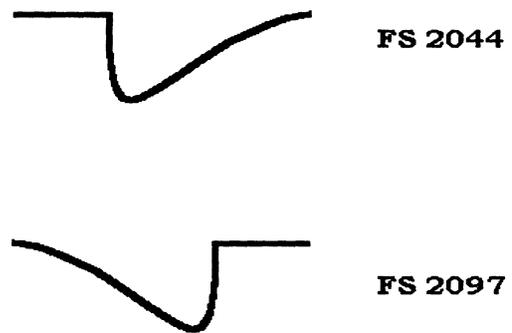
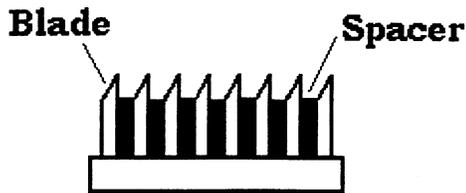


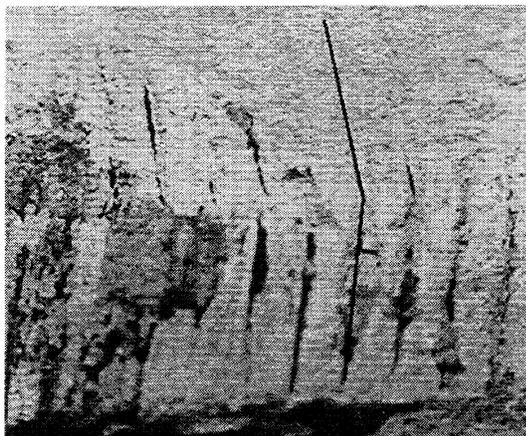
Figure 2. Cross Sections of Scoriations.

Further examination found there were sections on the bullets that showed errors in the scoriations. For example, on the .54 caliber bullet, there is an area of overlapping scoriations. On the .69 caliber, one section

of scoriations changes direction. The fact that overlapping and malformed scoriations were found gives further evidence to support the theory that the bullets were rolled over some type of bladed device (See Figures 3, 4, and 5).



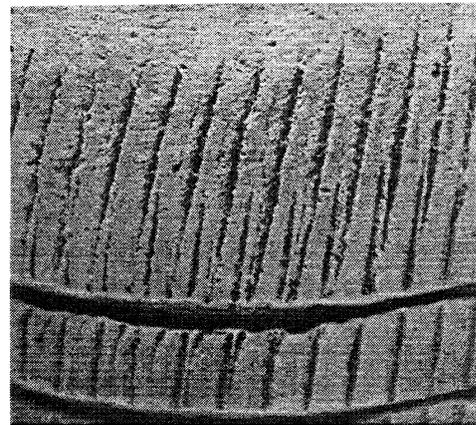
**Figure 3. Possible design of machine used to make scoriations. The bullets would have been rolled across the device.**



**Figure 4. FS 2044 – Note how scoriations change direction. Black line added to illustrate change.**

To verify the hypothesis that the same device was used to make the scoriations on both bullets, a mathematical analysis was conducted. Each bullet had a different number of scoriations and a different circumference. This allowed for a direct comparison of the distance between the scoriations. If the distance was the same, then the same device was used to produce the markings. Further, this method could show that circumference directly affected the number of scoriations present and further support the idea the bullets were rolled

across the device in Figure 3. If the distances were different, doubt could be cast on the device hypothesis and focus on a process more variable, like hand cutting of the scoriations. Table 2 details the calculations undertaken.



**Figure 5. FS 2097 – Note the two sets of scoriations that overlap.**

**Table 2: Mathematic relationship calculations for the scoriations on FS 2044 and 2097.**

**Key**

*d* – diameter of the bullet. Averaged from two measurements taken just above the top rim. Each measure was 90 degrees from the previous measurement.

$\pi$  - for the purposes of these calculations, value of 3.14 was used.

$\epsilon$  - allows for error due to overlapping scoriations.

$\epsilon_1$  - overlapping on FS 2097

$\epsilon_2$  - overlapping on FS 2044

*c* – circumference

$$c = d(\pi)$$

*D* - distance between scoriations

*D*<sub>1</sub> - distance between scoriations for FS 2097

*D*<sub>2</sub> – distance between scoriations for FS 2044

$s$  - number of scoriations

$$D = c / (s + \epsilon_x)$$

### **Calculations**

FS 2097 - .54 caliber

$s = 59$

$d = .5280$  inches

$c = d(\pi)$

$c = .5280$  inches (3.14)

$c = 1.65792$  inches

$D = c / (s + \epsilon_x)$

$D = 1.65792 / (59 + \epsilon_1)$

$D_1 = .02810$  inches

FS 2044 - .69 caliber

$s = 76$

$d = .67825$  inches

$c = d(\pi)$

$c = .67825$  inches (3.14)

$c = 2.129705$  inches

$D = c / (s + \epsilon_x)$

$D = 1.65792 / (76 + \epsilon_2)$

$D_2 = .02802$  inches

By analyzing the calculations, it seems justifiable to conclude that the scoriations on each bullet were made by the same process and probably by the same machine (Figure 3). The slight difference seen in values  $D_1$  and  $D_2$  is negligible given the overlapping of the scoriations. In reality, taking into account the adjustment  $\epsilon$ , the values are probably closer than was demonstrated by the calculations.

### **Finding an Explanation**

The scoriations were made by the same process, on the same machine and placed on two bullets of different calibers. Where did these bullets come from and why did they have scoriations?

Several hypotheses were developed to explain the scoriations. Most were rejected as not viable. Ideas such as a lubrication or cleaning function for the markings were considered, but rejected. Most bullets need some form of lubrication in order to properly exit the barrel of the weapon that

fired them. Inspection of the scoriations found that they lacked sufficient cavity space to hold any usable amount of lubrication. The hypothesis that the scoriations represented a form of cleaning or scouring mechanism was also considered. Specially designed bullets that cleaned powder and wad debris/build-up from the barrels of rifles were developed prior to the Civil War. After a certain number of shots, it was necessary to fire a so-called 'cleaning bullet' (like the one designed by Williams) to clear the barrel of any build-up that would hinder weapon function. As with the lubrication theory, the cleaning theory was rejected on the basis that the scoriations lacked both sufficient cavity area and certain abrasive qualities that would have facilitated barrel cleaning.

A more probable theory was formed after a photograph of a .44 caliber Colt Dragoon bullet was seen in a reference book (McKee and Mason 1980:58-59). It had similar, yet different lines at its base. Weapons of the Civil War age were plagued by wet powder. Pistols and shoulder arms were susceptible to water, making the powder in their chambers useless. Various attempts at manufacturing cartridges to protect the powder load occurred at various points before, during, and after the Civil War. Cloth, paper, and metal were all used. Indeed, the lines at the bottom of the Colt bullet were no doubt caused by a cartridge case.

But what does this mean for the Pea Ridge bullets? Usually the cartridge material was attached to a bullet with some type of adhesive. It is believed that the scoriations on the Pea Ridge bullets were used to attach a cartridge of unknown material. The scoriations most likely gave the glue a point of attachment on the bullets. The Federals had experimented with using striations on shoulder arm projectiles and even produced a bullet with short longitudinal lines for cartridge attachment that was developed for the Union carbine (Lewis 1968:120). The lines served as crimping for holding the bullet and casing together, much like a modern cartridge.

This crimping reduced the amount of time needed to load the weapon and protected the powder from water contamination. With this said, a time frame and framework must be given for the bullets found at Pea Ridge.

### Who carried the Pea Ridge bullets?

There were strains on supplies of weapons and ammunition during the war, especially in the months following its outbreak. With these strains it seems safe to conclude that weapons testing was moot during the first months of the war. It is therefore possible that the scoriated bullets were from a pre-war experimental batch produced by the Union in an attempt to create a more waterproof and reliable rifle load. Neither bullet was fired. But, did Union troops actually use the scoriated bullets? By consulting the history of the Pea Ridge battle and comparing the locations mentioned to the archaeological data, it is possible to know what Federal units might have been issued the scoriated bullets for use in the March 1862 engagement. The bullets were found in Clemon's Field. The fighting here was particularly intense and was conducted on the Union side by the 35<sup>th</sup> Illinois, 3<sup>rd</sup> Illinois Cavalry, 4<sup>th</sup> Iowa, and 8<sup>th</sup> Indiana (Shea and Hess 1992:198-202). Unfortunately, in the available histories and references to these units, no mention is made to a peculiar batch of ammunition. It would seem that since the bullets considered here were two out of over 100 they were rare and not noteworthy when issued. It is also possible that the rounds were carried by Confederate forces. Many Union arsenals were taken or surrendered to Southern forces prior to the formalization of hostilities. These captured rounds of federal ammunition were used by Confederate forces in the early battles of the war.

Regardless of who carried them, it is impossible to say whether or not the bullets saw battle with their cartridges still attached. It is possible that the bullets were harvested from old or ineffective cartridge loads and sent to battle along with other styles of minié ball.

### Conclusion

Two unusual minié balls from the Clemon's Field area of Pea Ridge National Military Park were uncovered during an archaeological field investigation in March 2001. These bullets, .54 and .69 caliber, had longitudinal lines that ran perpendicular to the usual minié ball grooves. Mathematic analysis of the markings, termed scoriations (scoring + striation), found that the lines were produced by the same machine. Consultation with Civil War ammunition references turned up some clues as to the function of the scoriations, but no other examples of the bullets were discovered. After formulating a series of hypotheses that included lubrication or cleaning functions, it was determined that the scoriations were most probably a method for cartridge attachment. The scoriations would have served as attachment points for the adhesive used to glue the bullet to the cloth or paper cartridge. Doing so would have protected the powder from water contamination. Since only two bullets have been found, it is reasonable to conclude that the bullets were rare and might be part of a failed Union munitions experiment. During the chaos of arsenal capture during the days preceding the beginning of the Civil War, these bullets could have been captured by Southern forces and pressed into service.

It is hoped that the next two planned years of archaeological exploration and research at Pea Ridge will yield more scoriated bullets that will increase the database and hopefully give credence to the explanation that has been advanced in this paper or allow a new one to be formed.

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