A COMPARISON OF THREE INDIVIDUAL BARRELS PRODUCED FROM ONE BUTTON RIFLED BARREL BLANK

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A number of factors led to the consideration of the uniqueness of button rifled barrels. The first was an article in this journal by Murdock (1) concerning consecutively button rifled .22 barrels. In affirming the individuality of the barrels he concluded that there was no carry-over of family-type markings. This was reassuring but he also indicated "some coarse (Fig. No. 14) and some fine striae were found to agree (Fig. No. 15)". Figure 15 in the Murdock article shows fine detail matching on two bullets which were fired from two different microgroove barrels. Another factor that prompted an investigation into the uniqueness of button rifled barrels were imperfections on a used rifling button obtained from the Wilson Arms Company. A microscopic examination of the button revealed numerous longitudinal scratches on the surface of the button. These scratches were primarily on the section of the button which is just ahead of the maximum diameter of the rifling portion (figures 1 and 2). A new button does not have any such imperfections (figures 1 and 3). Button rifling is noted for the large number of barrels that can be rifled by one button. Could these scratches leave carry-over type marks in numerous barrels, and if so, would this cause a problem for firearms examiners?

The literature was searched concerning the uniqueness of rifled barrels. A number of articles have been written on the comparison of test firings from consecutively rifled barrels. Cut rifling has been examined by Lutz (2) and Skolrood (3). Hammer forged barrels have been examined by Freeman (4). Buttoned barrels have been examined by Austin (5) and Murdock (1). In all the above instances the barrels were rifled as separate pieces.

To ascertain the possible carry-over effects from imperfections on a rifling button, the following 'worst case' experiment was devised. Three .30 caliber revolver barrels, all cut from the same section of rifled tube, were graciously supplied by George Wilson III of the Wilson Arms Company. They were machined at Sturm, Ruger to fit the Ruger .30 Carbine New Model Blackhawk revolver (figure 4). The machining consisted of tapering, threading, crowning and cutting the forcing cone. The barrels were all machined in the same orientation; no barrel is reversed with respect to the direction of bullet passage. Bullets fired from these barrels would be as alike as possible while still being fired from different barrels.

TEST FIRING

Prior to firing, a Mikrosil cast was made of a short section of the muzzle and breech end of each barrel. In order to minimize variables during test firing all barrels were fitted to the same revolver frame for the testing. In addition, one lot of ammunition was used and the initial five tests through each barrel were fired in the same chamber of the cylinder. Full metal jacket bullets were used and were recovered in a water tank. In the course of the study 30 rounds were fired from Barrel 1, and ten rounds each were fired from Barrels 2 and 3.

COMPARISONS

The Mikrosil casts were compared on a comparison microscope to determine if any carry-over type longitudinal striae had persisted in the rifling of the three barrels. The barrel lands showed no significant marks from the passage of the button. The barrel grooves, however, had numerous longitudinal striae due to the passage of the rifling button. A comparison of the Mikrosil casts showed that a few of the lines

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persisted through the length of all three barrels, but the majority of the groove striae changed along the length of the barrels.

The comparison of the bullets led to some very useful findings. The first thing that was apparent was that a newly rifled barrel undergoes some fairly rapid changes in the first few firings. Bullet #1 from each barrel exhibited numerous well defined lines in the land impressions which gave them a rough appearance. Subsequent tests showed a rapid change in number and size of these marks. As the firing progressed the surface of the land impressions become smoother, with the size of the striae becoming finer (fig. 5). This made comparisons of the early test firings difficult. As an example, for Barrel 1 it was not possible to make a conclusive match between test bullets #1 and #2. By test bullets #9 and #10, however, the bullets were very similar in appearance. A match of these two bullets was made based on fine detail in the land impressions as well as the comparatively coarser detail in the groove impressions. Test #30 was then compared to #9. A match could be made easily on groove impressions, but the finer detail in the land impressions, while similar, did not possess enough detail to stand alone as an identification. In comparing test #1 to #2 from Barrel 2, a match was possible but only on a groove impression. Again, the first bullet had a much rougher surface than the second. Later tests from Barrels 2 and 3 followed the same pattern of change as those from Barrel 1.

Intercomparison of the bullets from the three barrels was then conducted. Although the initial bullets from each of the barrels showed the same type of roughness and each barrel exhibited a settling-in period, it was not possible to find correspondence of individual characteristics; no match could be found when comparing bullets from different barrels. This held true for the first bullets and those fired later. For instance, bullets #9 and #10 from Barrel 1, and bullets #9 and #10 from Barrel 2 were intercompared. Bullets #9 and #10 from Barrel 1 were easily matched as were #9 and #10 from Barrel 2. Each barrel had 'settled in' fairly well by this time and they were firing bullets that were similar in surface appearance (i.e. 'roughness'). In this case the land impressions and groove impressions were useful for comparison. When comparing #9 to #9 or #10 to #10 from the different barrels it was possible to get the bullets in phase by use of the groove impressions. There was sufficient carry-over for phasing but not enough for a conclusive identification. The land impressions, not surprisingly, bore no consistency in markings.

RESULTS AND CONCLUSIONS

This worst case study, in which the three barrels tested were all cut from the same section of rifled tube, has reaffirmed past studies that have shown button rifled barrels to be unique.

While this study found these barrels to produce individual marks on bullets, one word of caution should be remembered. Biasotti has written "There is little question about the individuality of button swaged barrels when the physical processes involved are analyzed," but warned of "...any gross characteristics which appear to extend the entire length of the rifling..."(6). In approaching a comparison, the firearms examiner should make a point to examine the barrel interior. Any large defect that can be seen to follow a land or groove from one end of the barrel to the other is probably the result of a defective rifling tool; whether the barrel was buttoned, broached, or hammered. Many barrels could be produced by such a tool and could contain similar defects. Such features should be considered to be class characteristics. These Wilson/Ruger barrels had some fine striae that were shown by cast comparisons to extend the entire length. The likely sources of these persistent barrel marks are small wear defects on the button. These marks, however, were not visible on visual examination of the barrels and did not transfer to fired bullets.

OTHER FINDINGS

One other interesting finding that came from the study was the effect of the revolver cylinder chamber on the fired bullet. Murdock has reported that identifiable markings can be left on a fired bullet by a damaged chamber (7). A defect on the very front edge of one chamber of a Smith & Wesson revolver left reproducible marks on bullets fired from that chamber. In this study of the Wilson/Ruger barrels, it was found that one groove impression area of test fired bullets always had similar markings (figure 7). These marks appeared on bullets fired from all three barrels and were oriented in the same location with respect to phase (orientation) lines scribed on each bullet prior to firing. These marks were always at the base of the bullet, and were usually suitable for comparison. No obvious defects such as those cited by Murdock were on the front of the Ruger cylinder. To determine if the marks left on the bullets were due to expansion of the bullet base while in the chamber itself, the revolver was fired without a barrel. It was found that the bullet was indeed marked in the same location. Since Ruger drills and reams their cylinders, any marks on bullets caused by the chambers can be considered to be individual marks. These markings could be useful in cases where identification is difficult. The particular chamber might contribute significantly to the marks present on an evidence bullet. To determine which is the chamber of interest, the firearms examiner should mark test fired bullets in such a way that each test firing can be related back to the proper chamber. This allows additional tests to be made from the chamber that produces marks most like those on an evidence bullet.

When doing the test firing without a barrel an unexpected situation occurred. The bullets were heavily bulged at the base (figure 8). This happened when test firing with full metal case bullets which have exposed lead at the base AND when using soft point bullets which have the jacketing encompassing the base. This phenomenon is commonly seen when firing a lead bullet with a hollow base from a short barrel gun, but to see if happen with a jacketed bullet was surprising.

I wish to thank George Wilson III of Wilson Arms for not only his generous help in the supplying of the barrels and information necessary for this project but also for his general support of the Association.

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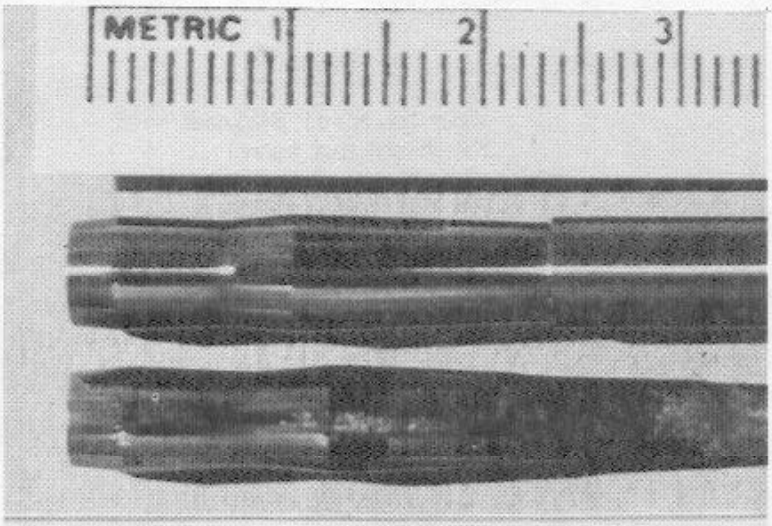

FIGURE 1

TOP- New Rifling Button: 243 caliber

BOTTOM- Used Rifling Button: 22 caliber

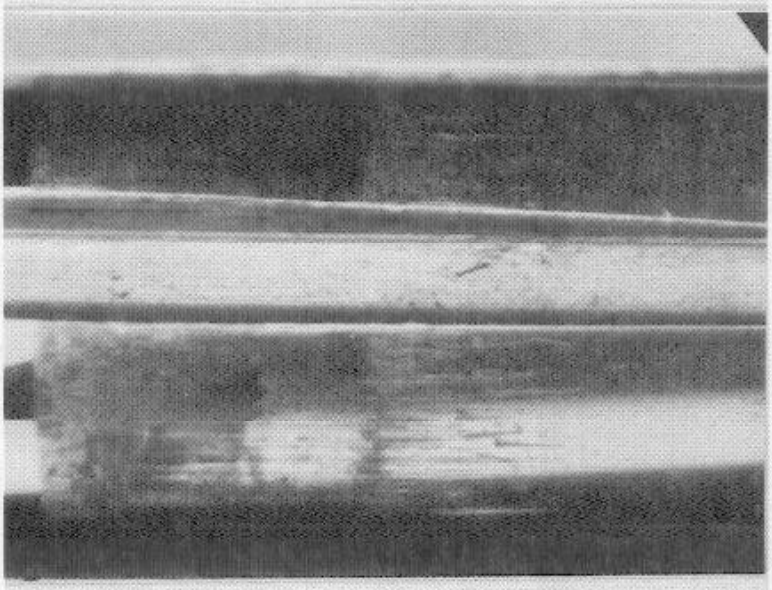

FIGURE 2

Rifling forming section of a used 22 caliber button. Direction of travel is from left to right.

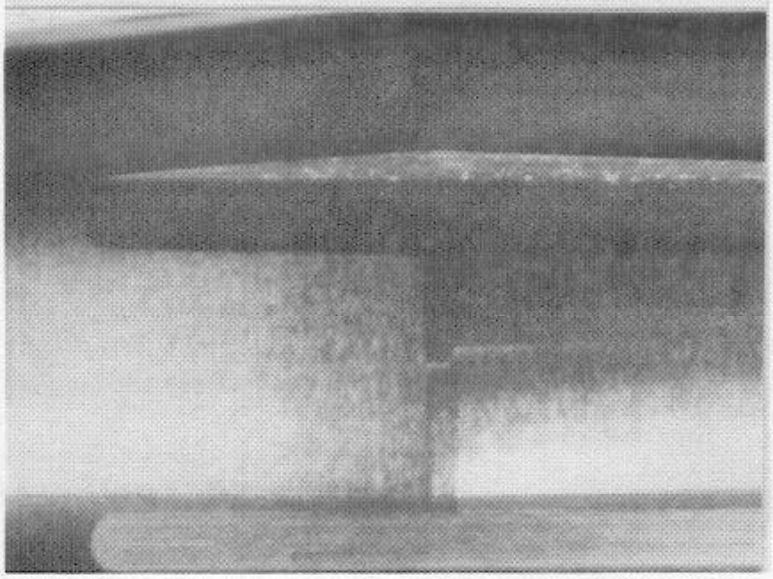

FIGURE 3

Rifling forming section of a new 243 caliber button.

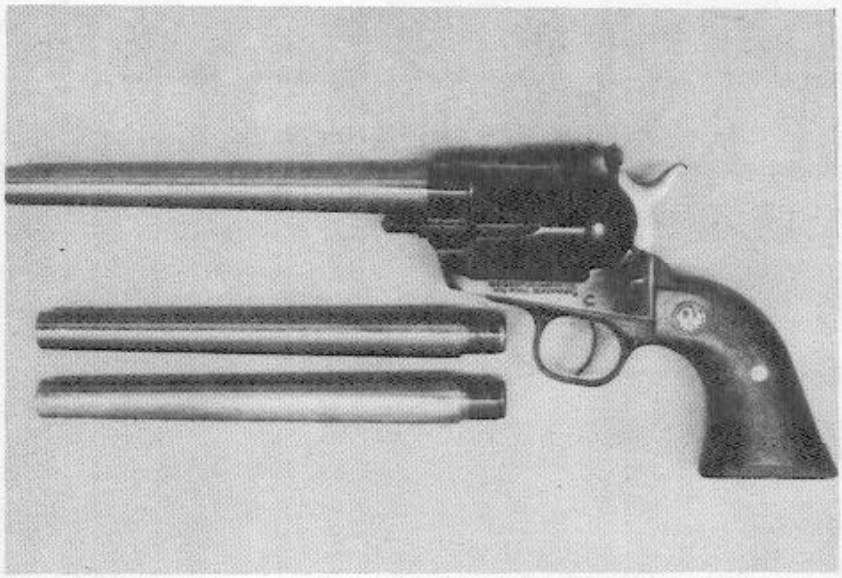

FIGURE 4

Ruger New Model Blackhawk with the Wilson test barrels.

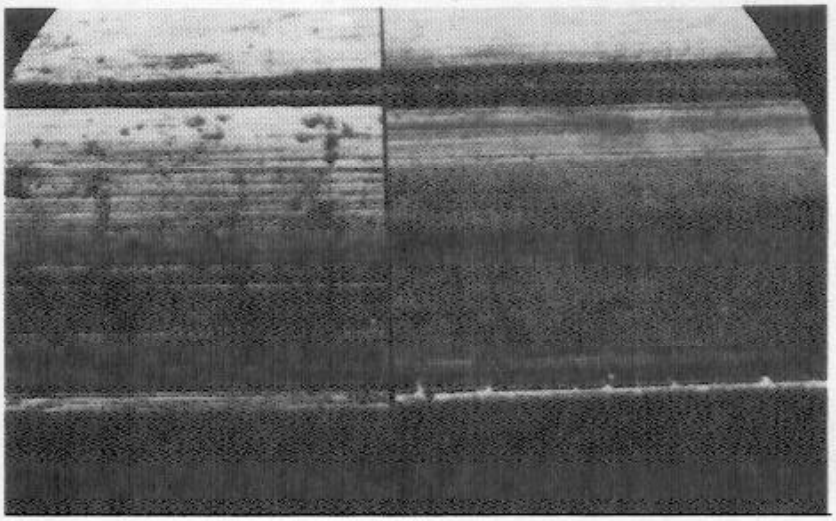

FIGURE 5

Land Impression Comparison:

Barrel 1 - T1 /T10

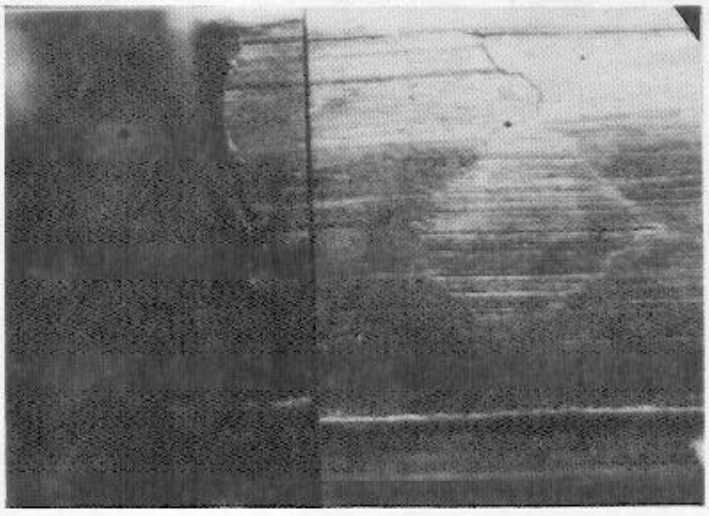

FIGURE 6

Chamber marks on groove impression at base of bullet.

T1 from Barrel 1/T1 from Barrel 2

FIGURE 7

Bullets fired from revolver without barrel installed.

Top: FMJ

Middle: JSP

Bottom: 30 Carbine Cartridge

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