The "Clean Fire" Ammunition is not so clean

P-GSR particle
Complements of David Flohr,
U.S. Army Crime Laboratory

We tested three types of "Clean Fire"(CF) ammunition. According to the manufacturers CF ammunition is free of lead, barium and antimony. Without those elements present, how are we to detect a classic Gunshot Residue (GSR) that is defined as particles with that composition? Even when lead is considered to be optional for GSR definition, without barium and antimony what might the new definition be? Hopefully, this analysis will tell us.

To our surprise, we found plenty of these elements present in samples collected from the shooter's hand after firing the CF ammunition.

The two handguns, Para-Ordnance P14-45 semiautomatic pistol and Taurus Tracker 357Magnum revolver, were carefully cleaned with solvent, phosphor bronze brush, then electrochemically cleaned and solvent and brush again. The test firing was done at an outdoor range to eliminate possible range contamination.

The following are results from GSR analysis of the samples. Each sample was collected on double sided carbon based tape and without any further preparation, inserted into the microscope for analysis. Each sample was scanned across a 5x5mm area with 0.5 micron resolution. With this setting, particles smaller than 0.5 micron were ignored. Each particle was measured with about 3% precision and the x-ray analysis was set to 5 seconds live time or 5000 counts which ever was reached first. The number of particles analyzed in each sample was between 5000-13000 particles.

In this analysis, the concentration of a given element or compound is expressed as a ratio of area covered by all particles of the same composition to the total scanned area. Normally shown as area percent, but for very small ratio as in the cases shown here, we used parts per million instead. This value is far more accu-

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In solving a problem of this sort, the grand thing is to be able to reason backwards. That is a very useful accomplishment, and a very easy one, but people do not practise it much. In the everyday affairs of life it is more useful to reason forward, and so the other comes to be neglected. There are fifty who can reason synthetically for one who can reason analytically.

"A Study in Scarlet "
Sherlock Holmes

Winchester Clean™ WC381 Ammunition:

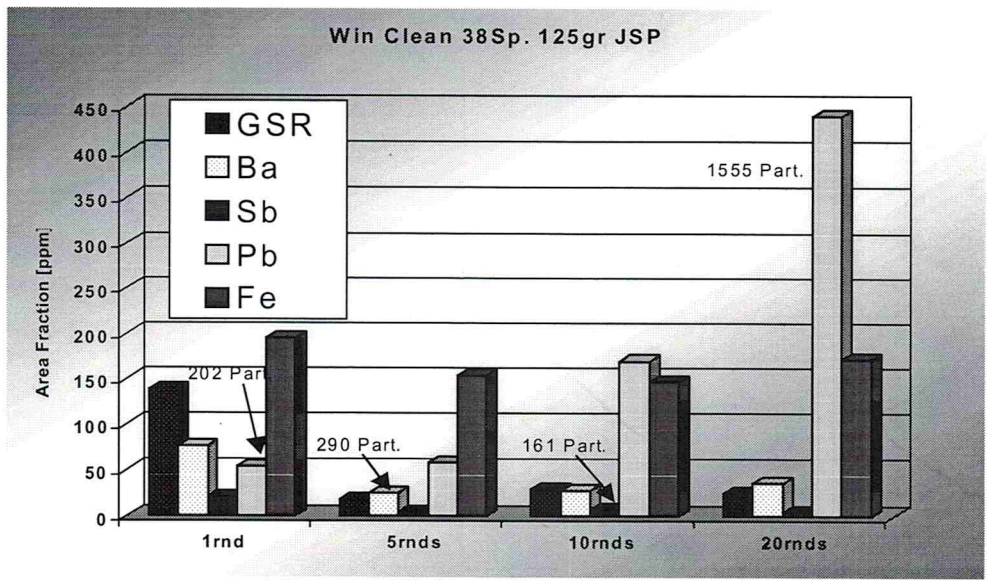

Fig. 1: *Win Clean™ 38 Special The concentration of heavy elements does not appear to be much cleaner than Win Western™ in Fig. 8*

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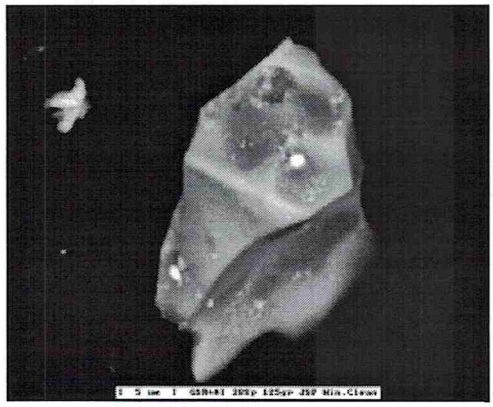

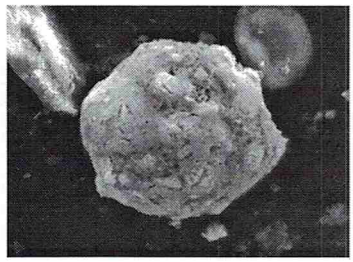

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Fig. 2: *Two GSR particles "Win. Clean™" ammunition selected from a set of 33 large ones. The average size is only about 0.9 microns.*

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rate than a simple particle count since it includes the particle size as well as particle count.

Some of the bars in the diagrams include the actual particle count just to illustrate the particle population. Please note that the number of particles does not always follow the concentration or the height of a given bar. This is because the particle count alone does not tell us anything about the size distribution.

The relatively high lead concentration may be explained by the construction of the Jacketed Soft Point (JSP) bullet. The front of the bullet is not jacketed and the lead core is exposed. Thus the "soft point." The CCI Blazer CF® features "Total Metal Jacket" resulting in a signifi-

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Winchester "Super Clean" NT™ 38 Special Ammunition:

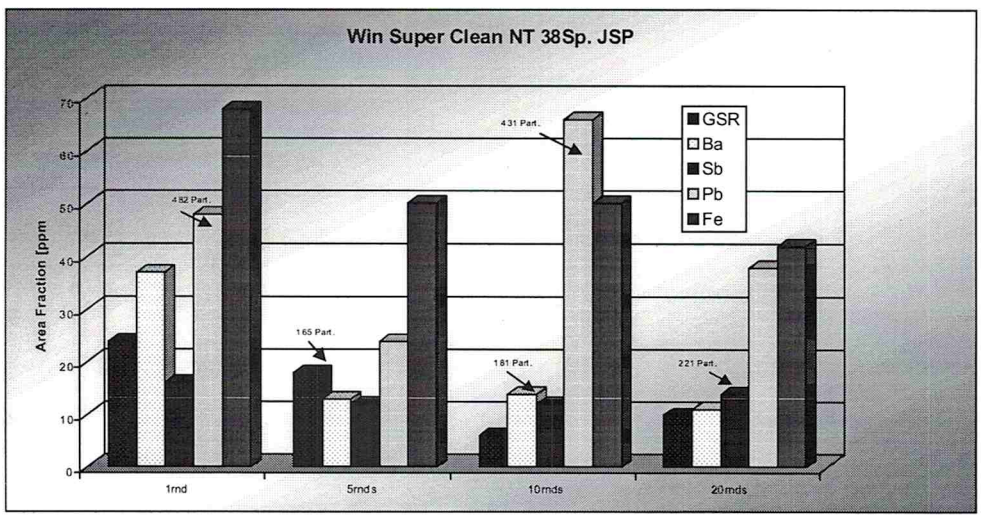

Fig. 3: *A much cleaner Win Super Clean NT™ [for Non Toxic]. Note the change in the vertical scale.*

Even if there is only one possible unified theory, it is just a set of rules and equations. What is it that breathes fire into the equations and makes a universe for them to describe? The usual approach of science of constructing a mathematical model cannot answer the questions of why there should be a universe for the model to describe. Why does the universe go to all the bother of existing?

Stephen W. Hawking

The "Clean Fire" Ammunition is not so clean...
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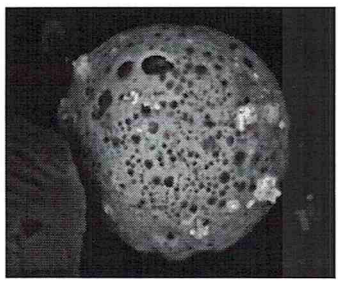

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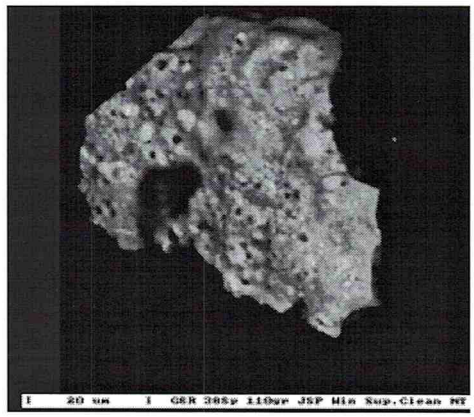


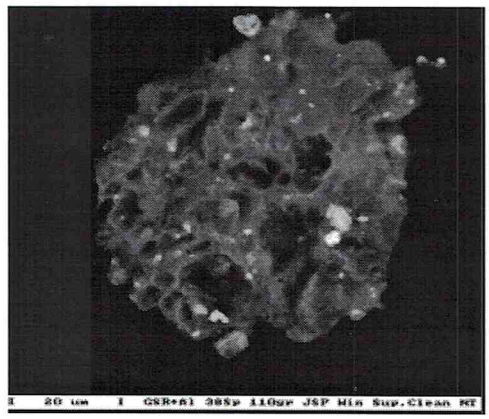


Fig. 4: *Two large GSR particles from " Win Super Clean™" ammunition.*

For every human problem, there is a neat, simple solution; and it is always wrong.

Mencken's Metalaw

CCI Blazer "Clean Fire®":

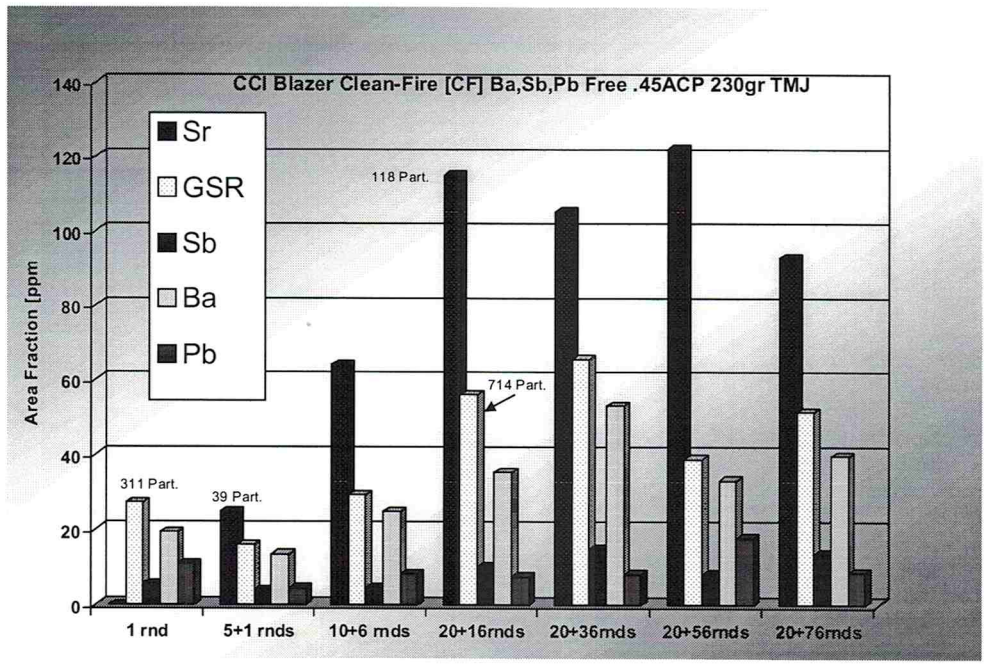
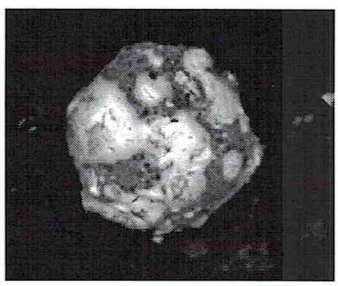


Fig. 5: *This is the cleanest ammunition tested. The low lead concentration is mostly due to the "Total Metal Jacket" bullet and lead free primer. One of the primary elements in this CF primer is strontium. Note the Sr increase with number of rounds fired until it settles around 100 ppm after 36 rounds. The lead stays fairly constant regardless of the number of rounds fired while the GSR, Ba and Sr also increases until it stays constant after 36 rounds. If we assume that the heavy elements originated from less than perfectly clean guns, we would expect their concentration to decline with number of rounds fired.*



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The "Clean Fire" Ammunition is not so clean... *Continued*

(Continued from page 5)

cantly lower lead concentration. See fig. 5.

A typical GSR analysis in fig.8 of 9 mm ammunition demonstrates concentrations of heavy elements expected from what is ***not*** claimed to be "Clean Fire" type.

The above results indicate that the cleanest ammunition is the CCI Blazer CF® 45ACP, followed by Win Super Clean™ 38 Special, while the Win Clean™ 38 Special is not much different from standard ammunition.

The concentration of GSR particles in the cleanest ammunition is still high enough to be reliably detected. For the present, we don't have to worry about the problem of detecting GSR from the so-called "clean fire" ammunitions.

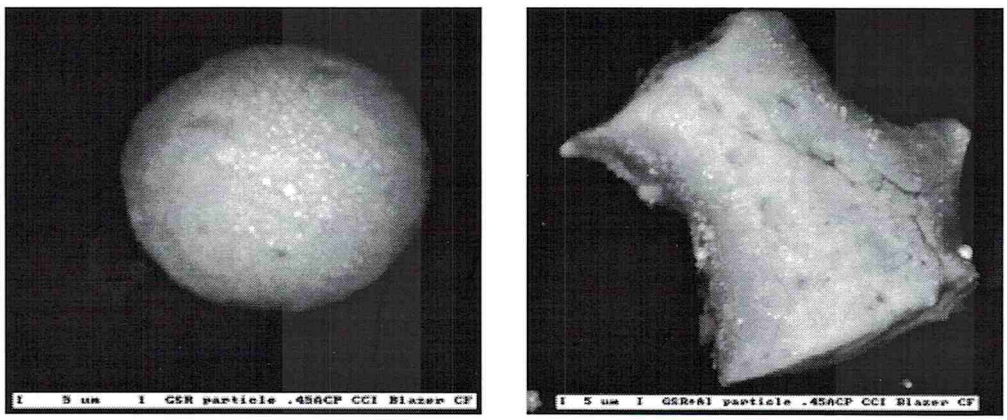


Fig. 6: *GSR particles found in CCI Blazer CF® Ammunition.*

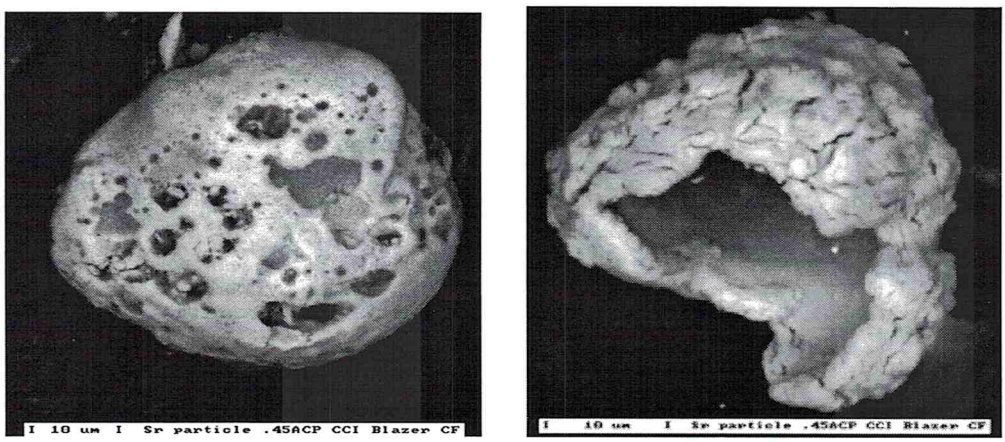


Fig. 7: *More interesting strontium particles found by the GSR analysis from CCI Blazer CF® sample. Most of the Sr particles were spheroids quite larger than the GSR particles. The average diameter was found about twice the GSR particles [1.8-2.0 micron].*

Forensic Science Personal Web Pages

Zeno's Forensic Site
by Zeno Geradts
http://forensic.to/forensic.html

Forensic Science
by Mike Martinez
http://home.satx.rr.com/forensic/

Carpenter's Forensic Science Resources by R. Scott Carpenter
http://www.tncrimlaw.com/forensic/

Crimes & Clues
by Daryl W. Clemens
http://crimeandclues.com/

Deans Forensic Web Page
by Dean Fetterolf
http://members.prestige.net/dfettero/home.html

Forensic Science Web Pages
http://home.earthlink.net/~thekeither/Forensic/forsone.htm

FirearmsID.com
by Jeffrey Scott Doyle
http://www.firearmsid.com/index.html

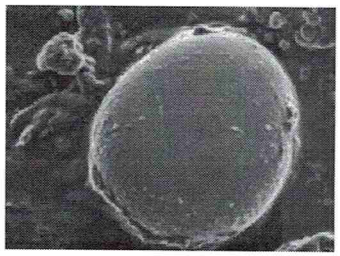
Reddy's Forensic Page
by Reddy P. Chamakura
http://www.forensicpage.com/

Crippin's Place
by James (Jamie) Crippin
http://members.home.com/jcrippin/

Evidence The True Witness
by The students of Windsor High School, CA
Glenunga International High School, Australia
http://library.thinkquest.org/17049/

Law Office of Kim Kruglick
http://www.kruglaw.com/forensic.htm

The "Clean Fire" Ammunition is not so clean... *Continued*



Lead, Barium and Antimony
IAMA Collection

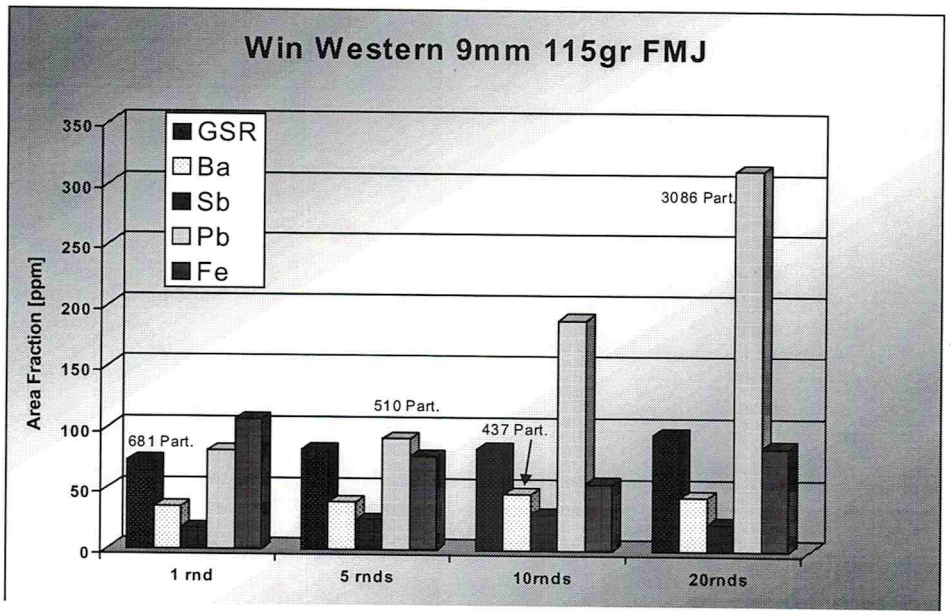


Fig.8: Typical GSR analysis of "not clean" Win Western® 9 mm FMJ ammunition. Note that lead concentration from this ammunition is about the same as "Win Clean™" ammunition.

If it weren't for my lawyer, I'd still be in prison. It went a lot faster with two people digging.

Mister Boffo

(Continued from page 7)

However, this may change when a truly clean type comes on the market.

We tested only three types of "clean" ammunitions that are easily available over the counter and any conclusion based on this limited study must be viewed as only preliminary and limited.

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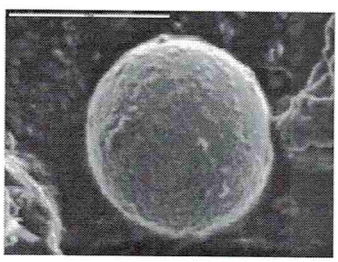

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