Chemical Analysis of 1794 & 1795 U. S. Silver Coins – Part 3

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1. Introduction

This is the third article of a multi-part series. Part 1 was published in the September 23, 2018 *John Reich Newsletter*. Part 2 was published in the October 7, 2018 *John Reich Newsletter*. The articles can also be downloaded from the *Newman Numismatic Portal* (https://nnp.wustl.edu/).

The Mint and Coinage Act of April 2, 1792 specified that silver coins were to contain 1485 parts of *pure* silver and 179 parts copper alloy. This equated to a standard of 1485 / 1664 or 89.24278% or 89.24+% pure silver, and 10.75722% or 10.76-% copper.

Based on documents written by Mint Directors Henry William de Saussure and Elias Boudinot[1], it has been postulated that the Mint attempted to produce some, most, or all of the 1794 and 1795 dated silver coins to a standard of 90% silver and 10% copper. If true, this was a violation of the Mint and Coinage Act.

Part 1 provided the historical overview of events that laid the foundation for this project. Part 2 reviewed the technologies available today to perform chemical analysis, the issues analyzing a silver-copper alloyed coin, and the goals of this project. This article provides the:

1. X-ray Fluorescence (XRF) analysis data from the surface and subsurface of 1795 Half Dollars,

2. Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) analysis data from the subsurface of 1794 and 1795 copper coins, and 1794 through 1855 silver coins,

3. results of the statistical analyses performed on the ICP-AES data, and

4. preliminary conclusions as to whether the Mint's melting targets were most likely 89.24+% silver and 10.76-% copper alloy, or 90% silver and 10% copper.

Note that a distinction has to be made between *refining* and *melting*. Silver bullion deposits were refined by the Mint in multiple manageable batches or heats. Each refined heat was weighed, and using pencil and paper, the math was performed to calculate the appropriate amount of copper to add to the silver. The silver and copper was then melted, and poured into one or more ingots. Whereas the refining target was

100% pure silver, the melting target was either 89.24+% silver and 10.76-% copper, or 90% silver and 10% copper. Although this step in the Mint's workflow is referred to as Melting & Refining, it is actually Refining & Melting.

Also note that this article uses the terms *trace* and *residual* in reference to unanticipated elements observed. Trace refers to a relatively low amount and residual refers to a relatively high amount of that respective element.

2. X-ray Fluorescence Surface Results – January, 2017

X-ray Fluorescence (XRF) analyzers determine the chemistry of a sample by measuring the fluorescent (or secondary) X-ray emitted from a sample when it is excited by a high energy X-ray source. The intensity of X-rays produced provide a measure of the amount of the element present by comparisons with *reference standards*. These standards are obtained from XRF manufactures and scientific industry suppliers. Depending on the specific elements and compounds expected to be observed, the cost for the reference standards can get very expensive.

In January, 2017, XRF analysis was performed on the surfaces of two 1795 Half Dollars. Although Half Dollars are approximately 2,150 microns thick, the XRF analysis could only penetrate 6 to 10 microns. Three different areas of each coin's surface was analyzed. Each area had above standard silver content (94% - 97%), below standard copper content (2% - 4%), and silicon (see Table 1).

The 1795 Half Dollars in Table 1 are listed in emission order sequence per *Early United States Half Dollars, Volume 1, 1794 – 1807* by Steve Tompkins.[2] The 1795 Overton 122 (or O-122) was the 5th 1795 Half Dollar die marriage struck, therefore it was from the early part of the emission order sequence. The 1795 O-105 was the 25th 1795 Half Dollar die marriage struck, therefore it was from the later part of the emission order sequence.[2]

What	Area	Silver %	Copper %	Silicon %
1795 O-122	1	97.43	2.09	0.48
	2	97.07	2.42	0.51
	3	96.36	3.11	0.53
1795 O-105	1	95.49	3.87	0.64
	2	94.45	3.92	0.63
	3	95.76	3.61	0.63

Table 1 – XRF Silver Coin Surface Analysis (January, 2017)

2.1 Copper Leaching And Environmental Contamination

Copper is much more prone to corrosion than silver. During the course of normal circulation and expose to air, liquids, and other environmental contaminants, copper will leach (dissolve) from the surface of silver coins. This results in an artificially higher percentage of silver and a lower percentage of copper on the surface. Based on only the results in Table 1, it was hypothesized that the presence of silicon was a result of environmental contamination as the coins circulated.

While surface analysis employing XRF is suitable for qualitative analysis, it is an inadequate methodology to base any scientific conclusions with respect to the true composition of the coin(s) in question.

3. X-ray Fluorescence Subsurface Results – January, 2017

The 1795 O-122 and 1795 O-105 Half Dollars were sliced into three pieces with a diamond cutter to minimize *kerf* loss [the loss associated with the cutting tool]. The center piece of each Half Dollar was ground, removing approximately 10% of the metals from each side and edge, and polished to insure uniform removal. The target of 10% removal by weight was to comfortably insure that no surface effect would interfere with the results.

In January, 2017, XRF analysis was performed on three different areas within the subsurface of each of the two 1795 Half Dollars. The results identified 90% - 91% silver content, 9% -10% copper content, and no silicon (see Table 2).

What	Area	Silver %	Copper %
1795 O-122	1	90.07	9.93
	2	90.38	9.62
	3	90.78	9.22
1795 O-105	1	90.04	9.96
	2	90.45	9.55
	3	91.02	8.98

Table 2 – XRF Silver Coin Subsurface Analysis (January, 2017)

3.1 Environmental Contamination Confirmed / No Trace Elements

Whereas the XRF analysis of the surface of the coins in Table 1 identified 0.48% to 0.64% silicon, no silicon was detected within the subsurface of the coins. The silicon on the surface of the coins was therefore most likely due to environmental contamination.

XRF analysis within the subsurface of the coins identified no trace elements. Since known reference standards were not available, this analysis was deemed semi quantitative. It was then decided that a better methodology was required for the level of discrimination for this project.

4. ICP-AES Results – February 2017

In February, 2017, the ground and polished center pieces of the 1795 O-122 and 1795 O-105 Half Dollars were sent to an independent laboratory. Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) analysis was performed on two different 0.5 gram samples from each coin (see Table 3).

With respect to ICP-AES analysis, each sample is first dissolved in nitric acid; a highly corrosive acid. A plasma torch then vaporizes fine droplets of the sample at a temperature of approximately 12,000 degrees Fahrenheit. The atoms of the sample generate wavelengths that were measured by an array of semiconductor photodetectors. Refer to Section 6 for the analysis of the ICP-AES results.

What	Sample	Silver %	Copper %	Gold %	Lead %	Other %
1795-122	1	90.00	9.20	0.38	0.35	0.07
	2	90.02	9.18	0.38	0.35	0.07
1795-105	1	90.40	9.16	0.20	0.22	0.02
	2	90.46	9.10	0.20	0.22	0.02

Table 3 – ICP-AES Silver Coin Subsurface Analysis (February, 2017)

5. ICP-AES Results – Copper Coins - August, 2018

In July, 2018, the ground and polished center pieces of one 1794 Large Cent and one 1795 Half Cent were sent to an independent laboratory. ICP-AES analysis was performed on two different samples from each coin. The results identified 98% - 99%

copper, with residual levels of lead and arsenic, and trace amounts of bismuth and silver in each coin (see Table 4).

5.1 There Is Arsenic, Bismuth, Lead And Silver In Copper

Arsenic, bismuth, lead and silver are generally found in copper ore. The processes available in the 18th century to remove the arsenic, bismuth and lead included *liquation*, *roasting* and *smelting* of the copper. Silver was separated and recovered from the copper via the *parting* process. All of these processes took time and cost money.

What	Sample	Copper %	Lead %	Silver %	Gold %	Arsenic %	Bismuth %
1794 Cent	1	98.20	1.62	0.01	0.00	0.08	< 0.01
	2	98.20	1.62	0.01	0.00	0.08	< 0.01
1795 ½ Cent	1	99.00	0.36	0.08	0.00	0.37	0.15
	2	98.99	0.36	0.08	0.00	0.37	0.15

Table 4 – ICP-AES Copper Coin Subsurface Analysis (August, 2018)

Based on entries in Mint ledgers stored at the National Archives and Records Administration (NARA), the Mint purchased approximately 75,000 Troy pounds of copper during 1792, 1793 and 1794; including approximately 35,000 Troy pounds of copper sheets that were imported from England in 1793 and 1794.[3] What is not known are the specific sources of the copper for any of the 1794 and 1795 copper coins, whether the copper was refined, and if any other processes were performed in an attempt to remove and/or part other elements. It is possible that the lead in the copper may be a combination of a trace level of it naturally being there plus a residual level from a refining process.

Whether or not parting and/or removal processes occurred, both copper coins contain residual levels of lead and arsenic, and trace amounts of bismuth and silver. Until additional 1794 and 1795 copper coins are analyzed via ICP-AES, it is assumed that all 1794 and 1795 copper coins contain residual levels of lead and arsenic, and trace amounts of bismuth and silver.

6. ICP-AES Results – Silver Coins - August, 2018

In July, 2018, the ground and polished center pieces of one 1794 O-105 Half Dollar and five 1795 Half Dollars (Overton die marriages O-117, O-115, O-116, O-109 and O-110)

were sent to an independent laboratory. ICP-AES analysis was performed on four different samples from the 1794 Half Dollar, and two different samples from each 1795 Half Dollar (see Table 5). The 1795 Half Dollars in Table 5 are arranged by emission order sequence.[2]

Note that the 1794 O-105 Half Dollar was donated by the Terry Brand Estate via Heritage Auctions. Also note that Table 5 includes the results for the 1795 O-122 and 1795 O-105 Half Dollars that were analyzed via ICP-AES in February, 2017.

The ground and polished center pieces of one 1806 Quarter, one 1807 Quarter, one 1807 Half Dollar, and one 1855-O Half Dollar were also sent to an independent laboratory for ICP-AES analysis in July, 2018 (see Table 6). Two different samples from each coin were analyzed.

The ICP-AES analysis results identify that the silver in the 1795 O-117 Half Dollar is notably lower than the other six 1795 Half Dollars. Likewise, the silver in the 1795 O-110 Half Dollar is notably higher than the other six 1795 Half Dollars. This was brought to the attention of the independent laboratory. They reran samples from the 1795 O-117 and 1795 O-110 Half Dollars. The ICP-AES results did not change. It is yet to be determined if these values represent part of the normal distribution or if some assignable but unknown cause is responsible. Additional testing is required.

6.1 Residual Gold In The Silver

Not only are residual levels of gold observed in the 1794 and 1795 Half Dollars, residual levels of gold are observed in all of the silver coins dated 1806 through 1855 (see Tables 5 and 6). One hypothesis for this was that the furnaces, pots, and crucibles that the Mint used to refine the silver bullion deposits were the same used to refine the gold bullion deposits. As a result, the silver bullion refining was contaminated with gold.

The rebuttal to this theory is the fact that gold is observed in the 1794 O-105 Half Dollar. The Mint's first gold bullion deposit occurred on February 12, 1795, and was made by Moses Brown (see Figure 1).[4] There was no gold in the Mint during calendar year 1794, therefore the residual levels of gold in the 1794 O-105 Half Dollar could not have originated from cross contamination.

Note that the residual levels of the gold in the 1795 Half Dollars are 33% to 317% higher than the residual levels of the gold in the 1794 Half Dollar. Was this due to cross contamination? Again, no. The last group of Half Dollars that were transferred from the custody of Chief Coiner Henry Voigt to Treasurer of the Mint Dr. Nicholas Way during calendar year 1795 occurred on June 5, 1795.[7] The first gold bullion deposit that was transferred to the custody of Henry Voigt for refining, melting and processing occurred 6 weeks later on July 21, 1795 (see Figure 2).[7] Since all 1795 Half Dollars were struck prior to the first gold bullion deposit being processed, the residual levels of gold in the 1795 Half Dollars could not have originated from cross contamination.

What	Sample	Silver %	Copper %	Gold %	Lead %	Other %
1794 O-105	1	88.67	11.01	0.12	0.17	0.03
	2	88.75	10.81	0.12	0.17	0.03
	3	88.43	11.14	0.12	0.17	0.02
	4	88.73	10.95	0.12	0.18	0.02
1795 O-117	1	88.96	10.23	0.36	0.43	0.02
	2	88.48	10.71	0.34	0.45	0.02
1795 O-122	1	90.00	9.20	0.38	0.35	0.07
	2	90.02	9.18	0.38	0.35	0.07
1795 O-115	1	89.24	10.34	0.20	0.19	0.03
	2	89.29	10.30	0.20	0.18	0.03
1795 O-116	1	89.83	9.87	0.20	0.09	0.01
	2	89.87	9.82	0.20	0.10	0.01
1795 O-109	1	89.79	9.83	0.21	0.14	0.03
	2	90.20	9.45	0.20	0.12	0.03
1795 O-110	1	90.97	8.70	0.16	0.14	0.03
	2	91.31	8.35	0.16	0.14	0.04
1795 O-105	1	90.40	9.16	0.20	0.22	0.02
	2	90.46	9.10	0.20	0.22	0.02

Table 5 – ICP-AES Silver Coin Subsurface Analysis (August, 2018)

What	Sample	Silver %	Copper %	Gold %	Lead %	Other %
1806 Quarter	1	88.27	10.75	0.85	0.10	0.03
	2	88.35	10.69	0.82	0.10	0.04
1807 Quarter	1	88.40	10.68	0.84	0.05	0.03
	2	87.86	11.17	0.85	0.11	0.01
1807 Half Dollar	1	87.87	11.24	0.80	0.08	0.01
	2	87.78	11.24	0.83	0.11	0.04
1855-O Half Dollar	1	88.64	10.63	0.47	0.21	0.05
	2	88.95	10.22	0.48	0.28	0.07

Table 6 – ICP-AES Silver Coin Subsurface Analysis (August, 2018)


REGISTER of GOLD BULLION received from Individuals

When received	No. receipt	By whom deposited	Description of Bullion	Gross Weight Oz dwts. grs.	Standard Weight Oz dwts. gr
1795. Feb 19.	1	Messrs Brown	Ingots	130. 1. 9	125. - 12
March 24	2	Joseph Searight	ditto	21. 13. 12	21. 8. 12
May 18	3	James & Fisher	Chain	27. - -	26. 13. -
22	4	Clestons John Price	Ingots	55. 2. 12	53. 11. 2
25	5	Joseph Anthony	Dust	21. 5. -	17. 12. 12

Figure 1 – Register of Gold Bullion: Deposits 1 – 5

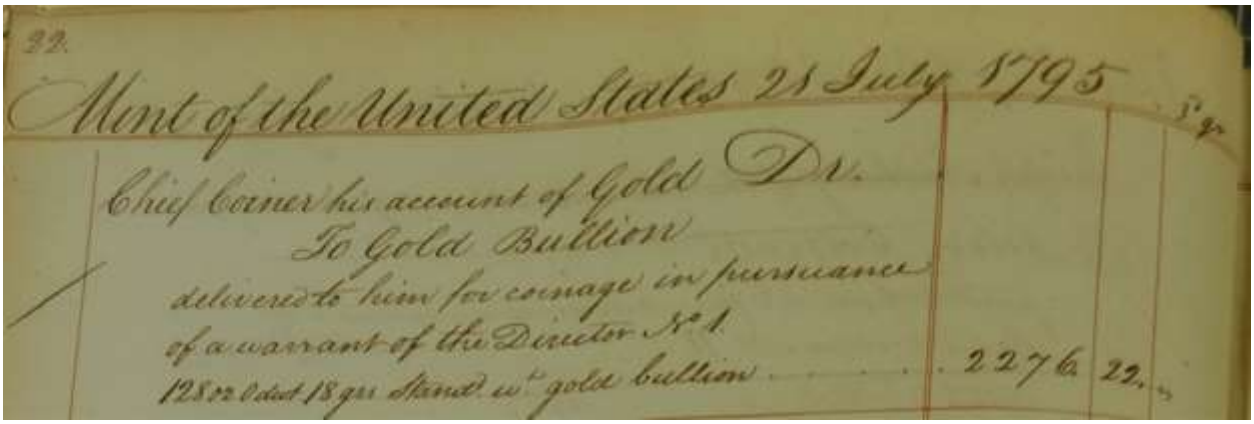


Figure 2 – Waste Book: July 21, 1795

Note that the residual levels of the gold in the 1806 through 1855 silver coins are 392% to 708% higher than the residual levels of the gold in the 1794 Half Dollar, and up to 531% higher than the residual levels of the gold in the 1795 Half Dollars. Was this due to cross contamination? Possibly. Further testing of post 1795 copper and silver coins is required.

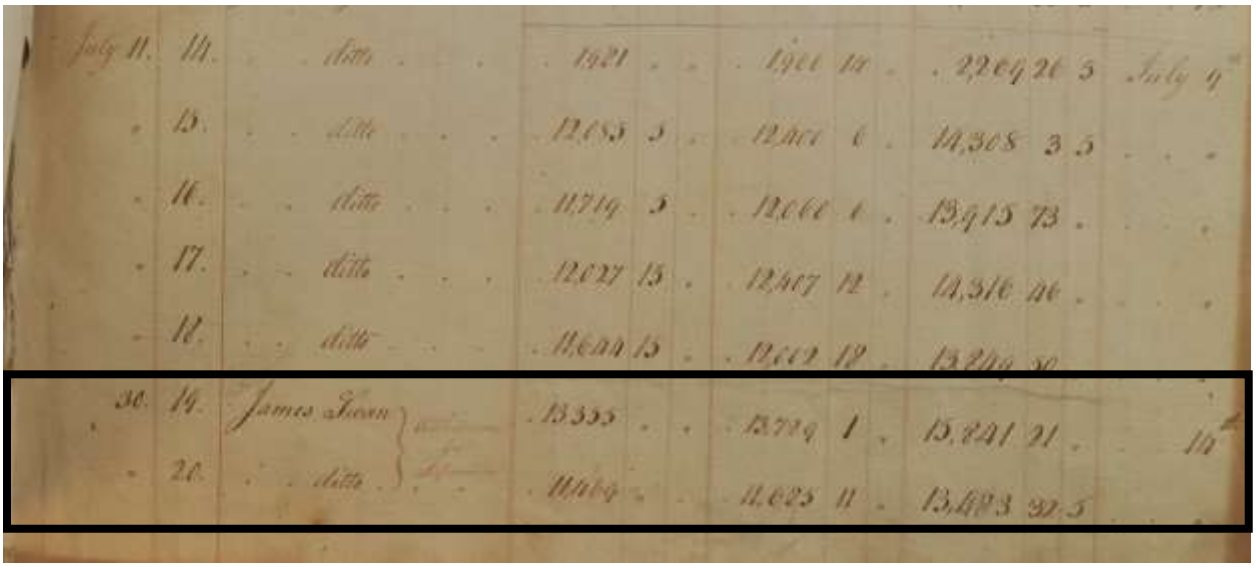
Gold is generally found in silver ore as a residual. Today, gold is *parted* from silver via Electrolysis, which obviously was not available in the 18th century. Parting in the 18th century was a relatively lengthy and expensive multi-step process. After assaying a silver bullion deposit, if the Mint determined there was a significant amount of gold, it was withdrawn from the Mint, and not converted into coinage. Case in point…

6.2 Silver Bullion Deposits Were Withdrawn For Parting In 1795

James Swan was a successful Boston merchant. He was a member of the Sons of Liberty. On December 16, 1773, he disguised himself as an Indian and participated in the Boston Tea Party. After the Revolutionary War, James Swan assumed the entire multi-million dollar debt that the United States owed to France. He resold these debts at a profit. Swan lived in Philadelphia during 1794 and 1795.

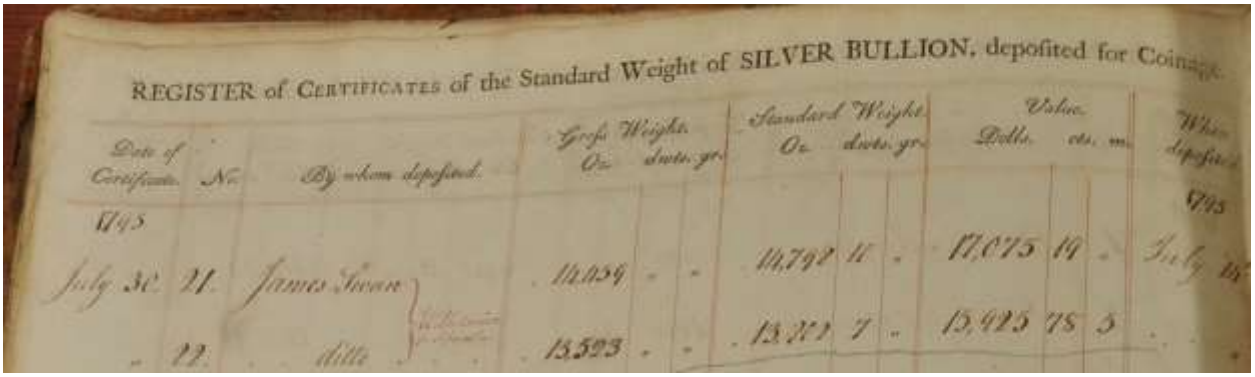
On July 14, 1795, James Swan made the 19th through 22nd silver bullion deposits with the Mint. These deposits were valued at $62,325.51 (see Figures 3 and 4).[5] When assayed, higher than normal amounts of gold were detected in the silver bullion. The silver bullion deposits were withdrawn, and the following entry was made in The Register of Silver Bullion (see Figure 5):[6]

> *"Assigned by James Swan to the Bank of the United States and withdrawn by said Bank from the Mint for the purposes of separating a certain proportion of Gold which the Bullion was discovered to contain".*



July 11.	14.	ditto	1921	1901 12	2209 21 5	July 4	
.	15.	ditto	12083 5	12461 6	14308 3 5	.	.
.	16.	ditto	11719 5	12066 6	13915 73	.	.
.	17.	ditto	12027 15	12407 12	14316 46	.	.
.	18.	ditto	11941 15	12319 18	14209 30	.	.
30.	19.	James Swan	13355	13779 1	15841 21	.	16
.	20.	ditto	11969	12345 11	14183 32 5	.	.

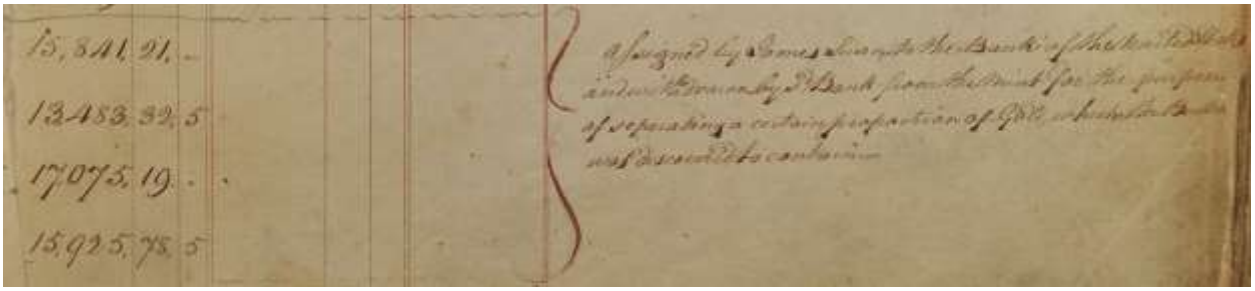
Figure 3 – Register of Silver Deposits: Deposits 19 & 20



REGISTER of CERTIFICATES of the Standard Weight of SILVER BULLION, depofited for Coinage.

Date of Certificate	No.	By whom depofited.	Grofs Weight Oz dwts. gr.	Standard Weight Oz dwts. gr.	Value Dolls. cts. m.	When depofited
1793						1793
July 30.	21.	James Swan	14959 - -	14792 11 -	17075 19 -	July 16
.	22.	ditto	13593 - -	13421 7 -	15925 75 5	.

Figure 4 – Register of Silver Deposits: Deposits 21 & 22



15,841 21.
13,483 32 5
17075 19 .
15925 75 5

assigned by James Swan to the Bank of the United States
under the authority of Congress for the purpose
of separating a certain proportion of Gold & Silver

Figure 5 – Register of Silver Bullion: Deposits 19 - 22

6.3 Residual Lead In The Silver

Residual levels of lead are observed in the 1794 Half Dollar and the seven 1795 Half Dollars (see Table 5). During and 18th century, lead was commonly used to refine silver. The process, known as the *Lead Refining Process*, is summarized as follows:

1. The silver bullion is melted. Silver melts at 1,763 degrees Fahrenheit.

2. A large amount of lead is melted with the bullion. Lead melts at 621.4 degrees Fahrenheit. Lead, being more dense than silver, melts and sinks to the bottom. Lead attracts precious metals. As the lead sinks, the silver and gold adhere to it.

3. The top layer (or the *slag* layer) of the solution contains the non-precious metals and other trace elements. This slag layer is removed. Note that when the Mint refined foreign silver coins, this slag layer included the copper alloy.

4. The remaining solution is a mixture of lead and silver, with residual levels of gold. Air is then blown over the molten mixture. Oxygen (O) combines with the lead (Pb) to form lead oxide or litharge (PbO).

5. The temperature of the furnace is raised, and the litharge is absorbed by capillary action into the furnace's hearth linings. This leaves silver with residual amounts of gold from the silver bullion and lead from the refining process.

To date, no contemporary documents have been found that confirm that the Mint used the Lead Refining Process during 1794 and 1795. The conclusion that this process was used is based on the residual levels of lead in the silver plus analysis of Mint warrant ledgers stored at the NARA. This analysis will be provided in Part 4 of this series.

6.4 Some Lead May Have Been Present In The Copper Alloy

Not only are there residual levels of lead in the silver coins, there are residual levels of lead in the 1794 copper Large Cent and 1795 copper Half Cent. It is therefore important to determine the true source of the lead found in the silver coins. Is the source of the lead:

- the residual lead from the silver bullion deposit being refined via the Lead Refining Process,
- a trace or residual level in the copper alloy, or
- a combination both?

Until additional 1794 and 1795 copper coins are analyzed, it is assumed that all copper coins dated 1794 and 1795 contain residual levels of lead, and the copper used to alloy the silver also contain residual levels of lead.

For the purpose of this preliminary analysis, the assumption is being made that five eighths or 62 ½ % of the lead in the silver coins was a residual of the Lead Refining Process, and three eighths or 37 ½ % of the lead in the silver coins originated from the copper alloy.

6.5 Preliminary Conclusions Regarding Gold and Copper

What the Mint thought was refined silver was actually the amount of the silver plus the entire amount of the gold plus 0.625 times the amount of the lead.

What the Mint thought was copper alloy was actually the amount of the copper plus the entire amount of the other trace elements, plus 0.375 times the amount of the lead.

6.6 Adjusted ICP-AES Results – Silver Coins - August, 2018

Refer to Table 7 for the adjusted percentages of the silver and copper, based on the preliminary conclusions in Section 6.5.

7. 1794: Statistical Analysis And Preliminary Conclusion

Based on the emission order sequence of 1794 Half Dollars, the 1794 O-105 was the third 1794 die marriage struck. It was struck after the 1794 O-109 (3 known) and 1794 O-111 (1 known).[2] It is therefore logical to conclude that the 1794 O-105 was most likely the first mass produced 1794 Half Dollar die marriage.

Multiple T-test statistical analyses were performed on the data for the 1794 O-105 Half Dollar in Table 7. Based on only the ICP-AES results for the 1794 O-105 Half Dollar:

1. For the heat (batch) of silver that struck the 1794 O-105 Half Dollar, there is a 2.8% probability that it was melted to a standard of 89.24+% silver and 10.76-% copper alloy.

2. Statistically, there is only a 0.1% probability that the metals in the 1794 O-105 Half Dollar were melted to a standard of 90% silver and 10% copper alloy.

Preliminary Conclusion: The authors are 28 times more confident that the 1794 O-105 Half Dollar was melted to a standard of 89.24+% silver / 10.76-% copper alloy as required by the Mint and Coinage Act of April 2, 1792.

If additional 1794 Half Dollars are obtained for ICP-AES analysis, statistical analyses will be performed, and the confidence levels will be updated.

What	Sample	Silver % + Gold % + 0.625 * Lead %	Copper % + 0.375 * Lead % + Other Trace %
1794 O-105	1	88.90	11.10
	2	88.98	10.90
	3	88.66	11.22
	4	88.96	11.04
1795 O-117	1	89.59	10.41
	2	89.10	10.90
1795 O-122	1	90.60	9.40
	2	90.62	9.38
1795 O-115	1	89.56	10.44
	2	89.60	10.40
1795 O-116	1	90.09	9.91
	2	90.13	9.87
1795 O-109	1	90.09	9.91
	2	90.48	9.53
1795 O-110	1	91.22	8.78
	2	91.56	8.44
1795 O-105	1	90.74	9.26
	2	90.80	9.20

Table 7 – Adjusted ICP-AES Silver Coin Subsurface Analysis

8. 1795: Statistical Analysis And Preliminary Conclusion

Between February 4, 1795 and June 5, 1795, 317,844 Half Dollars were transferred from the custody of Chief Coiner Henry Voigt to Treasurer of the Mint Dr. Nicholas Way. No Half Dollars were delivered between June 6, 1795 and December 31, 1795, therefore it is assumed that no 1795 dated Half Dollars were struck after June 5, 1795.[7] Since the seven 1795 Half Dollars in Table 5 are die marriages from the early, middle, and later parts of the 1795 emission order sequence[2], it can be stated with confidence that the silver for these Half Dollars was refined by the Mint over a period of several months (most likely between January, 1795 and early June, 1795).

Multiple T-test statistical analyses were performed on the data for the seven 1795 Half Dollars in Table 7. Based on only the ICP-AES results for the seven 1795 Half Dollars:

1. There is a 0.00 % probability that the metals in the seven 1795 Half Dollars were melted to a standard of 89.24+% silver and 10.76-% copper alloy.

2. There is a 13% probability that the metals in the seven 1795 Half Dollars were melted to a standard of 90% silver and 10% copper alloy.

Preliminary Conclusion: Based on this initial data analysis, the Mint attempted to melt most, and possibly all of the metals in the 1795 silver coins to a standard of 90% silver and 10% copper alloy. This was a violation of the Mint and Coinage Act of April 2, 1792.

9. 1794 And 1795: Preliminary Conclusions

Based on the statistical analysis results for the 1794 Half Dollar and the seven 1795 Half Dollars, plus historical facts, the following preliminary conclusions have been made:

1. To comply with the Mint and Coinage Act of April 2, 1792, the Mint initially attempted to melt the metals in the 1794 Half Dollars to a standard of 89.24+% silver and 10.76-% copper alloy.

2. The Dollars were the first silver coins struck by the Mint in 1794. Delivery Warrant 1 was issued on October 15, 1794 by Mint Director David Rittenhouse to transfer 1,758 Dollars from the custody of Chief Coiner Henry Voigt to the custody of Treasurer of the Mint Dr. Nicholas Way. Delivery Warrant 2 was issued on December 1, 1794 to transfer 5,300 Half Dollars from the custody of Henry Voigt to the custody of Dr. Nicholas Way.[7]

   Since the 1794 Dollars were struck before the 1794 Half Dollars, it is logical to conclude that the Mint also attempted to melt the metals in the 1794 Dollars to a standard of 89.24+% silver and 10.76-% copper alloy.

3. Based on the previous two preliminary conclusions, it is logical to conclude that the Mint *initially* attempted to melt the metals in the 1794 Half Dollars and Dollars to a standard of 89.24+% silver and 10.76-% copper alloy.

4. Although the Mint targeted the 1794 Dollars and some or all of the remaining 1794 silver coinage to an 89.24+% silver and 10.76-% copper alloy standard, the capabilities of the Mint personnel and/or limitations of 18th century chemical and metallurgical technology prevented the Mint from achieving their targets.

5. At this time it is unclear when the Mint began melting the metals in the silver coins to a standard of 90% silver and 10% copper alloy. See Section 9.1.

Henry William de Saussure was the second Director of the Mint from July 9, 1795 through October 28, 1795. On October 27, 1795, de Saussure wrote a letter to President Washington informing him that he continued with the practice of melting to a standard of 90% silver and 10% copper.[1] That letter included the following sections:

> "… the standard of the silver coins, in use at the mint, differs from the standard fixed by law… I did not feel myself qualified to alter the standard which I found in use in the mint".

6. Between May 6, 1795 and October 24, 1795, 203,033 Dollars were transferred from the custody of Henry Voigt to the custody of Dr. Nicholas Way.[7] Since all of the Dollars were delivered while David Rittenhouse and de Saussure were the Mint Directors, the metals in most or all of these coins were most likely melted to a standard of 90% silver and 10% copper.

7. Between February 4, 1795 and June 5, 1795, 317,844 Half Dollars were transferred from the custody of Henry Voigt to the custody of Dr. Nicholas Way.[7] Since all of the Half Dollars were delivered while Rittenhouse was Mint Director, the metals in most or all of these coins were most likely melted to a standard of 90% silver and 10% copper.

8. Between March 30, 1795 and October 24, 1795, 52,516 Half Dismes were transferred from the custody of Henry Voigt to the custody of Dr. Nicholas Way.[7] Since these Half Dismes were delivered while Rittenhouse and de Saussure were the Mint Directors, the metals in most or all of these coins were most likely melted to a standard of 90% silver and 10% copper.

Elias Boudinot received his temporary commission as the third Director of the Mint on October 28, 1795. Boudinot immediately reverted to the legal standard 89.24+ silver and 10.76-% copper. On November 6, 1795, he directed assayer Albion Cox to:

> *"be particularly careful in future, to see that the precious Metals issued for coining, be made precisely agreeably to the standard".*[8]

9. On November 26, 1795, 33,900 Half Dismes were transferred from the custody of Henry Voigt to the custody of Dr. Nicholas Way.[7] Since these Half Dismes were delivered while Boudinot was Mint Director, most or all of the metals in these coins were most likely melted to a standard of 89.24+% silver and 10.76-% copper.

10. Regardless as to whether the Mint was attempting to melt the metals in the silver coins to a standard of 89.24+% silver / 10.76-% copper alloy, or a standard of 90% silver / 10% copper alloy, the capabilities of the Mint personnel and/or limitations of 18th century chemical and metallurgical technology prevented the Mint from achieving their targets.

9.1 When Did The Mint Start Melting To A 90% Silver Standard?

The Mint struck Half Dismes, Half Dollars and Dollars during calendar year 1795.[7] While the silver bullion deposits were being refined, alloyed with copper, and poured into ingots, the Director of Mint most likely did not know what denominations and how many coins of each denomination were going to be struck. It is therefore logical to conclude that ingots were poured to a thickness that was slightly greater than the thickness of a Dollar. Then, when the Director issued a warrant to strike a specific number of coins by denomination, the ingots were rolled to the appropriate thickness, then punched into planchets. As a result, the silver and copper standard of the Half Dollars was identical to the silver and copper standard of the Half Dismes and Dollars.

The first group of 1795 Half Dismes that were transferred from the custody of the Chief Coiner to the custody of the Treasurer of the Mint during calendar year 1795 occurred on March 30. The first transfer of Half Dollars occurred on February 4, 1795. The first transfer of Dollars occurred on May 6, 1795.[7] Since the first group of 1795 Half Dollars were transferred before any 1795 Half Dismes and Dollars were transferred, it is logical to conclude that the first group of 1795 Half Dollars were struck before the first 1795 Half Dimes and Dollars.

1. If the melting standard for the first group of 1795 Half Dollars is determined to be 86.24+% silver and 10.76-% copper, it is logical to conclude that the metals in all silver coins struck during calendar year 1794 were also melted to a standard of 86.24+% silver and 10.76-% copper. Then, sometime during 1795, the Mint began to melt the metals to a standard of 90% silver and 10% copper.

2. If the melting standard for the first group of 1795 Half Dollars is determined to be 90% silver and 10% copper, then either:

    - the metals in the 1794 silver coins were initially melted to an 86.24+% silver and 10.76-% copper standard, and the Mint changed to a standard of 90% silver and 10% copper sometime in 1794, or

- the metals in all 1794 silver coins were struck to a standard of 86.24+% silver and 10.76-% copper, and the Mint changed to 90% silver and 10% copper when the first group of Half Dollars were struck in 1795.

3. The first three die marriages in the 1795 Half Dollar emission order sequence are the O-119, O-121 and the O-117.[2] Although an O-117 was obtained for ICP-AES analysis, 1795 O-119 and O-121 Half Dollars were not obtained. Based on the ICP-AES analysis of the O-117 Half Dollar, it is unclear as to whether the silver standard was 89.24% or 90%.

4. ICP-AES analysis of 1795 O-119 and O-121 Half Dollars is required to determine whether the Mint's melting target for the metals in the first group of 1795 Half Dollars was 89.24+% silver / 10.76-% copper or 90% silver / 10% copper.

To be continued…

References:

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3. National Archives and Records Administration, Records of the U. S. Mint, Record Group 104, List Of Warrants For Expenses Paid, July 1792 To Dec. 1817.

4. Ibid, Register Of Gold Bullion.

5. Ibid, Register Of Silver Deposits.

6. Ibid, Register Of Silver Bullion.

7. Ibid, Waste Books and Bullion Journals.

8. Ibid, Letters Sent, 1795-1804, G-09-07-07-3, Boxes 1-2.