Chemical Analysis of 1794 & 1795 U. S. Silver Coins – Part 5

David Finkelstein & Christopher Pilliod – December 16, 2018

1. Introduction

This is the fifth and final article of a multi-part series. Part 1 was published in the September 23, 2018 *John Reich Newsletter (JRN)* and provided the historical overview of events that laid the foundation for this project. Part 2 was published in the October 7, 2018 *JRN* and reviewed the technologies available today to perform chemical analysis, the issues analyzing a silver-copper alloyed coin, and the goals of this project. Part 3 was published in the October 21, 2018 *JRN* and provided the X-ray Fluorescence (XRF) and Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-AES) analysis data for 1794 and 1795 copper and silver coins. Part 3 also provided the statistical analyses performed on the ICP-AES data, and preliminary conclusions based on the statistical analyses. Part 4 was published in the November 4, 2018 *JRN* and revised in the November 11, 2018 *JRN.* It provided an analysis of the silver bullion deposits made during 1794 and 1795, the quantity of lead purchased by the Mint from 1792 through 1795, and confirmed that enough lead was procured to support the Lead Refining Process. 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 alloy (copper). This equated to a standard of 1485 / 1664 or 89.24278% or 89.24+% pure silver, and 10.75722% or 10.76-% copper.

Documents written by Mint Directors Henry William de Saussure and Elias Boudinot report the Mint attempted to produce some, most, or all of the 1794 and 1795 dated silver coins to a standard of 90.00% silver and 10.00% copper.[1] In Part 3 of our study, we shared a major finding. Statistical analyses performed on the ICP-AES data did in fact support de Saussure's and Boudinot's statements. It was concluded that the Mint initially produced 1794 silver coinage to a standard of 89.24+% silver and 10.76-% copper, and by early 1795 the Mint amended the silver coinage standard to 90.00% silver and 10.00% copper. This was a violation of the Mint and Coinage Act.

2. 90% Silver .vs. 90.00% Silver

Note that a standard of 90% means anything between 89.51% and 90.49%, but a standard of 90.00% means 90% only. It is our belief that when the Mint changed the melting standard from 89.24+% silver to 90.00% silver, their target was exactly 90.00% silver and not 90% +/- silver. One may ask why? Was it because Assayer Albion Cox

believed that 89.24+% silver coins would turn dark and be valued less by the public[2] or because it made the math easier when calculating a 90.00% / 10.00% ratio versus a 89.24278% / 10.75722% ratio.

We believe in Occam's razor; the problem solving principle that the simplest solution tends to be the correct one. It is our belief that the Mint, without Congressional change to the Mint and Coinage Act, decided to melt to a standard of 90.00% silver and 10.00% copper alloy simply to make their math calculations easier. Although the calculations can be done quickly today in a few nanoseconds using Excel or a $3.00 calculator, in the 18th century the calculations were done longhand, on paper, and had to be verified.

3. The Value of Gold and Silver Effective April 2, 1792

Section 9 of the Mint and Coinage Act of April 2, 1792 specified that every dollar in silver coins should weigh 416 grains, and be comprised of 371.25 grains of pure silver and 44.75 grains of alloy. It also specified that the $10.00 Eagle should weigh 270 grains, and be comprised of 247.5 grains of pure gold and 22.5 grains of alloy.

As a result of the Mint and Coinage Act, the value of silver and gold was set by Congress. Since there are 480 grains in one Troy ounce, one Troy ounce of silver was worth $1.29, and one Troy ounce of gold was worth $19.39. The ratio of gold to silver was therefore 19.39 to 1.29, or 15.03 to 1.00.

4. The Precious Metals in the 1795 Half Dollars Analyzed

Table 5 from Part 3 of this article series provided the ICP-AES chemical analysis data from the subsurface of one 1794 and seven 1795 Half Dollars. That table is reproduced below (see Table 1). Two separate samples were cut from each coin. The 14 samples analyzed via ICP-AES from the seven 1795 Half Dollars had an average of 89.9157% (or 89.92%) silver and 0.2421% (or 0.24%) gold.

Note that there are 31 known 1795 Half Dollar die marriages; Overton die marriages O-101 through O-117, and O-119 through O-132. Die marriage O-118 is presently unknown and may not even exist.

All Half Dollars transferred from the custody of Chief Coiner Henry Voigt to the custody of Treasurer of the Mint Dr. Nicholas Way during calendar year 1795 occurred between February 4, 1795 and June 5, 1795.[4] The seven 1795 Half Dollars analyzed via ICP-AES were from the 3rd, 5th, 10th, 11th, 16th, 21st and 25th die marriages within the 1795 Half Dollar emission order sequence.[3] It is therefore highly probable that the silver used to produce the seven 1795 Half Dollars came from silver bullion deposits melted between January/February 1795 and May/June 1795.

Had it been possible, ICP-AES analysis would have been performed on all 31 different 1795 Half Dollar die marriages (note: we are accepting donations for the next phase of this project --- LOL). This was not practical, nor was it possible:

- The 1795 O-132 Half Dollar is unique, and sold for $66,000.00 in the September 6, 2018 Heritage Long Beach Auction. It is safe to assume that we will not be analyzing this coin.

- This is Phase 1 of a multi-phase project. Due to budgetary constraints, only seven 1795 Half Dollars were analyzed via ICP-AES analysis. This quantity balances an appropriate budget, while providing an adequate database to allow us to make statements based on statistical analyses with confidence.

After additional 1795 Half Dollars are analyzed during future project phases, any new findings will be shared as necessary.

5. The Average Precious Metal Content in One 1795 50C

Per the Mint and Coinage Act of April 2, 1792, a Dollar coin weighed 416 grains, therefore a Half Dollar coin weighed 208 grains.

- The average silver content of the seven 1795 Half Dollars in Table 1 is 89.92% silver. There are 208 * 0.8992 or 187.03 grains of silver on average in each 1795 Half Dollar. Since 371.25 grains of silver was valued at $1.00, 187.03 grains of silver was valued at $0.5037845 or 50.38 cents.

- The average gold content of the seven 1795 Half Dollars is 0.24% gold. There are 208 * 0.0024 or 0.4992 grains of gold on average in each 1795 Half Dollar. Since 247.5 grains of gold was valued at $10.00, 0.4992 grains of gold was valued at $0.0201696 or 2.02 cents.

Although the face value of each 1795 Half Dollar was $0.50, the precious metal value content of each 1795 Half Dollar was on average 52.4 cents.

6. The Excess Precious Metal Value in the 1795 Silver Coins

The following quantities of silver coins were transferred from the custody of Chief Coiner Henry Voigt to the custody of Treasurer of the Mint Dr. Nicholas Way between February 4, 1795 and October 24, 1795:[4]

- Half Dismes: 52,516 ($2,625.80 face value)
- Half Dollars: 317,844 ($158,922.00 face value)
- Dollars: 203,033 ($203,033 face value)

At this point in our research we have not yet made the determination as to when the Mint began melting to a standard of 90.00% silver and 10.00% copper alloy. For the following calculations, assume the Mint melted to a standard of 90.00% silver effective with the first silver coin struck in calendar year 1795.

- The above silver coin transfers totaled $364,580.80.

- If each 1795 Half Dollar contained on average $0.5240 precious metal content, then every $1.00 in 1795 silver coins contained on average $1.048 precious metal content.

- The $364,580.80 in silver coins transferred to Dr. Way during calendar year 1795 therefore contained approximately $364,580.80 * 1.048 or $382,080.67 precious metal content.

- Through October 24, 1795, the Mint's 1795 silver coin production contained approximately $382,080.67 - $364,580.80 or $17,499.87 in excess precious metals.

One may ask why the 33,900 Half Dismes transferred from Henry Voigt to Dr. Way on November 26, 1795 were not included in the above silver coin quantities.[4] Elias Boudinot, upon becoming the third Director of the Mint, reverted the melting of silver bullion deposits to the legal standard of 89.24+% silver and 10.76-% copper. On November 6, 1795, Boudinot 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".*[5]

It is therefore assumed that the 33,900 Half Dismes transferred on November 26, 1795 were melted to a standard of 89.24+% silver and 10.76-% copper.

7. The Purchasing Power of $17,499.87 in 1795

If it was chemically, metallurgically, technically, and financially possible in the 18th century, one could have:

1. acquired 1795 silver coins,
2. parted the gold from the silver,
3. melted the remaining metals into ingots to a standard of 89.24+% silver and 10.76-% copper, and
4. deposited the ingots with the Mint during 1796 for conversion into coins.

Not only would one end up with more face value in silver coins than what was started with, one would have a small stash of gold, and make a profit of 4.80% before

expenses. So, assuming all of the excess precious metals were extracted from the entire 1795 silver coin production, what could $17,499.87 purchase in 1795?

Based on entries in the *Ledger of the Ordinary Receipts and Expenditures of the Mint*, 1795 labor expenses for the Mint was $22,198.64.[6] This was broken down as follows:

- Salaries - Officers & Clerks: $8,845.75

  The salaried Mint employees were the Director of the Mint, Treasurer of the Mint, Assayer, Chief Coiner, Engraver, Director's Clerk, Treasurer's Clerk, and Chief Coiner's Clerk.

- Wages - Furnace Laborers, Coining Business Laborers & Mechanics: $6,517.54

  During 1795, Mint laborers were paid weekly, every Saturday, for the prior Monday through Saturday.[7] Mint laborers worked Monday through Saturday, 11 hours per day. Assuming 365 days per year and 52 Sundays (non-working days) per year, there was an average of 313 work days or 3,443 work hours per year. There was no vacation pay.[9]

  Entries in the Mint's *Labor Book 1796 – 1800*[8] are consistent with the payroll information in *Illustrated History of the United States Mint*[10] (see Figure 2). Those that worked in the cool confines of the Coining Room (e.g., general laborers, Pressman, Adjusters, Filers, Drawer) were usually paid $1.00 to 1.20 per day, or approximately 9 to 11 cents per hour. Those that worked near the hot furnaces (e.g., Melters, Annealers, Roller) were usually paid $1.40 to $1.60 per day, or approximately 13 to 15 cents per hour. There were some exceptions, including Adjusters Henry Voigt Jr., Sarah Waldrake, and Rachael Summers, and John Bay (boy), who were paid 4 ½ cents to 8 cents per hour.

  Mint ledgers do not identify the furnace laborers, coining business laborers and mechanics by name. It is therefore estimated that the $6,517.54 paid the yearly wages for approximately 24 full-time hourly employees.

- Contract Workers: $6,835.35

  Payment warrants in the Mint's *List of Warrants for Expenses Paid 1792 – 1817*[7] indicate that the following contract workers were paid by the Mint during 1795:

  - Frederick Brown and Martin Summers (Night Watchmen): $160.64
  - George Turner (Blacksmith): $482.82
  - John Schreiner (Coiner and Chief Pressman): $513.19
  - John Smith Gardner (Assistant Engraver): $775.60
  - David Ott (Contract Refiner): $1,098.63
  - Thomas Town (Millwright, plus expenses): $1,356.93
  - Adam Eckfeldt (Forging and hardening dies, plus expenses): $1,682.63

So, to answer the question “What could $17,499.87 purchase in 1795?”… It could pay for the yearly salaries of the 7 Mint officers and clerks, approximately 24 furnace workers, coin business workers and mechanics, the wages for night watchmen, a Blacksmith, a Chief Pressman, an Assistant Engraver, and 15% of a contract Refiner, plus 40 gallons of rum.

References

1. American State Papers. Documents, Legislative and Executive, of the Congress of the United States, Gales and Seaton, 1832, Finance, pages 356-358.

2. National Archives and Records Administration, NC-152, E-14, Box 1, General Correspondence 1792-1899. On December 20, 1794, Treasurer of the Mint Dr. Nicholas Way responded to questions posed by the Congressional Committee to examine the Mint. One of Dr. Way’s responses was “*The alloy directed by the Law for the Silver is declared by the Assayer to be such an overproportion that the Coin would soon become of so dark a color as to injure its credit”.*

3. Early United States Half Dollars, Volume 1, 1794 - 1807, Steve Tompkins, 2015.

4. National Archives and Records Administration, Records of the U. S. Mint, Record Group 104, Waste Books.

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

6. Ibid, Register of the Ordinary Receipts and Expenditures of the Mint, Commencing December 1794.

7. Ibid, List Of Warrants For Expenses Paid, July 1792 To Dec. 1817.

8. Ibid, Ibid, Labor Book 1796 – 1800.

9. Orders and Directions for Conducting The Mint Of The United States, Established By Elias Boudinot, Director Of Said Mint. November 2, 1795, John Fenno, Philadelphia, 1796.

10. Illustrated History of the United States Mint With a Completed Description of American Coinage, George G. Evans, Philadelphia, 1885.

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 1 – ICP-AES Silver Coin Subsurface Analysis (August, 2018)
(Table 5 from Part 3 of this article series)

The following is a copy of an old pay roll, framed and hanging upon the wall of the Cabinet.

NAMES AND SALARIES OF THE OFFICERS, CLERKS, AND WORKMEN EMPLOYED AT THE MINT THE 10th OCTOBER, 1795.

Henry Wm. DeSaussure, Director	@ 2,000	Drs. per Ann.
Nicholas Way, Treasurer	1,200	" "
Henry Voigt, Chief Coiner	1,500	" "
Albion Cox, Assayer	1,500	" "
Robert Scott, Engraver	1,200	" "
David Ott, Melter and Refiner pro tem	1,200	" "
Nathaniel Thomas, Clerk to the Treasurer	700	" "
Isaac Hough, ditto to Director and Assayer	500	" "
Lodewyk Sharp, ditto to Chief Coiner	500	" "
John S. Gardiner, Assistant Engraver	936	" "
Adam Eckfeldt, Die Forger and Turner	500	" "

Workmen Employed in Chief Coiner's Department.

	Wages per day. Doll.	Cts.
John Schreiner, Chief Pressman	1	80
John Cope, Chief Adjuster	1	60
William Hayley, Roller	1	40
Nicholas Sinderling, Annealer	1	40
John Ward, Miller	1	20
Joseph Germon, Drawer	1	20
Lewis Laurenger, Brusher	1	20
Henry Voigt, Junr, Adjuster		88
Sarah Waldrake, ditto		50
Rachael Summers, ditto		50
Lewis Bitting, ditto	1	20
Lawrence Ford, ditto	1	20
Christopher Baum, Pressman	1	
John Keyser, ditto	1	
Frederick Bauck, ditto	1	
Barney Miers, Cleaner	1	
Martin Summers, Doorkeeper	1	
Adam Seyfert, Hostler	1	
John Bay, Boy		66

Workmen Employed at the Furnace of the Mint.

Peter LaChase, Melter	1	60
George Myers, ditto	1	50
Eberhart Klumback, ditto	1	40
Patrick Ryan, Filer	1	25
Valentine Flegler, Labourer	1	25
Andrew Brunet, ditto	1	
William Ryan, ditto	1	

Endorsed in two places, "Names and Salaries of the Officers, Clerks and Workmen employed in the Mint the 10th Oct. 1795."

Table 2 – 1795 Mint Employee Salaries & Wages (From *Illustrated History of the United States Mint*)