# Exploring Color Mysteries in the United States Large and Small Numeral Postage Due stamps using X-ray Fluorescence Spectrometry

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*The paper treats both the Large Numeral and Small Numeral Postage Dues. In the interest of time only the results for the Large Numeral Dues will be presented.

# Introduction

- *The United States Large Numeral Postage Due stamps, designed and produced by the American Bank Note Company, were introduced in 1879.*
- *The Large Numeral Dues were printed with three major colors of inks (brown, red-brown, and bright claret) but variations exist.*


**Brown** **Red-Brown** **Claret**

***Combining XFS results with simple UV fluorescence this presentation will explain or at least provide insights into the color mysteries associated with the Large Numeral Postage Due stamps.***

# Analysis-Equipment

- ***Equipment:***
  - A hand-held Brunker Tracer III-SD X-ray fluorescence spectrometer was used to obtain ink spectra from a variety of Large and Small Numeral Postage Due stamps, essays, and proofs.
  - The hand-held X-ray source and detector assembly were placed in a support stand to make a stable platform upon which to place the various stamps for analysis.
  - All spectra were collected with a primary source at 40 keV.

***In addition to various machine configuration and filter parameters two fundamental issue were of concern to the author.***

1. ***Selection of X-ray exposure time.***
2. ***Repeatability of placing the sample on the X-ray head.***

# Analysis-Time Selection

- The goal was to select a short sample time without sacrificing accuracy and the ability to do valid comparisons.
- Various exposure times from 30 seconds to 210 seconds in 30 second increments were selected.
- Count data for the Ba, Fe, and Ca peaks of a J30 Postage Due stamp.

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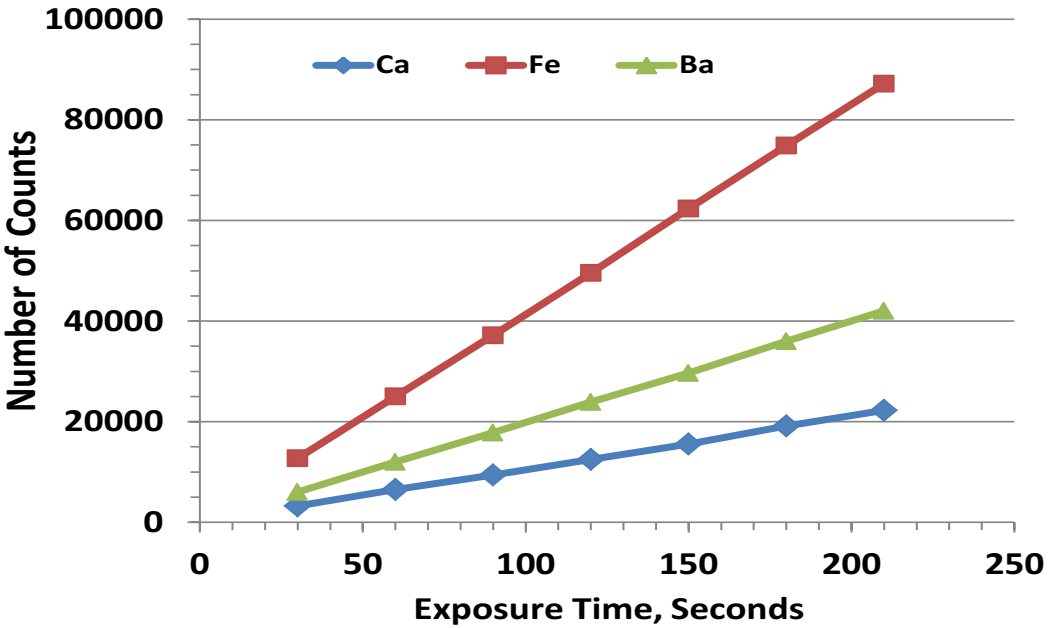
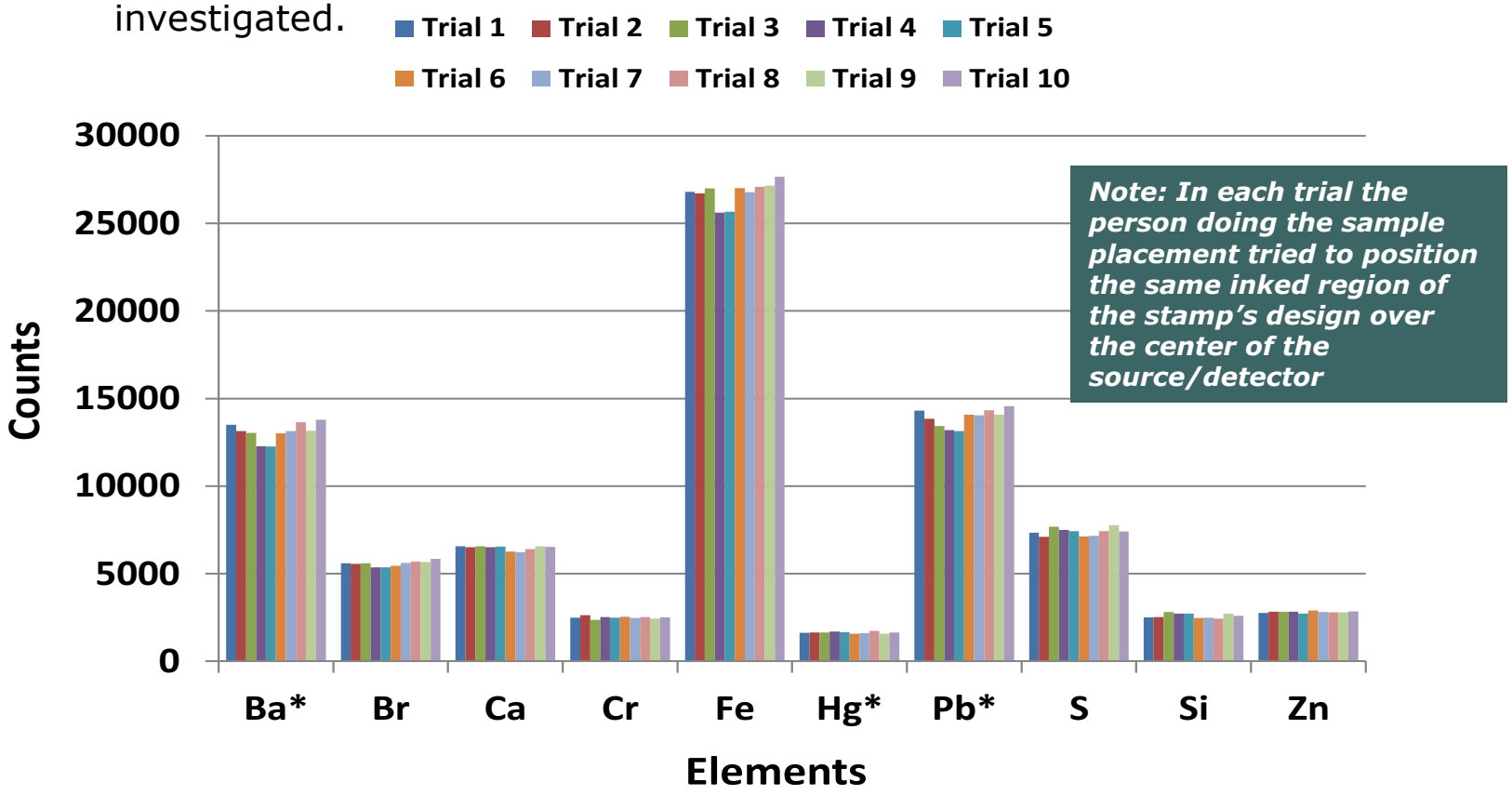



A linear regression analysis was conducted on the count versus time lines for the various peaks-yielding very high correlation coefficients ($r > 0.995$) indicating strong linearity as a function of time.

***Based on this result, the need for rapid analysis and for compatibility with previous measurements— an exposure time of 60 seconds (1 minute) was chosen.***

# Analysis-Positioning

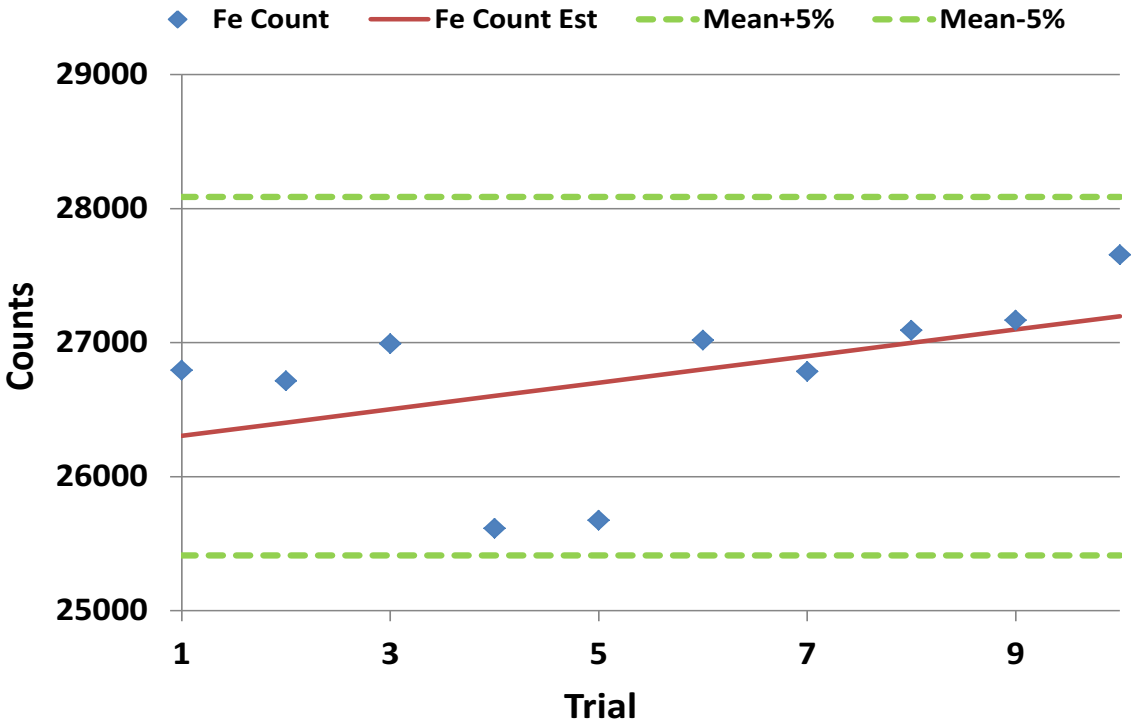
- Another concern was the position of the sample on the X-ray source/detector head since there were no guides or locator grids.
- The expected error from a series of 10 placements of the same sample was investigated.




***The spread of the peak counts is relatively small (less than ± 7%).***

# Analysis-Positioning

- It is clear that significant repeatability of a given measurement is quite possible given some care in the alignment of the stamp during placement.
- Iron for example was within ±5%.




***Thus, it was concluded that a single measurement of the X-ray spectrum for a given sample could be made and then used to compare with other single spectrum results from a sample with the same design and region of analysis.***

# Background-Bank Note Dues

- ***Large Numeral Dues***

**-** Postage Due stamps, with a common large numeral vignette, were produced by the American Bank Note Company in three distinct series.

- The 1879 series stamps (Scott Nos. J1 to J7, 1¢ to 50¢ values, respectively) were issued in a brown color rather than the specified red-brown.

- The next production series (Scott Nos. J15 to J21, 1¢ to 50¢ values, respectively) was produced in shades of red-brown. The red-browns were officially said to have been issued in 1884, but stamps with distinctly reddish tones began appearing years earlier on cover.

- In 1891, a third series of Large Numeral Postage Due stamps (Scott Nos. J22 to J28*, 1¢ to 50¢ values, respectively) was issued in a bright claret color and is easily identified by its orange fluorescence under ultraviolet illumination (long wavelength).

- In total, including all three series and denominations, 201,396,804 Large Numeral Postage Due stamps were issued.

***Note Scott Nos. J18 to J14 are missing. These numbers were used by Scott to identify a special printing that was not widely distributed and not used in the general course of mail delivery.**

# Large Numeral Postage Dues

***Large Numeral Postage Due Stamps***

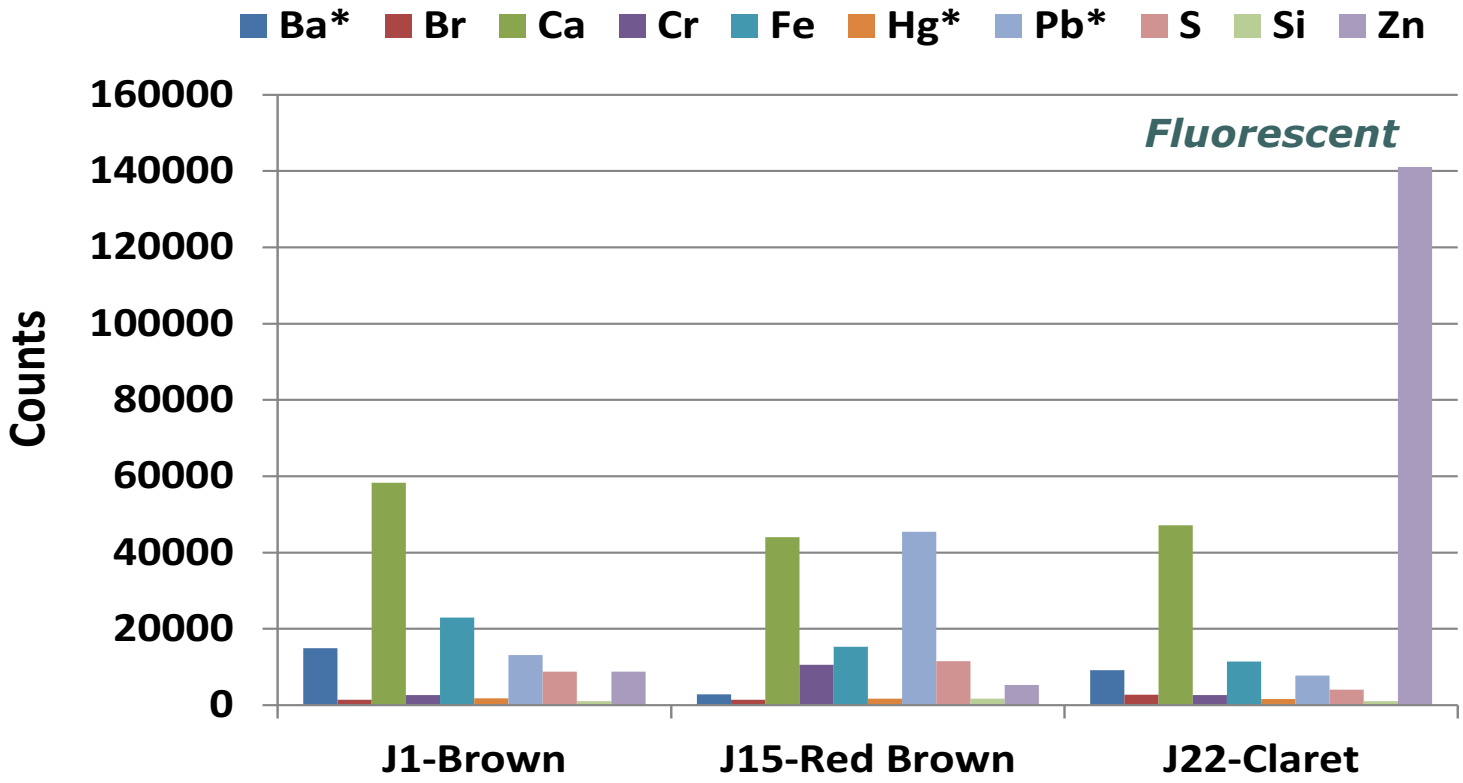

**Brown (J2)** **Red-brown (J16)** **Claret (J23)**

For the Large Numeral Postage Dues questions concerning color and fluorescence of the following stamps and proofs will be investigated.

- **Three series of Large Numeral Postage**
- **India paper plate proofs of 1879**
- **Large Numeral plate proofs on card**
- **High and low value Roosevelt proofs of 1903**

# Large Numeral Colors

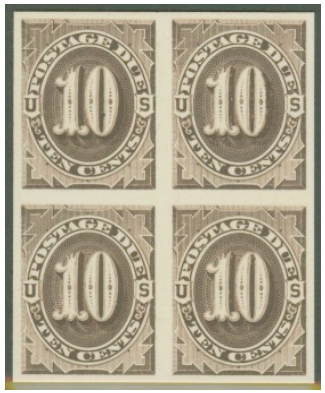
***Comparison of the X-ray spectra derived column charts for 1¢ Brown (J1, 1879 Series), Red-Brown (J15, 1884), and Bright Claret (J22, 1891) Postage Due stamps.***



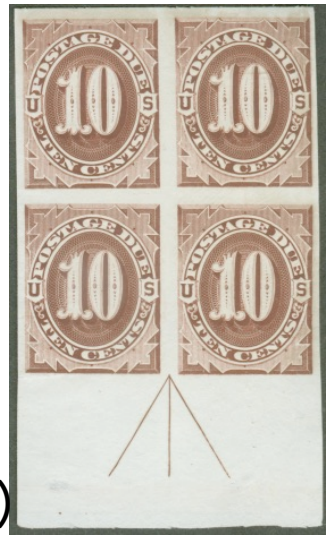

***Inks of the three main series are distinctly different!***

# Large Numeral India Plate Proofs

Brown(J4P3)



Red-Brown(J19P3)

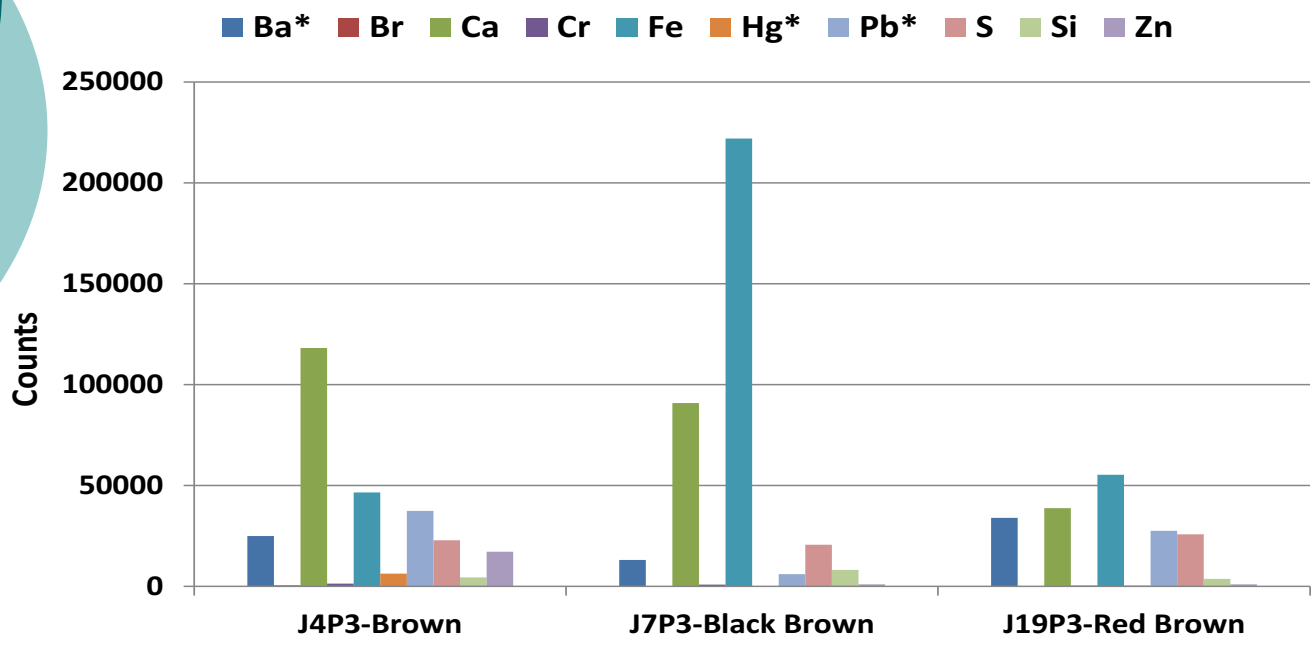


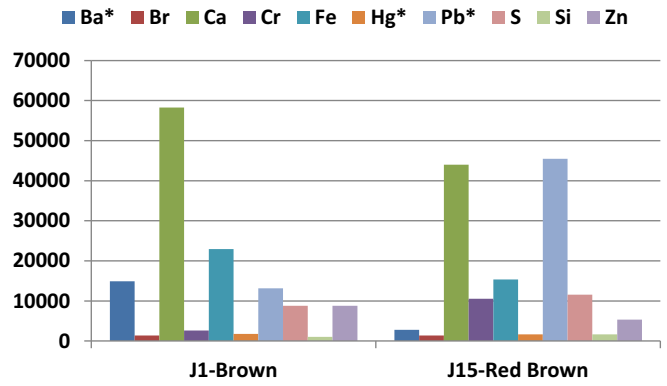
Black-Brown(J5P3)


- There is much confusion about the color of the high value Large Numeral plate proofs on India Paper.
- The high value Black-Brown plate proofs are now listed by Scott as J5-J7P3 and the high value Red-Brown Plate Proofs are listed by Scott as J19-J21P3, associating them with the red-brown stamps of 1884.
- The red-brown proofs were made in 1879 as shown on the plate approval copy.

Red-brown(J19P3)
Approved Proof
Sept. 16-17, 1879

# Large Numeral India Plate Proofs

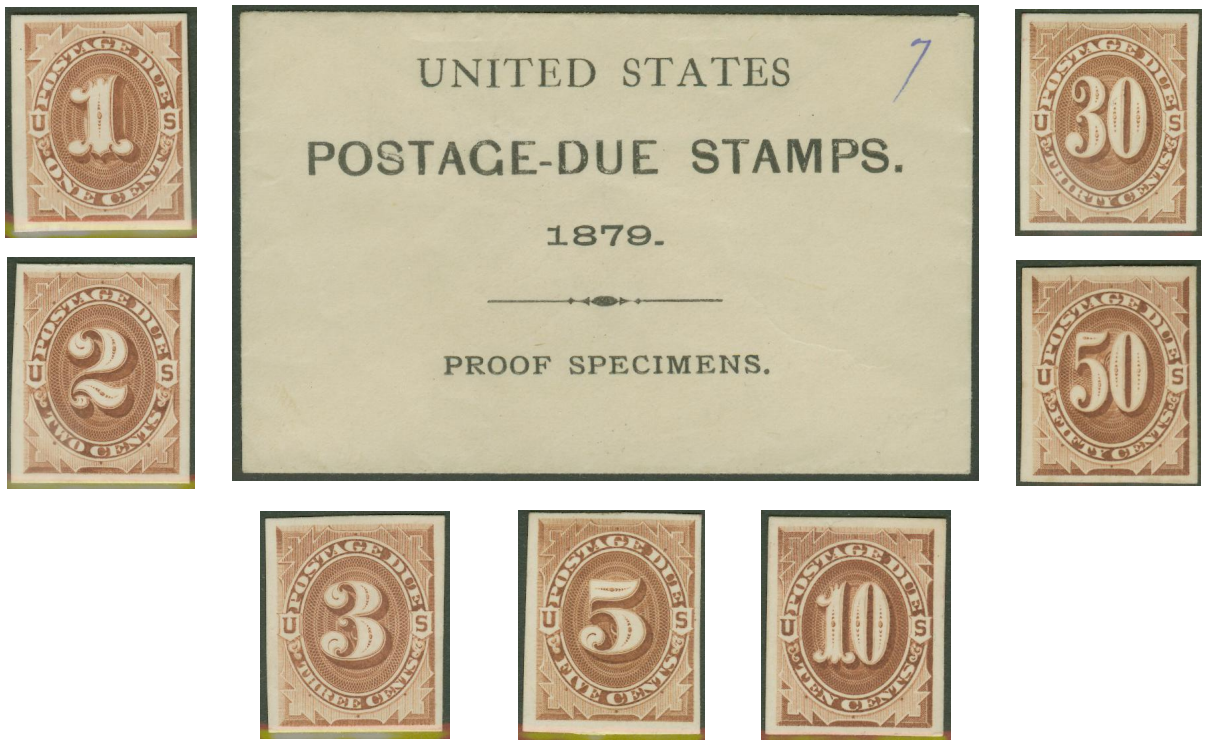



**The ink spectra of the J1 Brown Postage Due stamp and the J4P3 Plate Proof on India paper are almost identical-indicating the same ink formulation was used.**

**The J19P3 Red-Brown does not match the Red-Browns of the 1884 stamp series (J15-J21) and since it was made in 1879 it should probably have been considered a trial color along with the black-brown Postage Dues.**

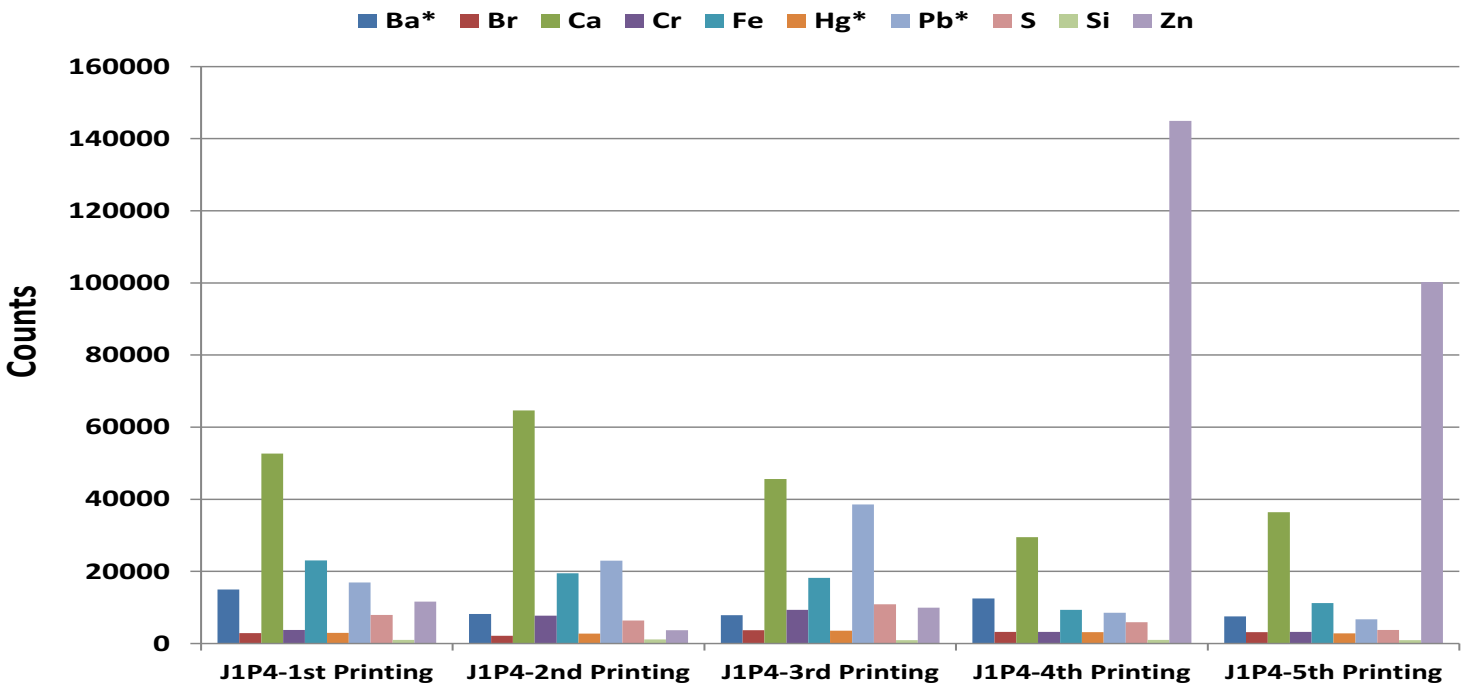
# Large Numeral Plate Proofs on Card




**Large Numeral Plate Proofs on Card (J1P4-J7P4). The first of five printings. The color is a medium brown. Each of the five printings has a distinctive envelope. Envelopes and proofs have been disassociated and re-associated over time.**

***Can X-ray fluorescence spectrometry be used to positively distinguish each of the printings?***

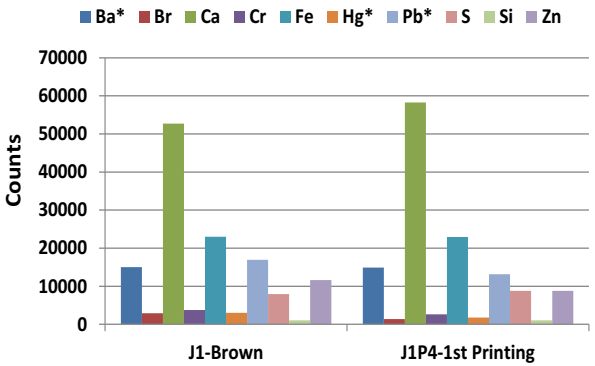
# Large Numeral Plate Proofs on Card

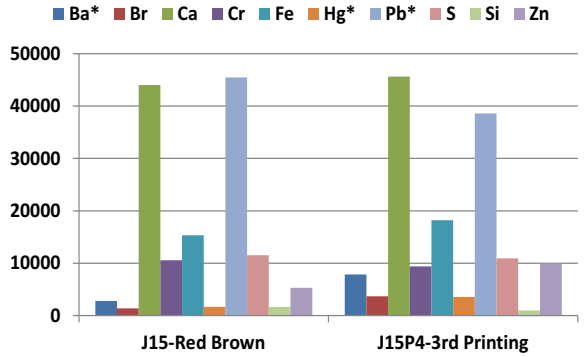


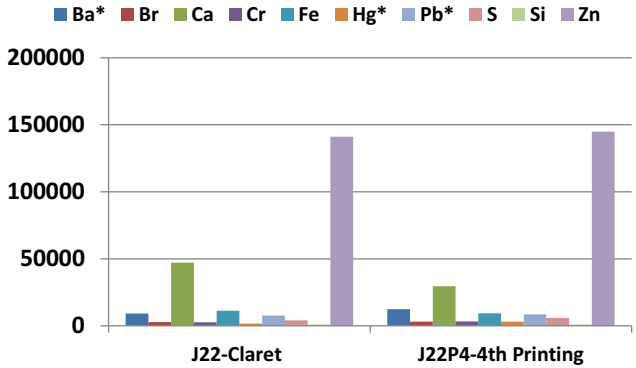

**The X-ray spectra of the brown (1st & 2nd printings), red-brown (3rd printing), claret (4th and 5th printings) card proofs are clearly different and so is their visual appearance. The real issue is sorting between the brown printings (1st & 2nd) printings and the claret Printings (4th and 5th).**

***While small differences exist, its unclear that XFS can be an effective sorting tool between similarly colored card proofs- without a larger statistical sample.***

# Large Numeral Plate Proofs on Card




**Its also clear that the first brown printing of the card proofs is very similar to that of the first brown postage due stamps. Similarly, the red-brown card proofs mirror the 1885 issue red-brown stamps. Also the claret card proofs (4th printing) are a close match to the claret Postage Due stamps issued in 1891.**

***Large Numeral Postage Due card proofs exist in the color of the three main series of Large Numeral Postage Due stamps.***

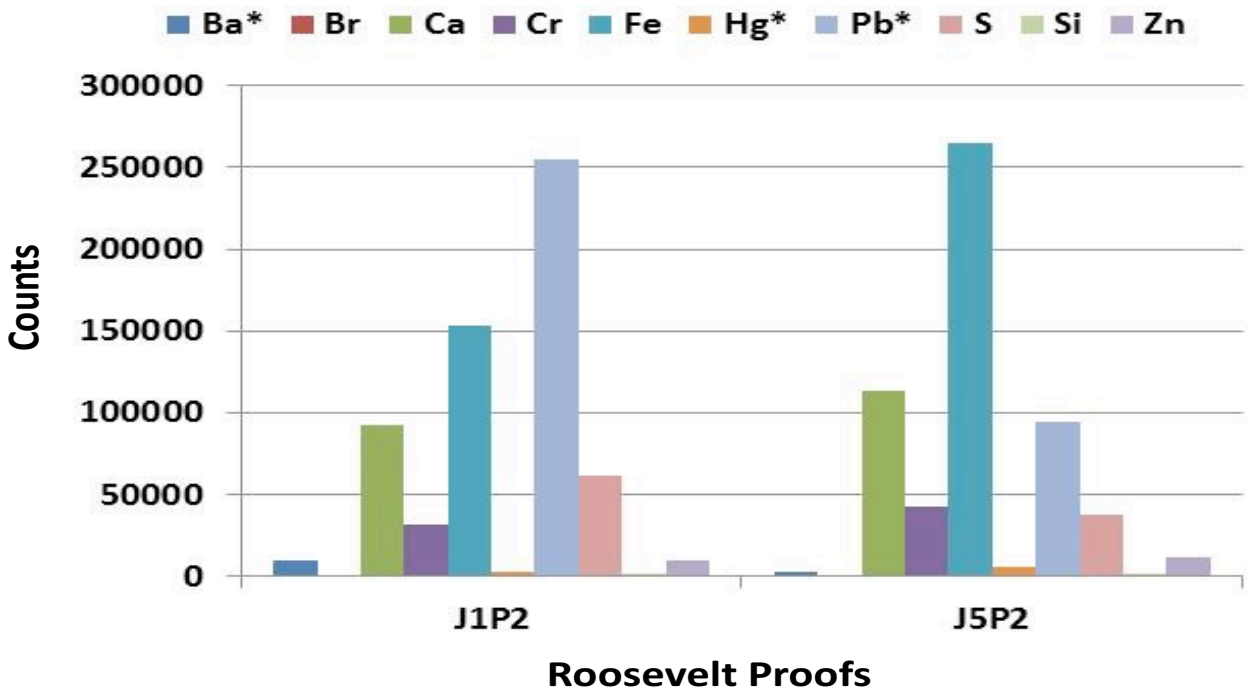
# Large Numeral Roosevelt Die Proofs


*Higher Values*

***Large Numeral Postage Due Page from a Roosevelt Proof Presentation Album (1903).***

***Only 85 were printed. 10¢ to 50¢ denominations were printed along side the lower denominations yet the color was perceived to be different, supposedly indicating the 3-month delay in issuing the higher values.***

# Large Numeral Roosevelt Die Proofs




- **X-ray spectra column charts for low value (J1P2 on the left) and high value (J5P2 on the right) 1879 Series Roosevelt Die Proofs .**
- **The low values (1¢, 2¢, 3¢, and 5¢) were initially issued in July of 1879. while the later high values (10¢, 30¢, and 50¢) were issued in September of 1879.**

***The X-ray spectra column charts for the two samples are quite different with the J1P2 having a significantly larger lead peak and a significantly lower iron peak than its J5P2 counterpart. Conclusion: Purposefully Different Inks!***

# Summary

- **Ink spectra of stamps can be collected by XFS both off and on cover and can be used to identify stamps with different ink compositions despite similarity in color.**
- **Spectra are stable, repeatable, and linear with exposure time.** Even multiple placements on the sample head give relatively consistent results.
- **For the Large Numeral Postage Dues there are distinct color differences between the three series.** With further analysis of dated covers it maybe possible to pin down the exact date of the red-brown stamp introduction.
- **The low denomination plate proofs for the Large Numeral Dues are printed with ink that matches the issued stamps.** The high value proofs come in two colors (both printed in 1879) black-brown and red-brown. Each of these colors has a different ink constituents and the red-brown does not match that of the later stamps.

# Summary

- **The Large Numeral Plate Proofs on card showed marked differences between the three major series (1879 First Printing, 1884 Third Printing, and 1891 Fourth Printing).** Unfortunately, the in-series printings (second printing and the fifth printing) yielded spectra similar to the first and fourth printings respectively-hence distinguishing the former from the latter is difficult and more data will need to be collected.
- **The 1903 Roosevelt small die proofs for the 1893 Large Numeral Dues clearly show major ink differences between the low and high values.** Since low and high value stamps were printed on both printing days for the proofs-the differences were purposeful**.**

***More Work Needs to be Done!***