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Diode Laser Analysis of 2¢ Carmine Ink



Richard Judge

Diode Lasers as Excitation Source

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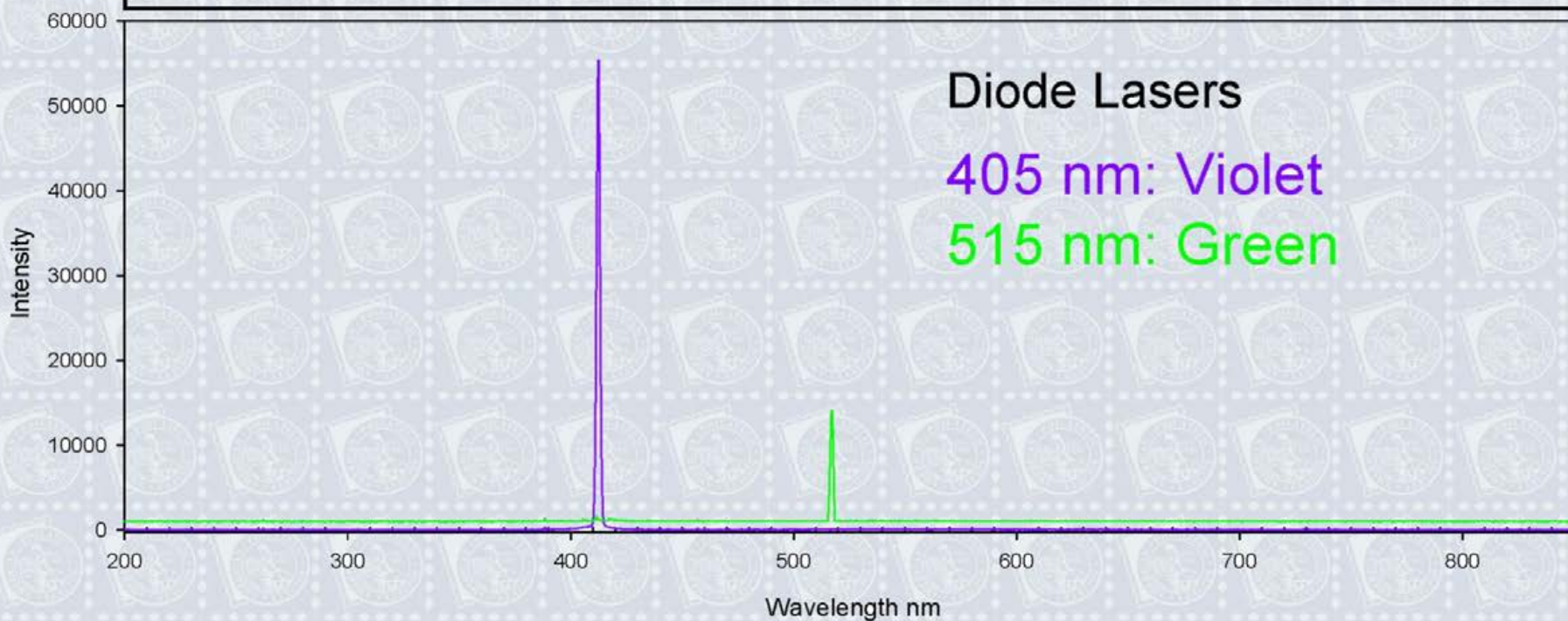
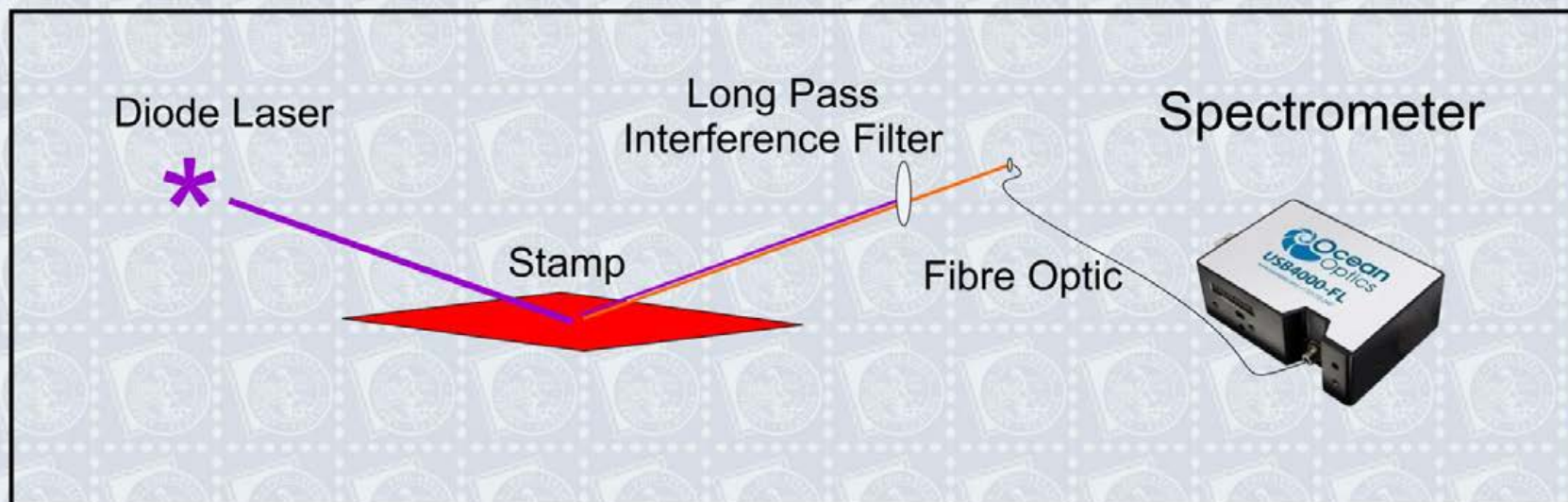
Untagged stamps often appear to show little or no fluorescence from the ink or paper.

However, diode lasers are many times more intense light sources and fluorescence can easily be seen using them.

A violet laser at 405 nm is now commercially available and inexpensive.

As a laser source, a single sharp wavelength is produced.

Optical Configuration for Resolved Emission



Fluorescent Properties of Paper

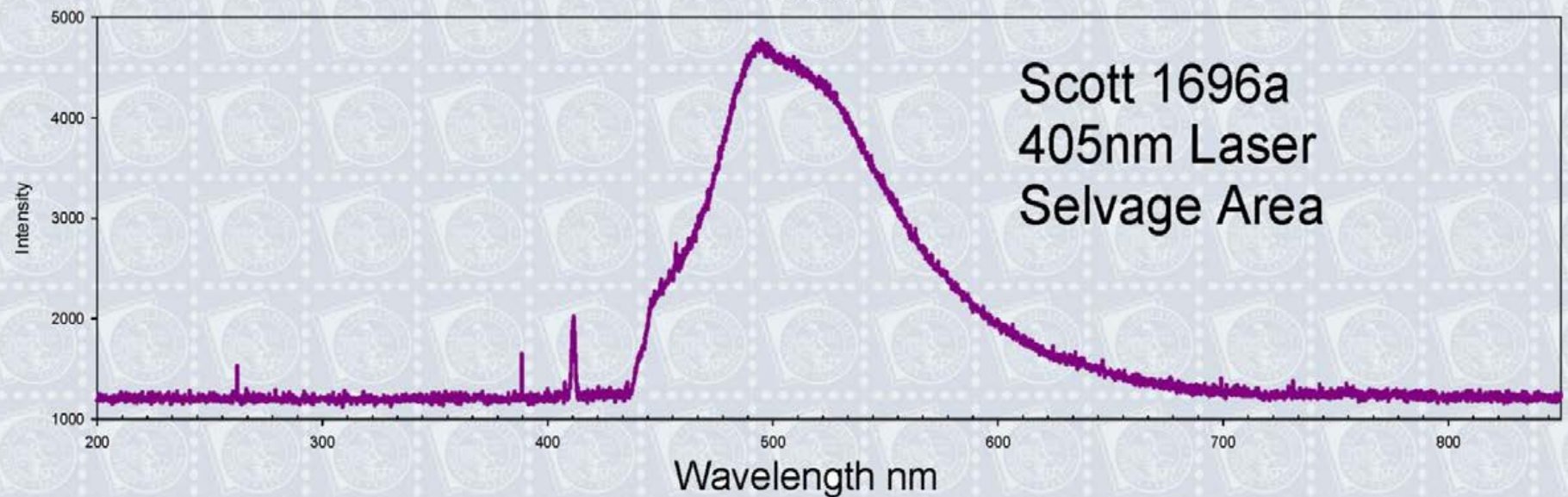
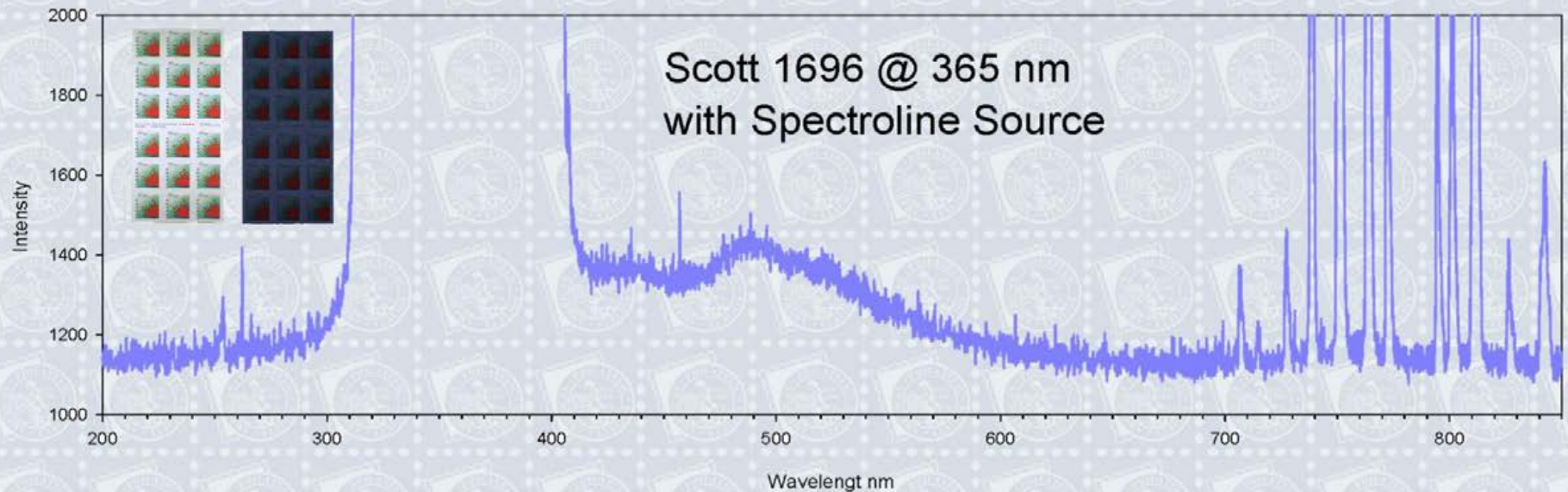
Researchers are not sure of the source of fluorescence from wood pulp paper.

Some say it is the cellulose itself.

Other suggest that it is the lignin impurities that fluoresce.

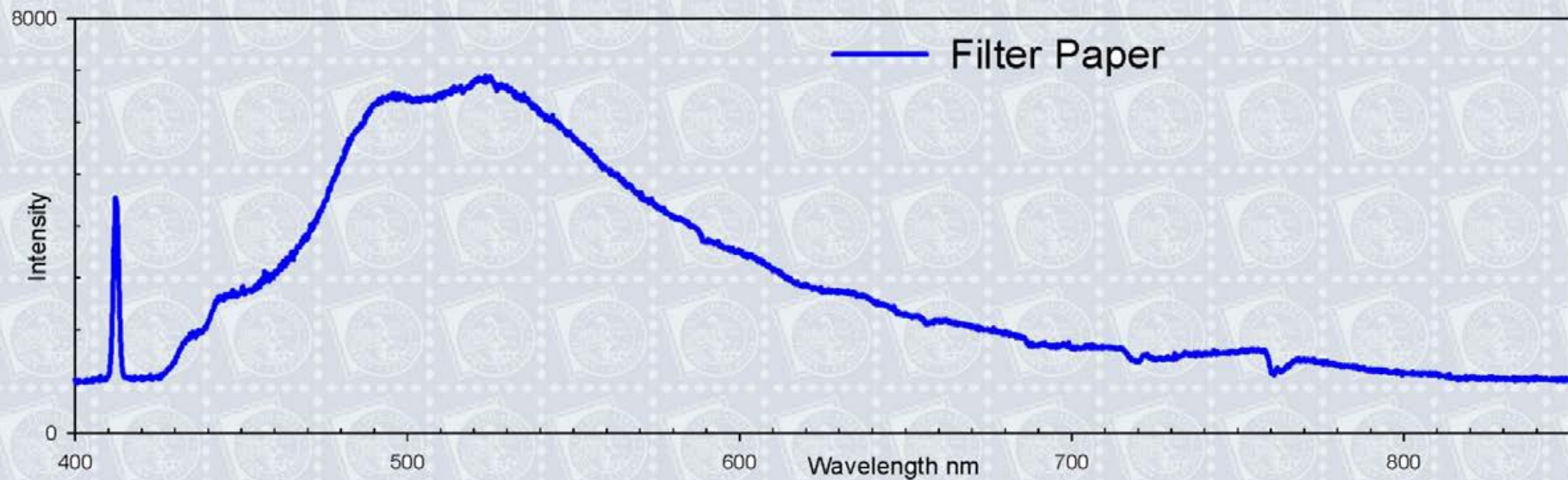
Regardless of source, the luminescence has been present in all the stamps studied.

Sensitivity of the Diode Laser Has Allowed the Recording of Very Weak Fluorescence Signals.



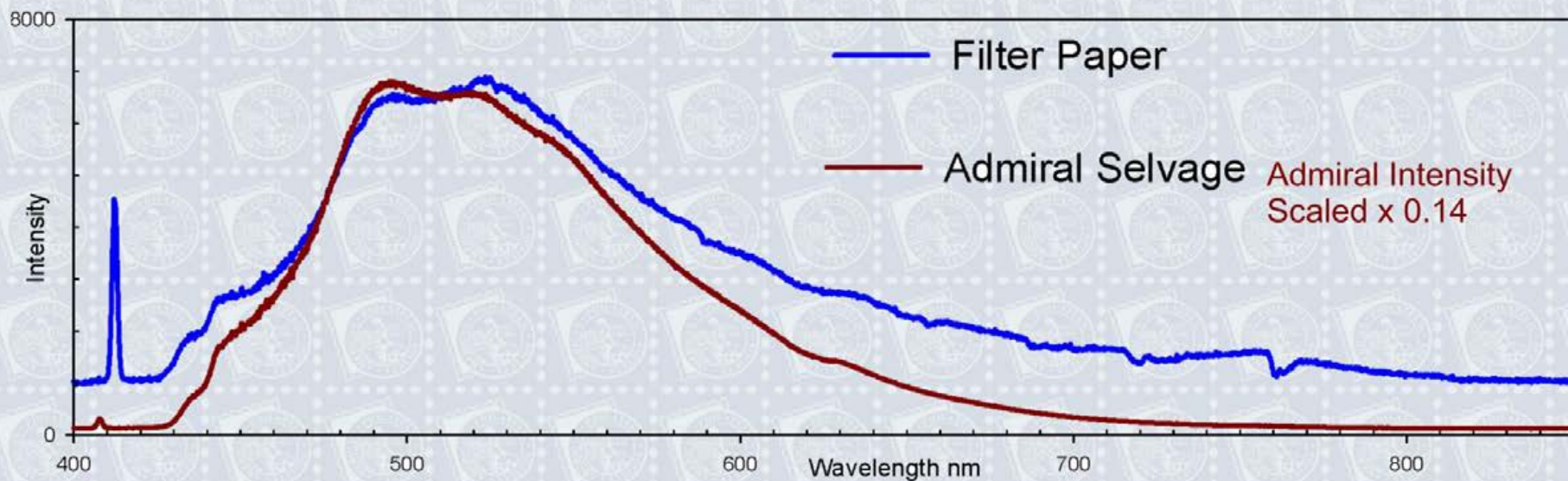
Wavelength Resolved Fluorescence of Paper

Whatman Filter Paper



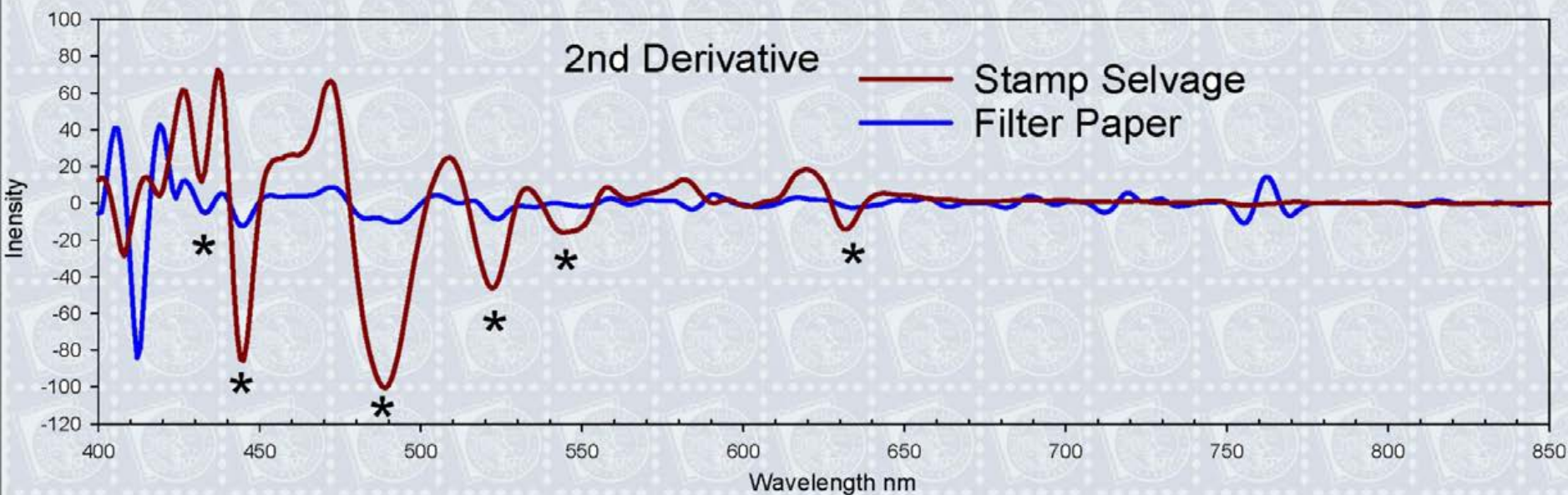
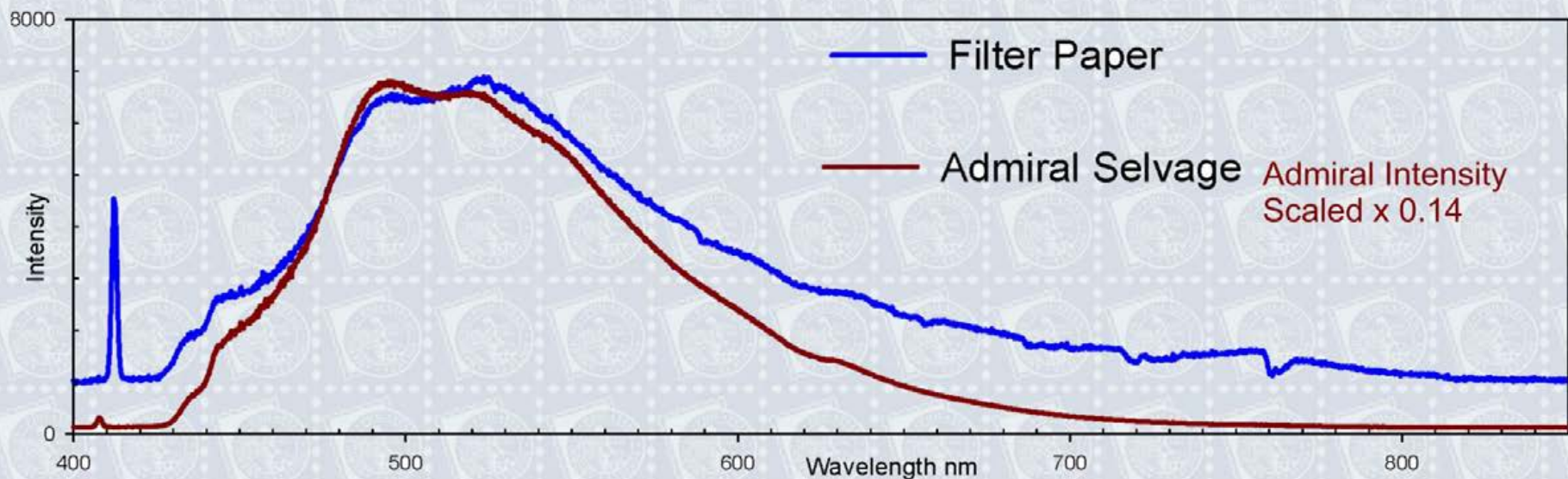
Wavelength Resolved Fluorescence of Paper

Whatman Filter Paper + Selvage Area of an Admiral Plate Block



Wavelength Resolved Fluorescence of Paper

Whatman Filter Paper + Selvage Area of an Admiral Plate Block + Second Derivative Plots



Resolved Fluorescence Study of the 2¢ Red Admiral Issue of Canada, Scott 106

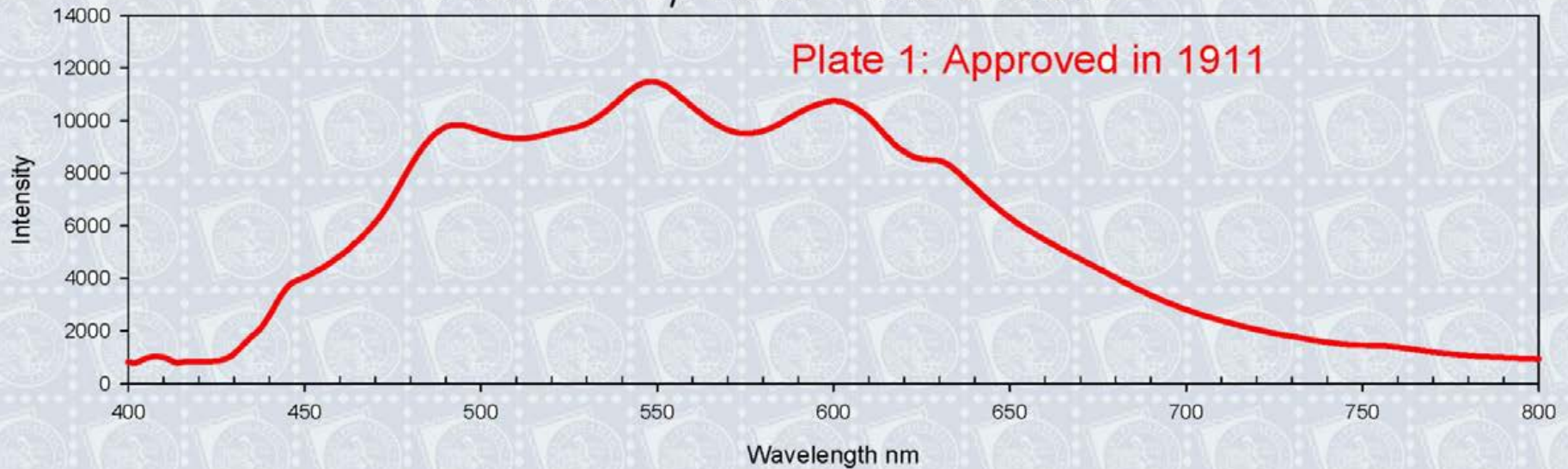
The resolved fluorescence partitions into two major types as illustrated in the following slides.

Plate 1 Rose Carmine
1911

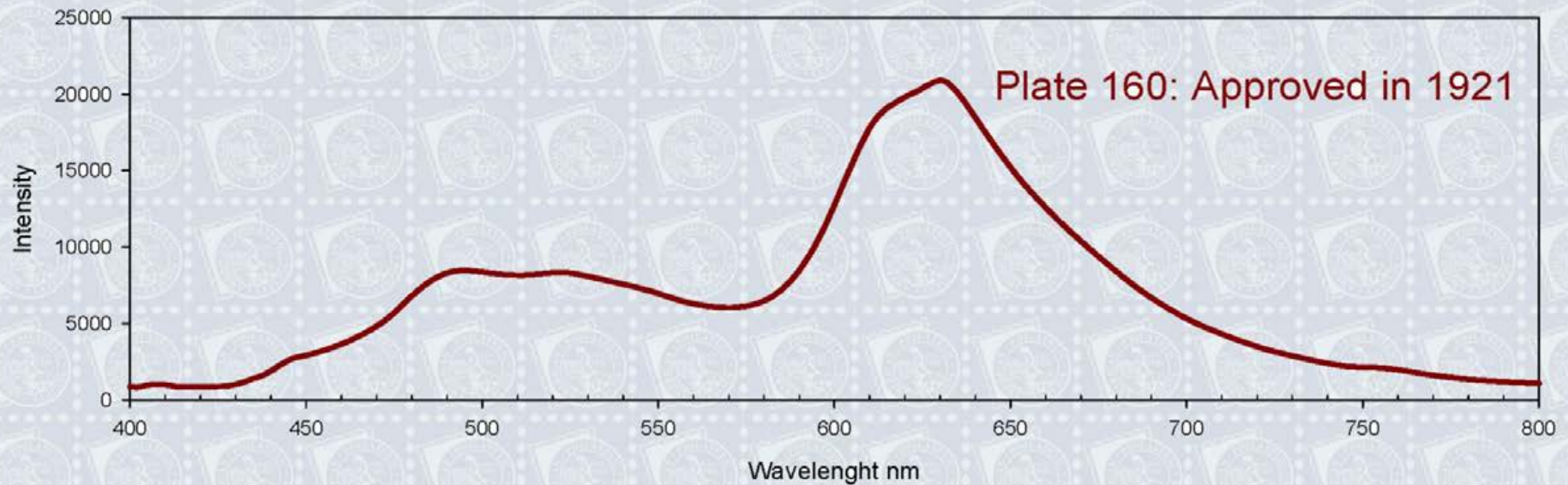
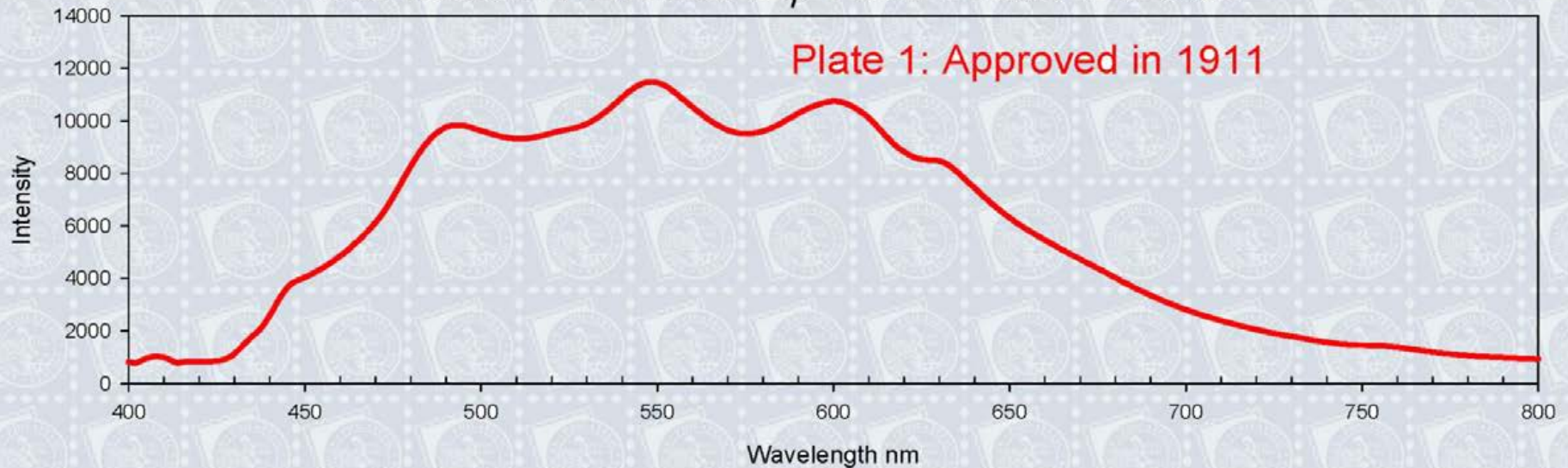


Plate 160 Carmine
1921

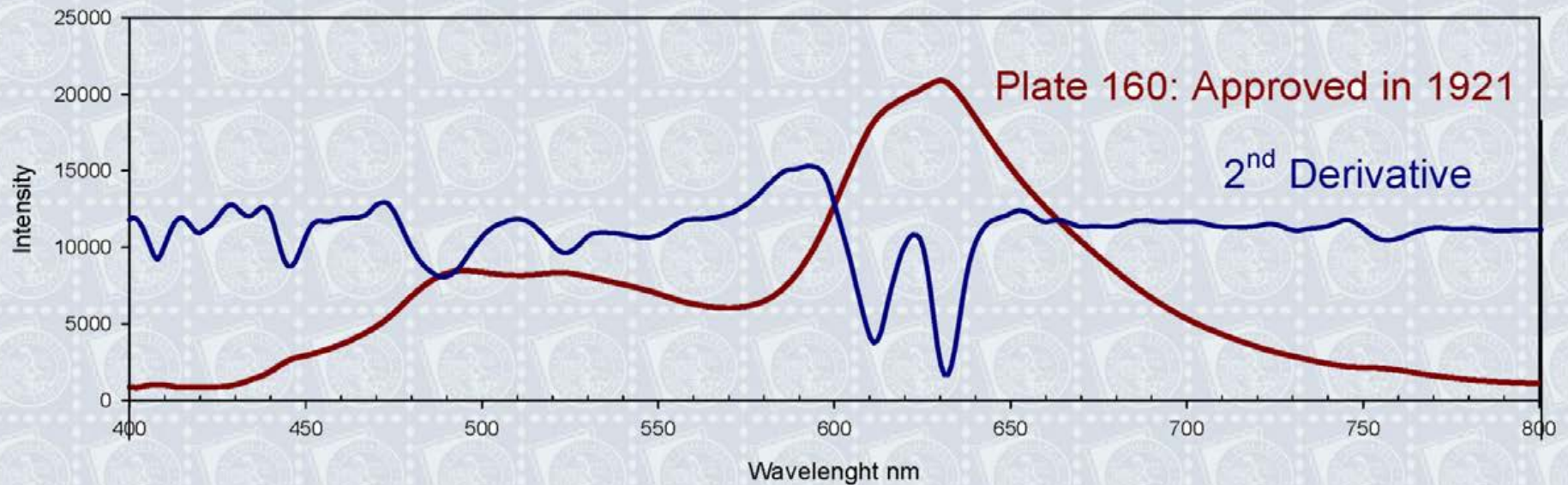
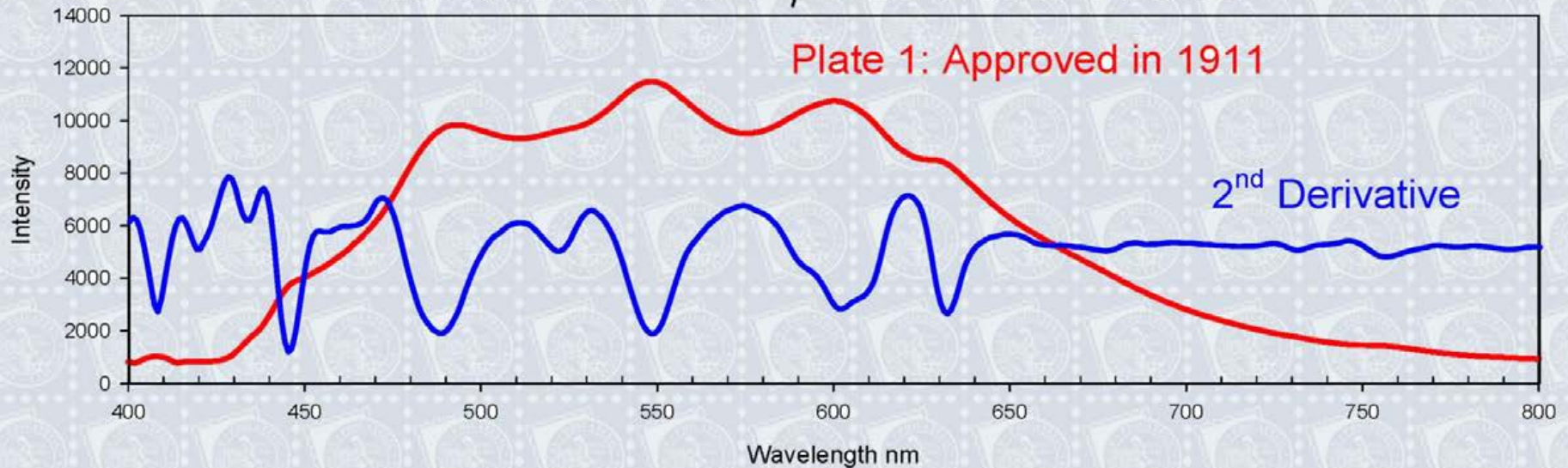
Wavelength Resolved Emission Spectra of the First Canadian Admiral 2¢ Red Plate Blocks



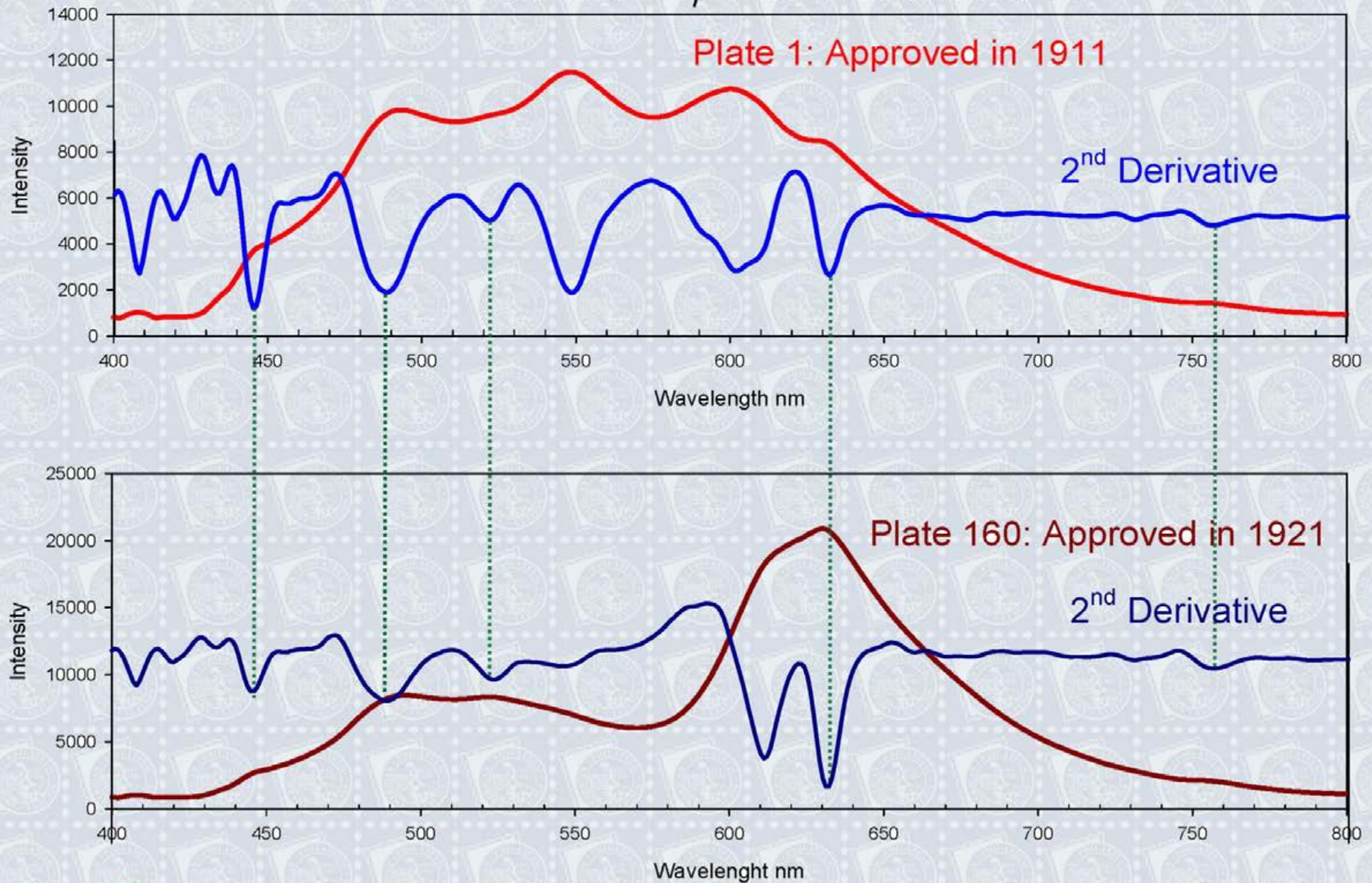
Wavelength Resolved Emission Spectra of the First and Last Canadian Admiral 2¢ Red Plate Blocks



Wavelength Resolved Emission Spectra of the First and Last Canadian Admiral 2¢ Red Plate Blocks

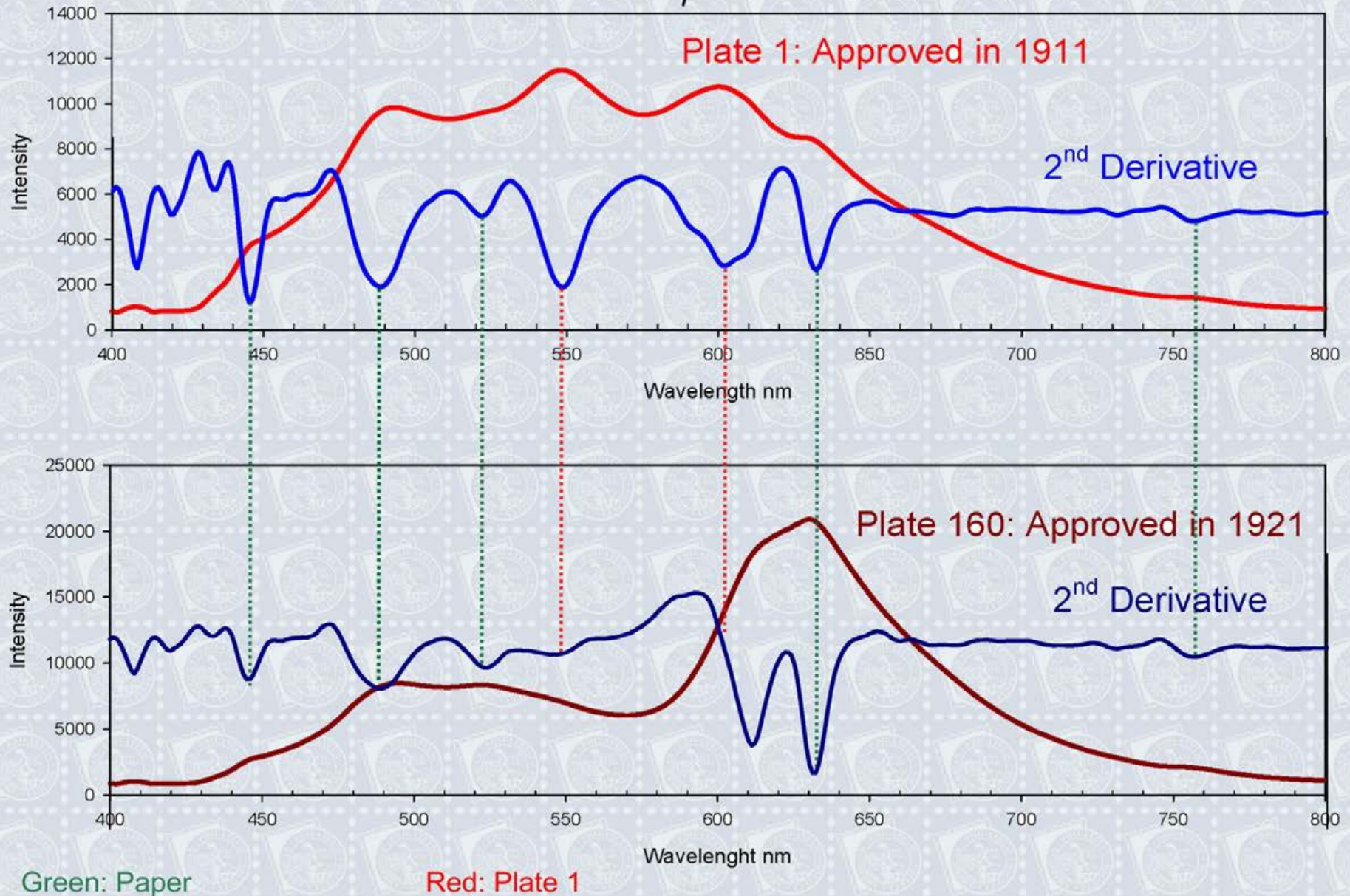


Wavelength Resolved Emission Spectra of the First and Last Canadian Admiral 2¢ Red Plate Blocks

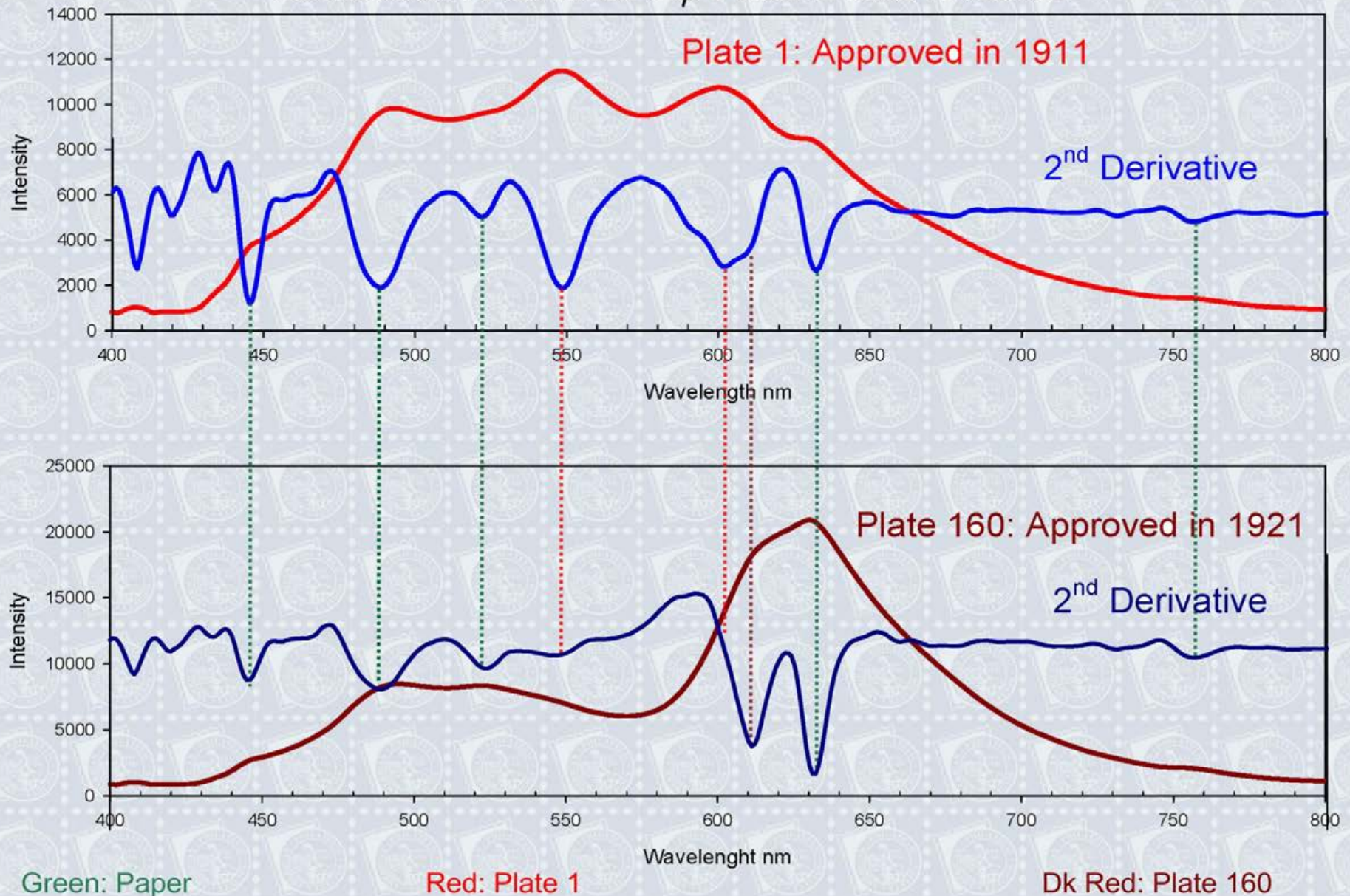


Green: Paper

Wavelength Resolved Emission Spectra of the First and Last Canadian Admiral 2¢ Red Plate Blocks



Wavelength Resolved Emission Spectra of the First and Last Canadian Admiral 2¢ Red Plate Blocks



Principle Component Analysis (PCA)

The 2¢ Red Admiral Series of Canada was produced from 1911-1921. During this time, many shade variations have been noted by philatelists.

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Resolved fluorescence can identify the shades through changes in the emission spectra.

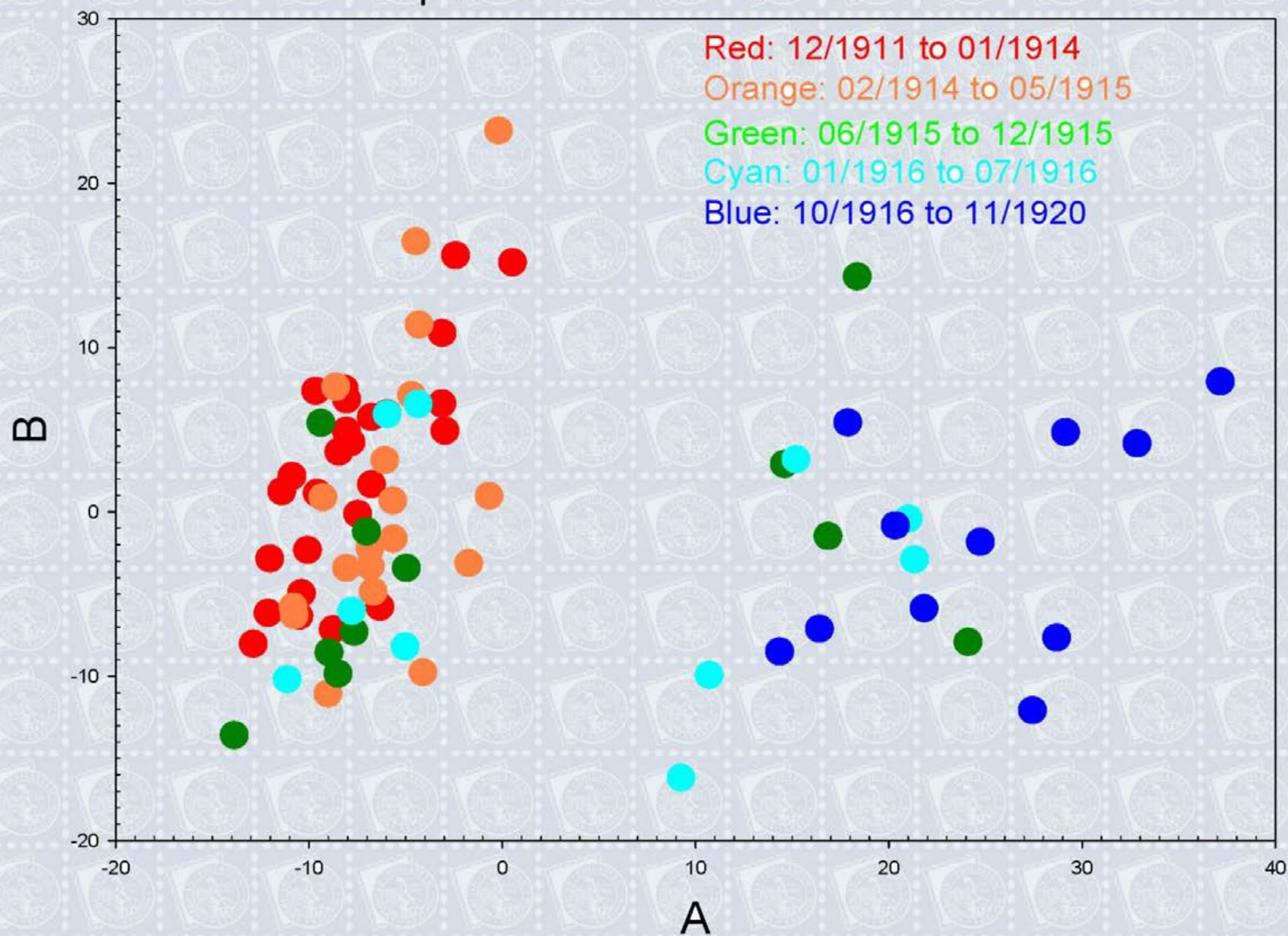
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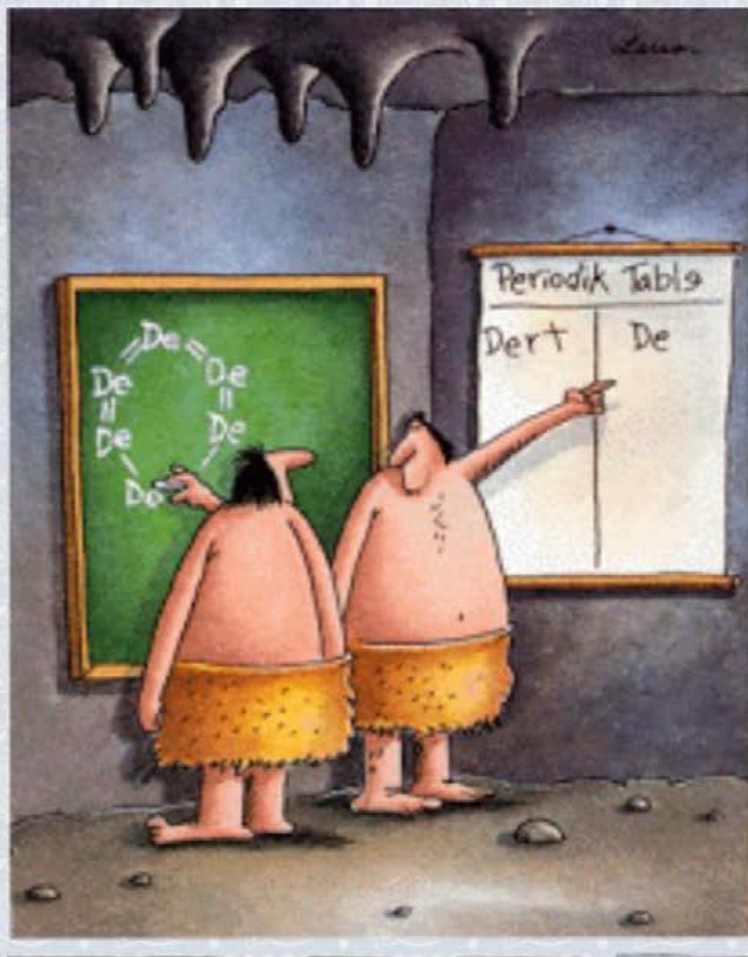
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Though a statistical analysis (PCA) of the 2nd derivative of the resolved emission spectra of 78 plate blocks over the full production period, a major partitioning of shades is confirmed.

Score plot for the Admiral Plate Blocks



Resolved Fluorescence: Hopefully the start of a fruitful journey as envisioned by these early chemists.



*Early chemists describe
the first dirt molecule.*

Cartoon by Gary Larson
The Far Side