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# TECHNICAL ANALYSIS OF WATERCOLOR PIGMENTS

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# IN EARLY AMERICAN **fraktur**

## INTRODUCTION

Prior to the exhibition “Paper Trail: Documenting Rites of Passage in German-Speaking America” at the Abby Aldrich Rockefeller Folk Art Museum, 29 early American Fraktur were unframed for examination, condition reporting and replacement of old framing materials such as backing boards or spacers. This provided an opportunity for in depth study of the artists’ materials.

The availability of a handheld X-ray Fluorescence Spectroscopy (XRF) unit in the conservation department at the Colonial Williamsburg Foundation (CWF) allowed for the elemental identification of watercolor pigments predominantly through a non-destructive means of sampling. The framework of this project was based on previous research by John Krill and Janice Carlson which used solely XRF for pigment analysis. This project expanded upon that scope with the addition of organic yellow pigment identification using Fourier Transform Infrared Spectroscopy (FTIR) and polarized light microscopy (PLM). Krill and Carlson dispelled the idea that fraktur artists were using “home-made” pigments by showing they were in fact using many of the same inorganic watercolor pigments contemporary watercolorist were using; however, are there other things we can learn about these artist by observing trends in their pigment selection? Are there identifiable patterns based on region, time period or specific artist?

## EXPERIMENTAL DESIGN

Fraktur media, both watercolor and ink, were examined using a Bruker Tracer III-SD handheld XRF unit.

- ❖ General scan setting of 40 keV, 4.0 uA for 60 seconds with vacuum and no filter to detect a broad range of elements.
- ❖ Instances where additional clarity of the data was required for lighter elements settings were changed to 15 keV, 25 uA for 60 seconds with vacuum and a titanium filter (blue).

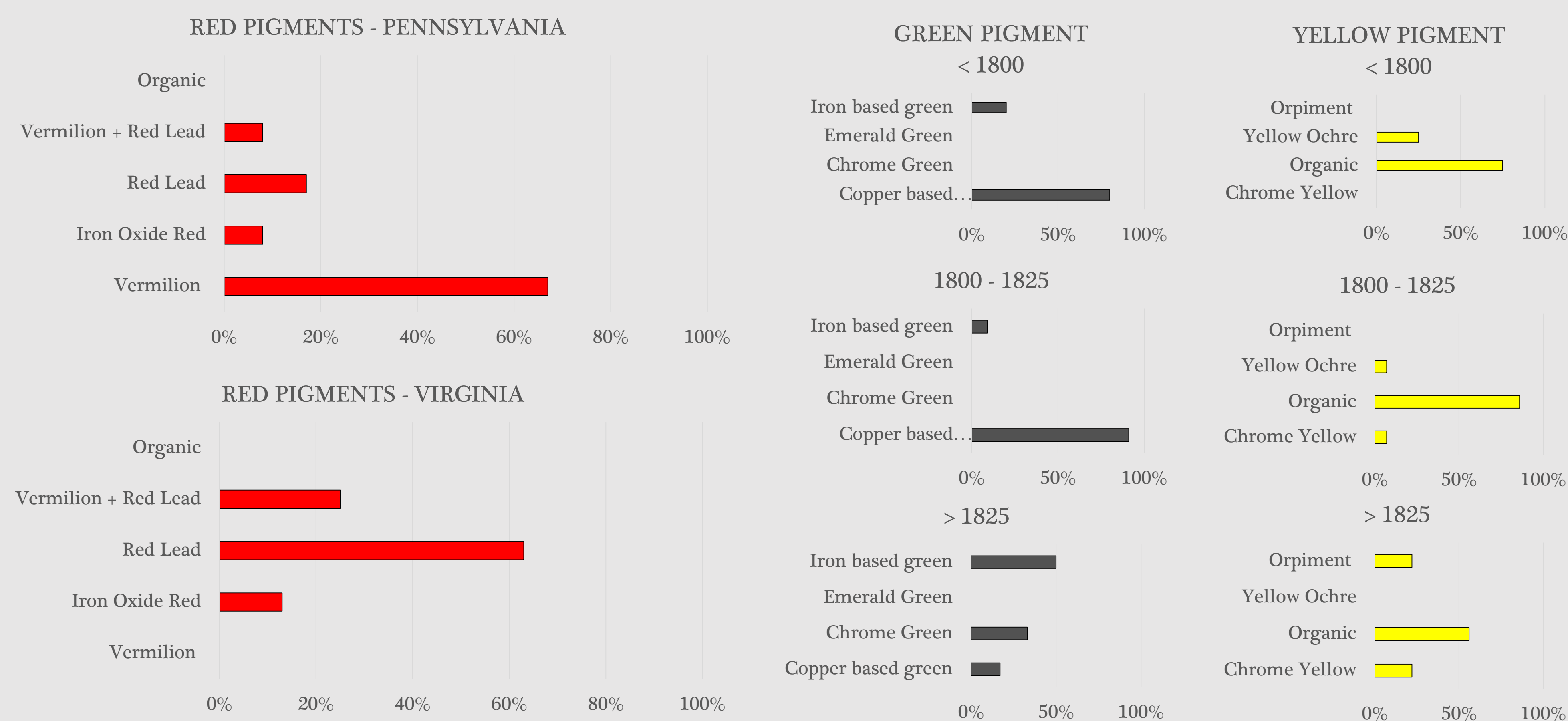
Conservators and curators saw value in adding information about the organic yellow colorants used for fraktur; the decision was made to sample the yellow pigment for FTIR and/or PLM. FTIR spectra collected from fraktur samples were compared with spectra libraries with artist materials both modern and naturally aged.



## RESULTS

OVERALL SET - 29 SAMPLES			OVERALL SET Containing Pigment		BY REGION				BY TIME PERIOD			
Color	Pigment	Chemical Formula	No.	Percent	Pennsylvania	Virginia	< 1800	Percent	1800 - 1825	Percent	> 1825	Percent
Red	TOTAL		26	-	12	8	4	-	13	-	9	-
	Vermilion	HgS	12	46%	8	67%	0	0%	2	50%	3	23%
	Iron Oxide Red	Fe <sub>2</sub> O <sub>3</sub>	2	8%	1	8%	1	13%	0	0%	2	15%
	Red Lead	Pb <sub>3</sub> O <sub>4</sub>	8	31%	2	17%	5	63%	1	25%	7	54%
	Vermilion + Red Lead ^	HgS + Pb <sub>3</sub> O <sub>4</sub>	3	12%	1	8%	2	25%	1	25%	1	8%
Orange	Organic		1	4%	0	0%	0	0%	0	0%	1	11%
Orange	TOTAL		1	-	0	-	0	-	1	-	0	-
	Vermilion*	HgS	1	100%	0	0%	0	0%	1	100%	0	0%
Blue	TOTAL		19	-	10	3	1	-	7	-	9	-
	Prussian Blue	Fe <sub>4</sub> (Fe(CN) <sub>6</sub> ) <sub>3</sub>	18	100%	10	100%	3	100%	1	100%	8	89%
	Cobalt Blue	CoO · Al <sub>2</sub> O <sub>3</sub>	1	4%	0	0%	0	0%	0	0%	1	11%
Green	TOTAL		22	-	9	7	5	-	11	-	6	-
	Copper based green (12/14 likely Verdigris)	Cu <sub>2</sub> (C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> · 2Cu(OH) <sub>2</sub>	14	64%	5	56%	4	80%	10	91%	1	17%
	Chrome Green	Fe <sub>3</sub> (Fe(CN) <sub>6</sub> ) <sub>3</sub> + PbCrO <sub>4</sub>	2	9%	1	11%	0	0%	0	0%	2	33%
	Emerald Green	Cu <sub>2</sub> (C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> · Cu(AsO <sub>2</sub> ) <sub>2</sub>	1	5%	1	11%	0	0%	0	0%	0	0%
	Iron based green- either Prussian Blue + yellow mixture or Green Earth	Fe <sub>4</sub> (Fe(CN) <sub>6</sub> ) <sub>3</sub> or Fe, Mg, Al, K, Si	5	23%	2	22%	0	0%	1	9%	3	50%
Yellow	TOTAL		27	-	13	8	4	-	14	-	9	-
	Chrome Yellow	PbCrO <sub>4</sub>	3	11%	2	15%	1	13%	0	0%	1	7%
	Organic	Gamboge	20	74%	10	77%	5	63%	3	75%	12	86%
	Yellow Ochre	Fe <sub>2</sub> O <sub>3</sub> · H <sub>2</sub> O	2	7%	0	0%	1	13%	1	7%	0	0%
	Orpiment	As <sub>2</sub> S <sub>3</sub>	2	7%	1	8%	1	13%	0	0%	2	22%
Pink	TOTAL		8	-	3	5	1	-	5	-	2	-
	Lead based***	Pb <sub>3</sub> O <sub>4</sub> and/or 2PbCO <sub>3</sub> · Pb(OH) <sub>2</sub>	5	63%	0	0%	5	100%	0	0%	0	0%
	Vermilion****	HgS	2	25%	2	67%	0	0%	1	100%	0	0%
	Organic		1	13%	1	33%	0	0%	0	0%	1	50%

<sup>\*</sup>possibly modified with organic yellow  
<sup>\*\*</sup> Spot size of blue on four examples too small and/or overlapped with other colors- limited results by detector size  
<sup>\*\*\*</sup> Could be white lead plus an organic red or red lead or thin application of red lead  
<sup>\*\*\*\*</sup> either thin application or modified with white (non-lead based)  
<sup>^</sup> Appears to be a saturated red not modified with white lead to form a tint (i.e. pink)



## CONCLUSIONS

In general, the palette of fraktur artists was very limited consisting of red, blue, yellow, green, orange and pink. Colorants were mostly used in pure form, little mixing – with the exception of pink and some greens – or the creation of tints or shades are noted.

- ❖ A common palette was vermilion, Prussian blue, gamboge and verdigris.
- ❖ Organic yellow pigments confirmed to be gamboge by both FTIR and PLM.
- ❖ Interestingly some variations in colors/pigments selected appear to be noted by region and time period. This may speak to availability of materials, creative divergence from traditional forms or economy.

## FUTURE WORK

- ❖ Further exploration of fraktur from outside of Southeastern Pennsylvania to gain more insight into the materials used especially in Southern examples. How much variation is there? What are the motivations for palette differences? How does this compare with other traditional artforms from Germanic communities in America at that time such as painted furniture?
- ❖ Collaboration with other scholars studying fraktur to compare observations of works by specific artists. Eg. Are the materials used by the Ehre Vater artist the same throughout the course of his work or are differences seen as he moved further south where availability may have changed?

## ACKNOWLEDGEMENTS

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- ❖ Images and data courtesy of the Colonial Williamsburg Foundation

### References

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