Analysis of a Sample of the "Bassoon Stop" of a Joseph Newman Square Pianoforte

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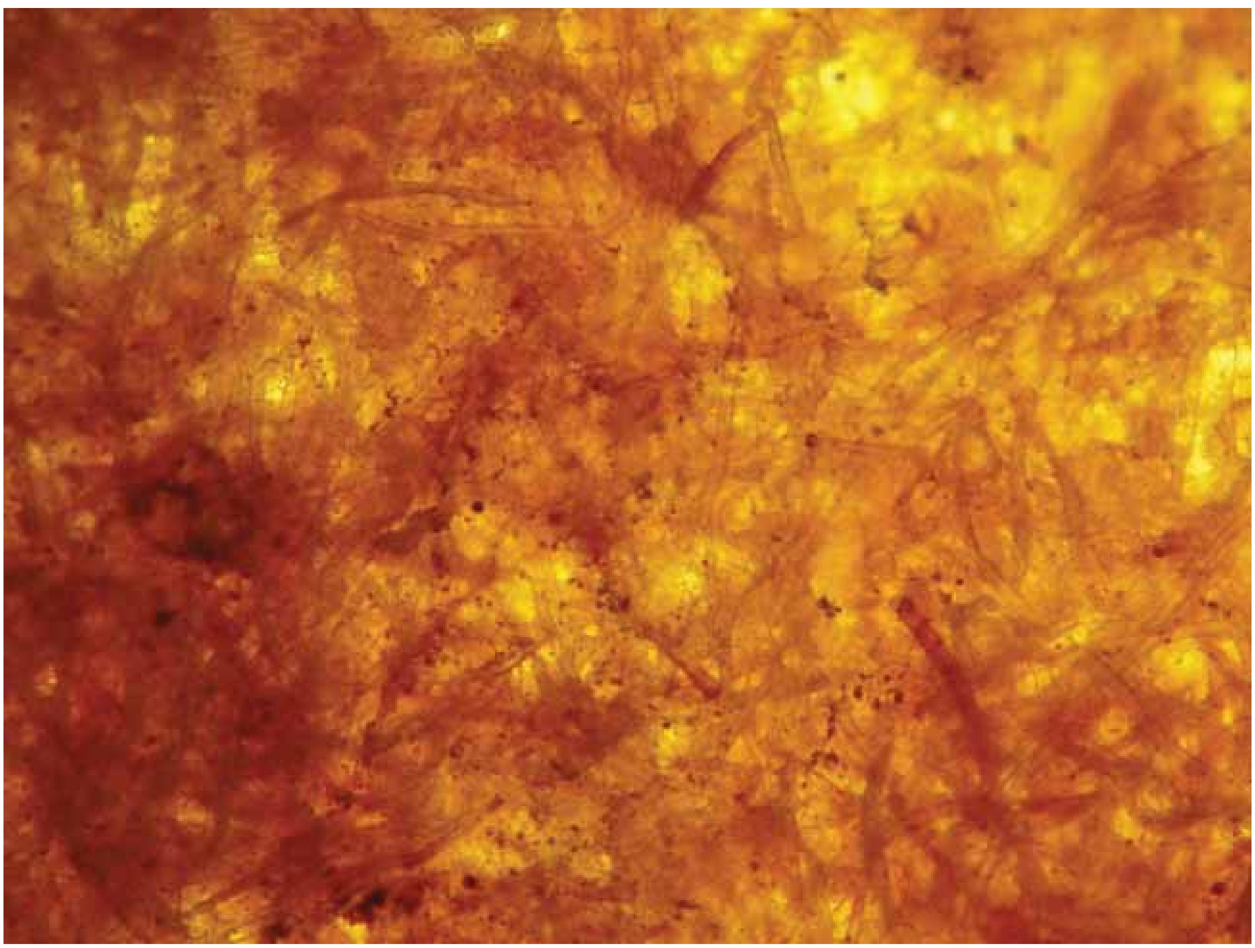
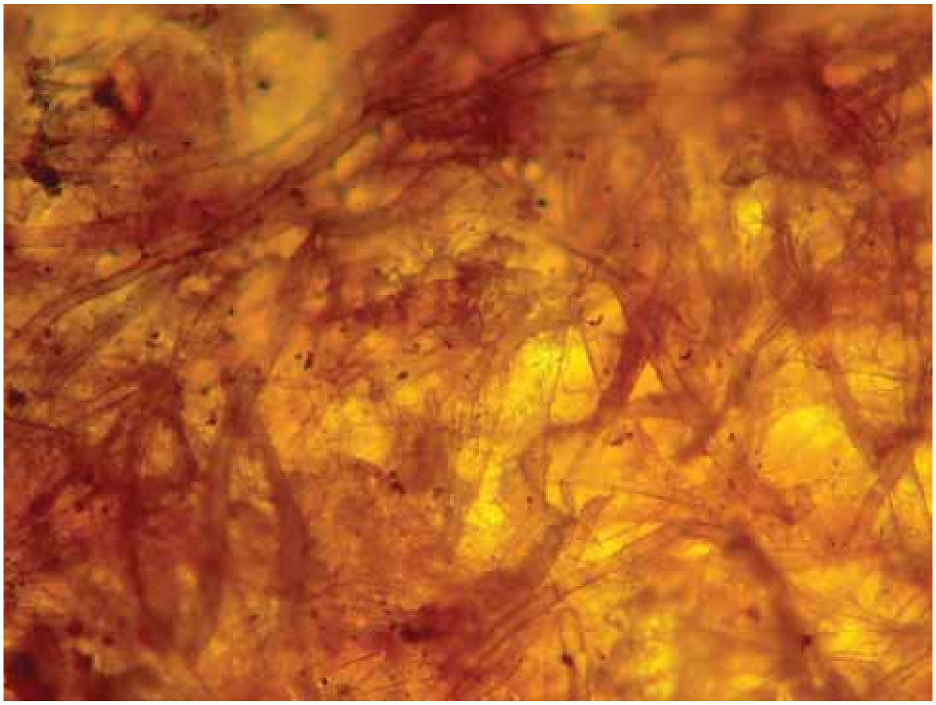
A sample of a paper "bassoon stop" from a 1830s square pianoforte by the Baltimore, Maryland builder Joseph Newman was submitted to St Jude Medical for analysis of composition prior to reconstruction of the stop as part of a separate restoration process of another piano. A similar stop was once in place for an Andrew Reuss SPF of circa 1834 and owned by Tom Strange, and the analysis was conducted to help make a complete reconstruction of the stop for the Reuss.

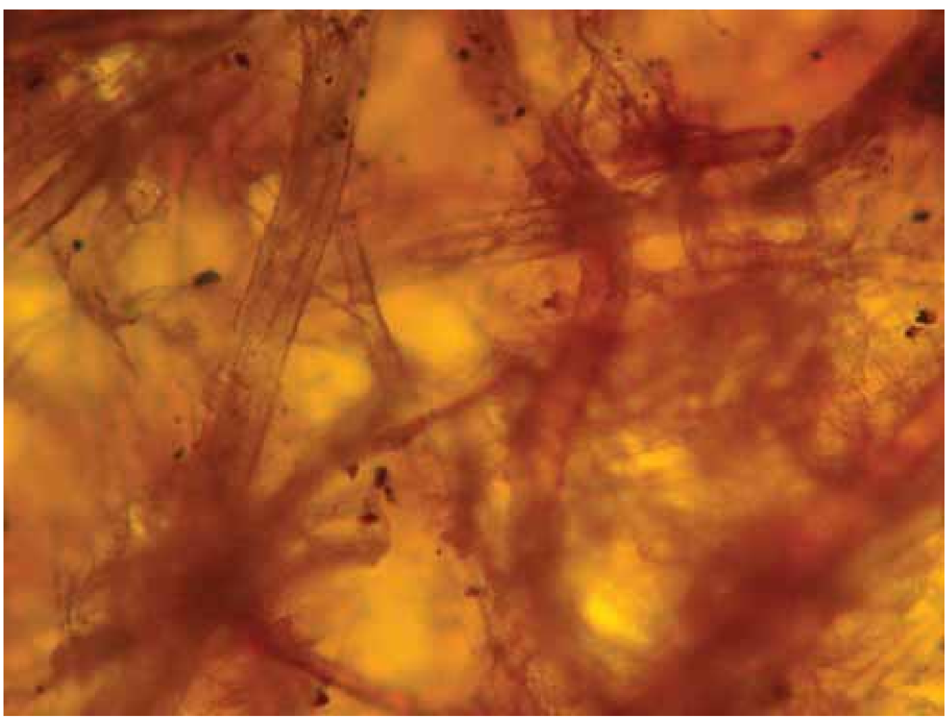
We received a chip of paper ~0.6 cm^2, and 0.12 mm (.0047") thick. The density was difficult to determine with accuracy as there is a pigment layer on one side, but visually it compares favorably with a low to medium density brown Kraft paper, however the **rounded fibers with a central lumen and nodes are those of flax, employed here as linen fibers**. The coated and uncoated sides were examined under magnification between 50X and 500X, and a photographic record made (Nikon Eclipse ME 600). These micrographs follow.



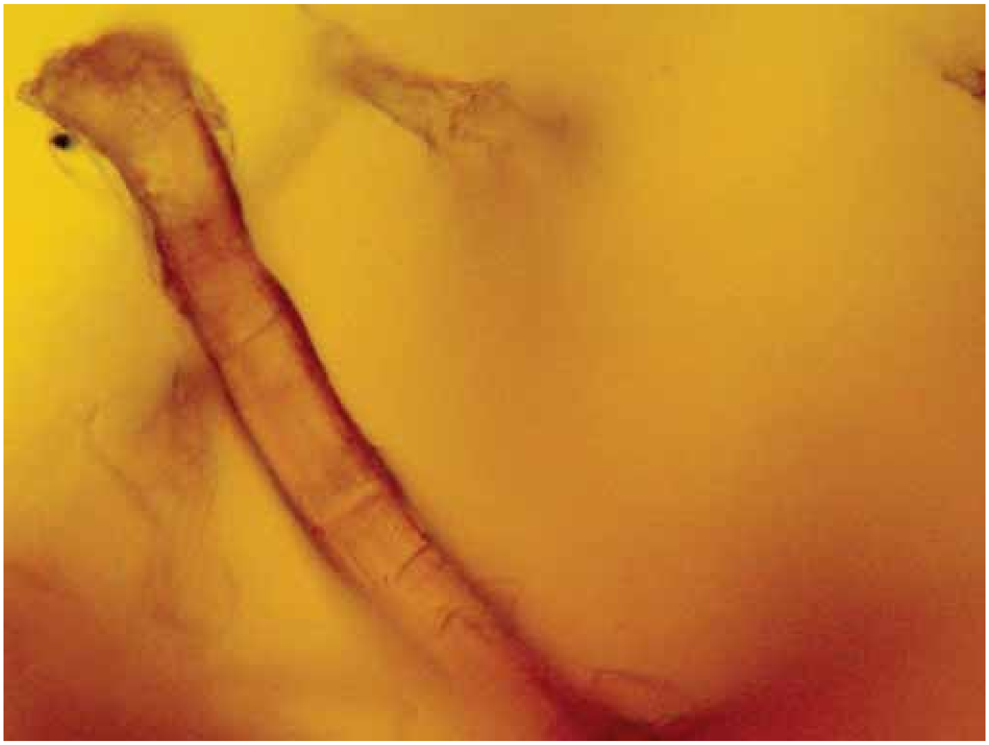
Uncoated side, 50X, transmission illumination



Uncoated side, 100X, transmission illumination

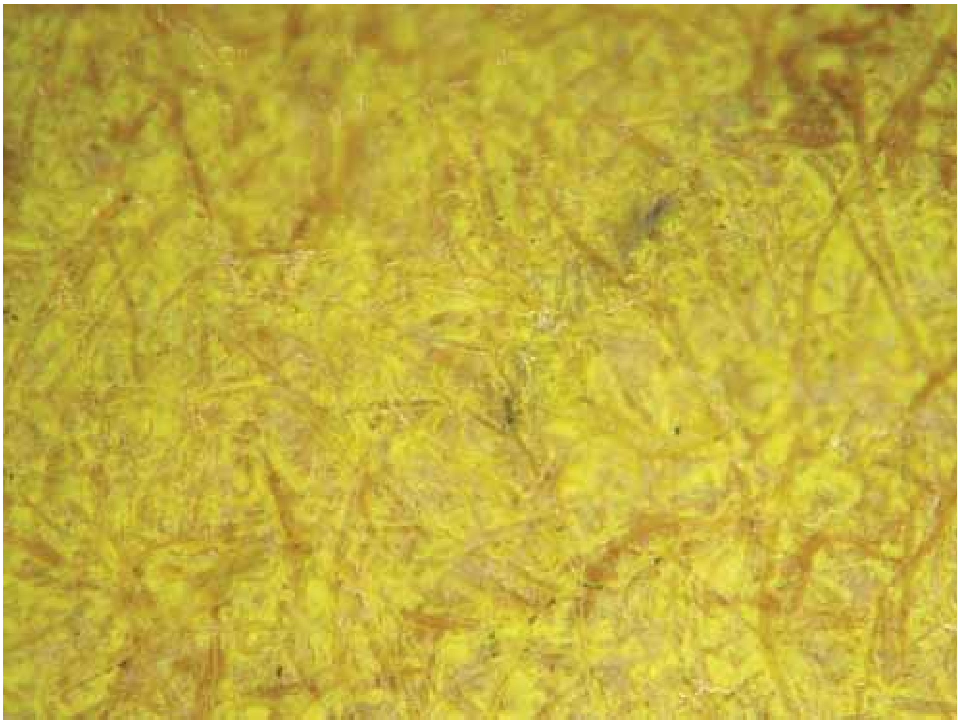


Uncoated side, 200X, transmission illumination

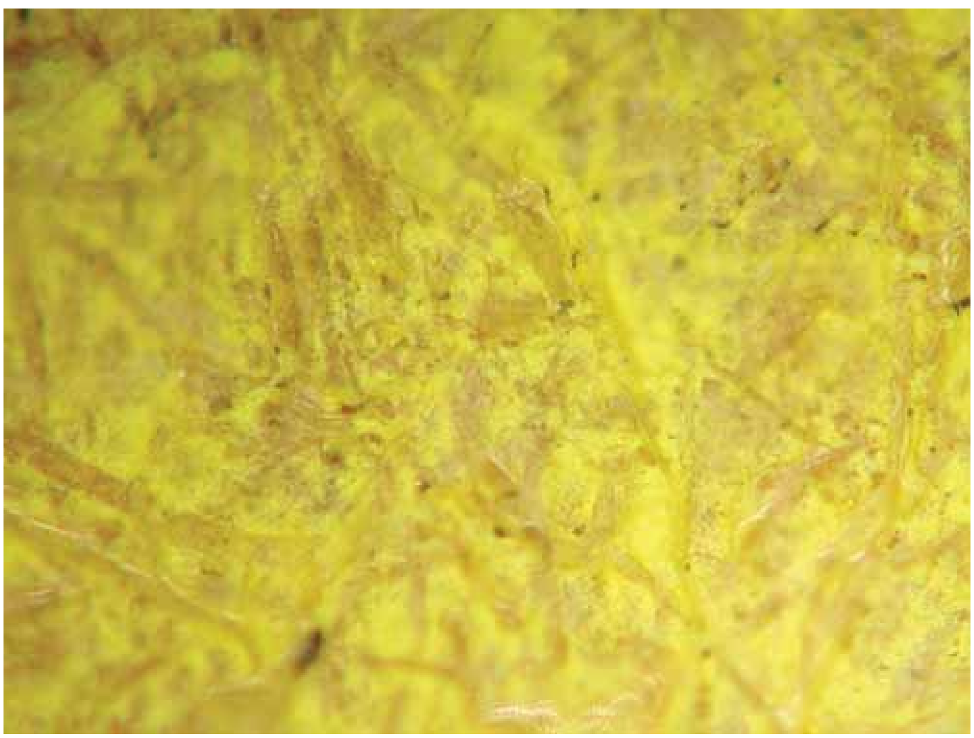


Uncoated side, single fiber, 500X, transmission illumination

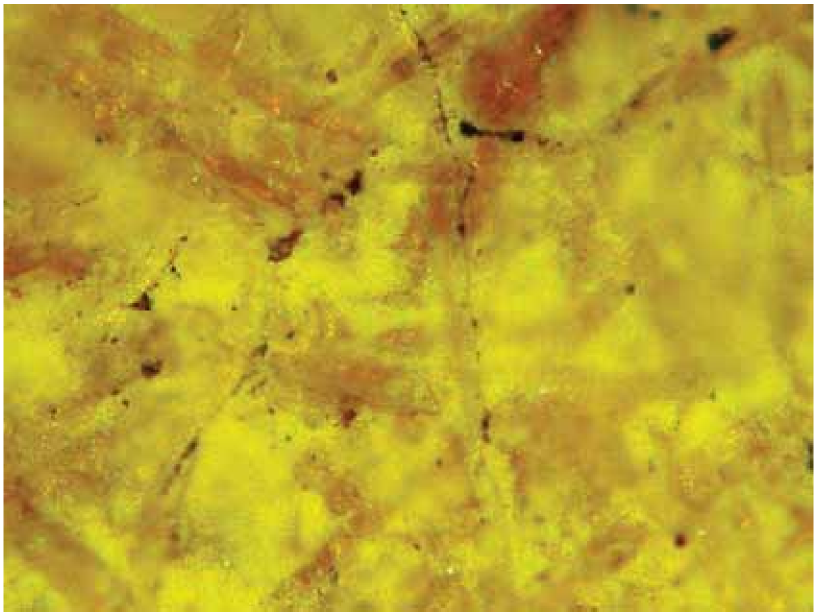
Uncoated side, 100X, epi-illumination – dark field



Coated side with pigment, 50 X, epi-illumination – dark field

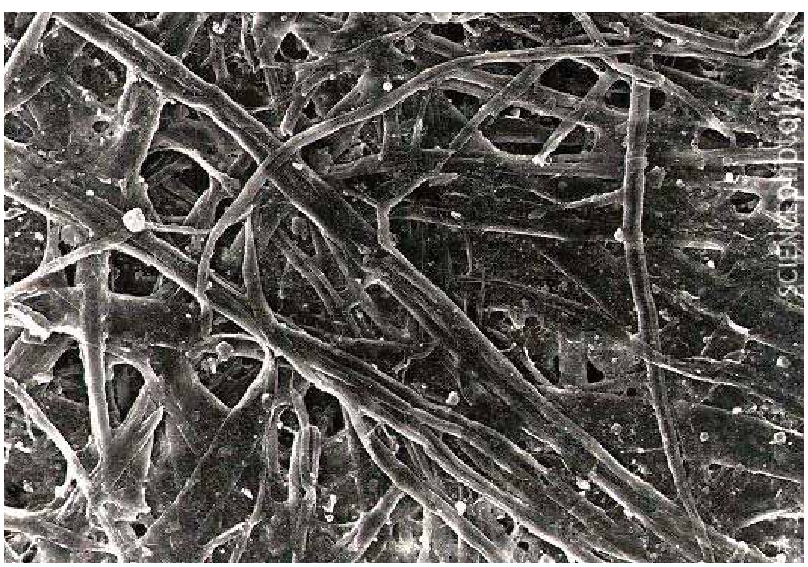


Coated side with pigment, 100X, epi-illumination, dark field



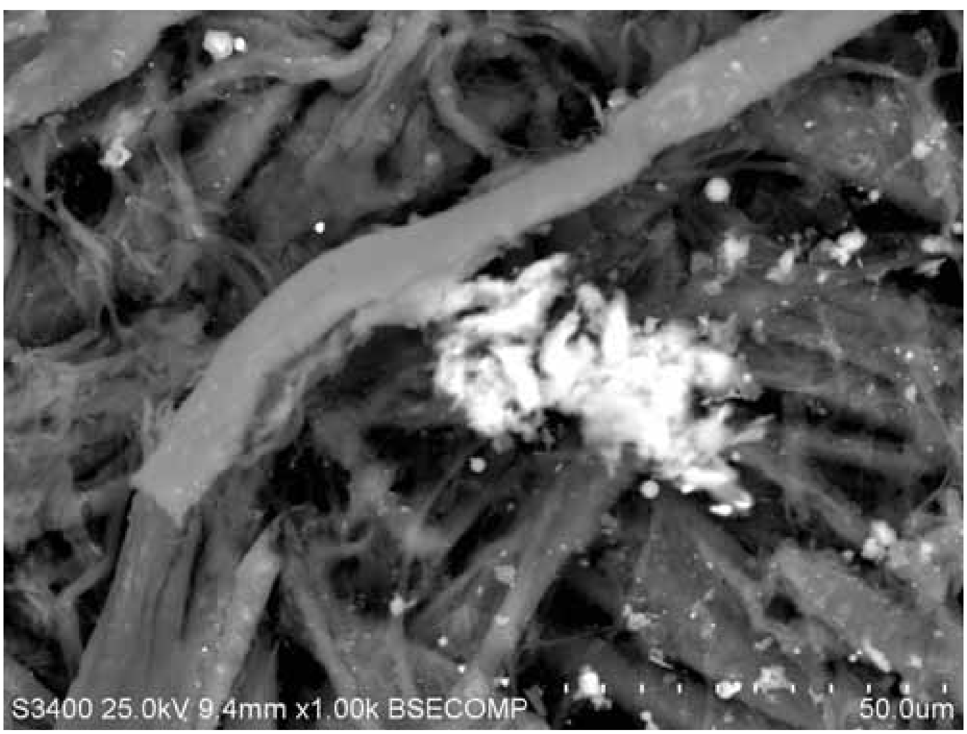
Coated side, 200X, epi-illumination, bright field with cross polarization.

The sample was cut in half, one half flipped over, and the two pieces mounted on carbon tape and examined in a Hitachi S-3400N, environmental variable pressure SEM. The use of a variable pressure SEM allows direct examination of organic materials without charging artifacts. Secondary X-Ray analysis of the surface was done using IXRF 500i energy dispersive X-Ray analysis (EDXA). This allows the production of X-Ray maps that detail the surface chemistry, as well as high resolution SEM images of the coated and uncoated surfaces.



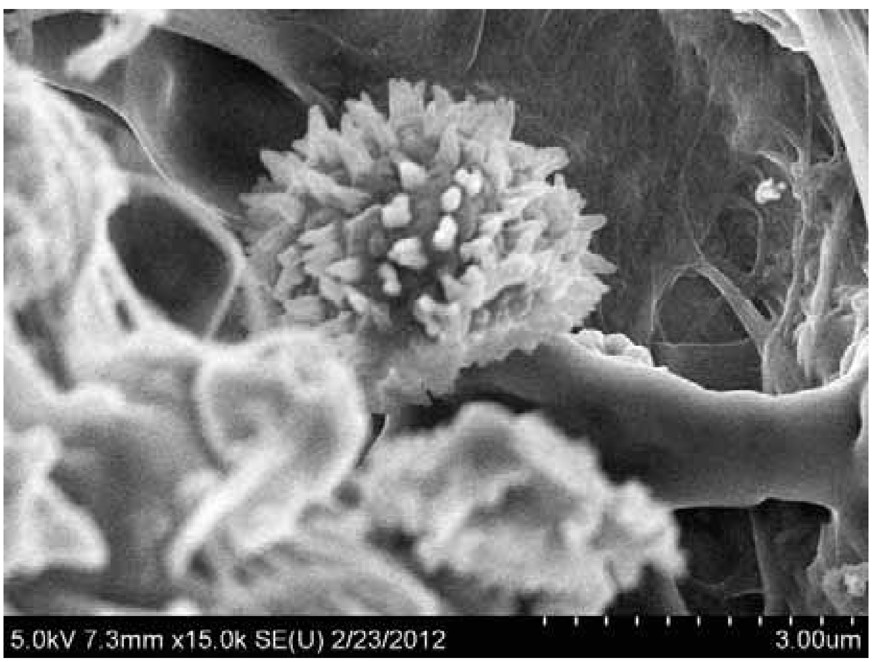
Modern kraft paper, SEM, stock photo

Uncoated side, SEM, 250X

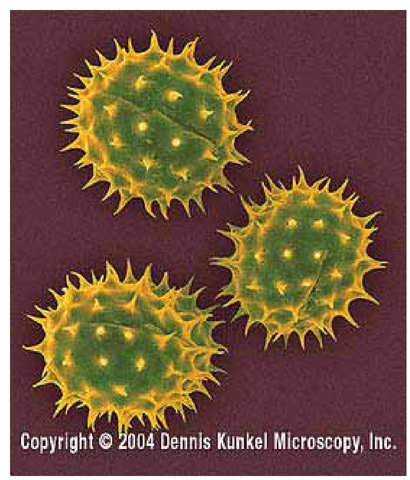


Uncoated side with fibers, SEM, 1000X

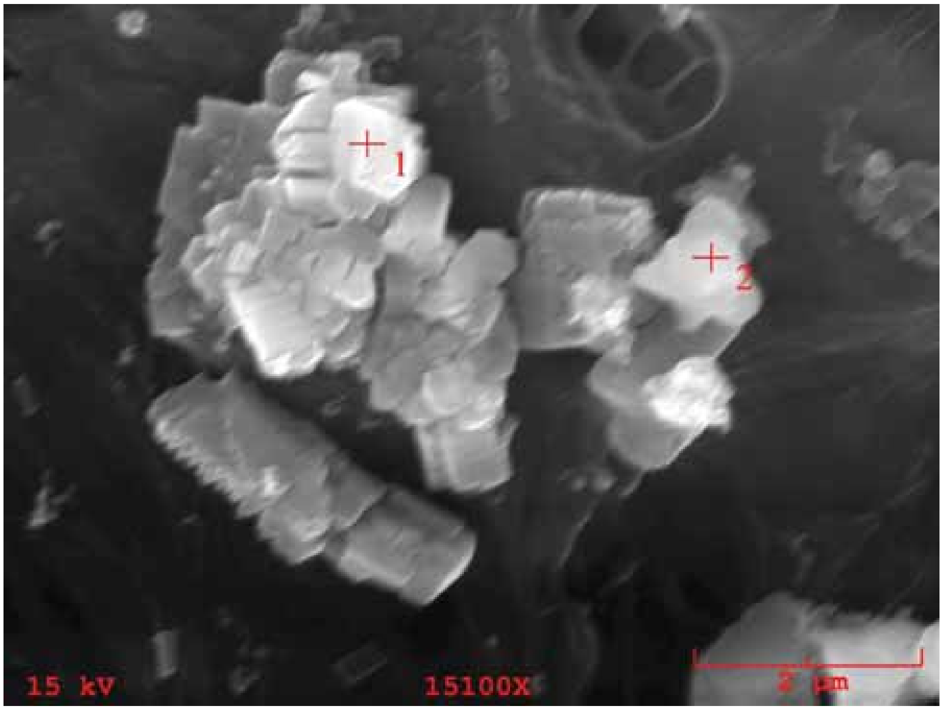
Uncoated side, showing pollen (arrows) and detritus such as dander, insect feces, etc., SEM, 5000X



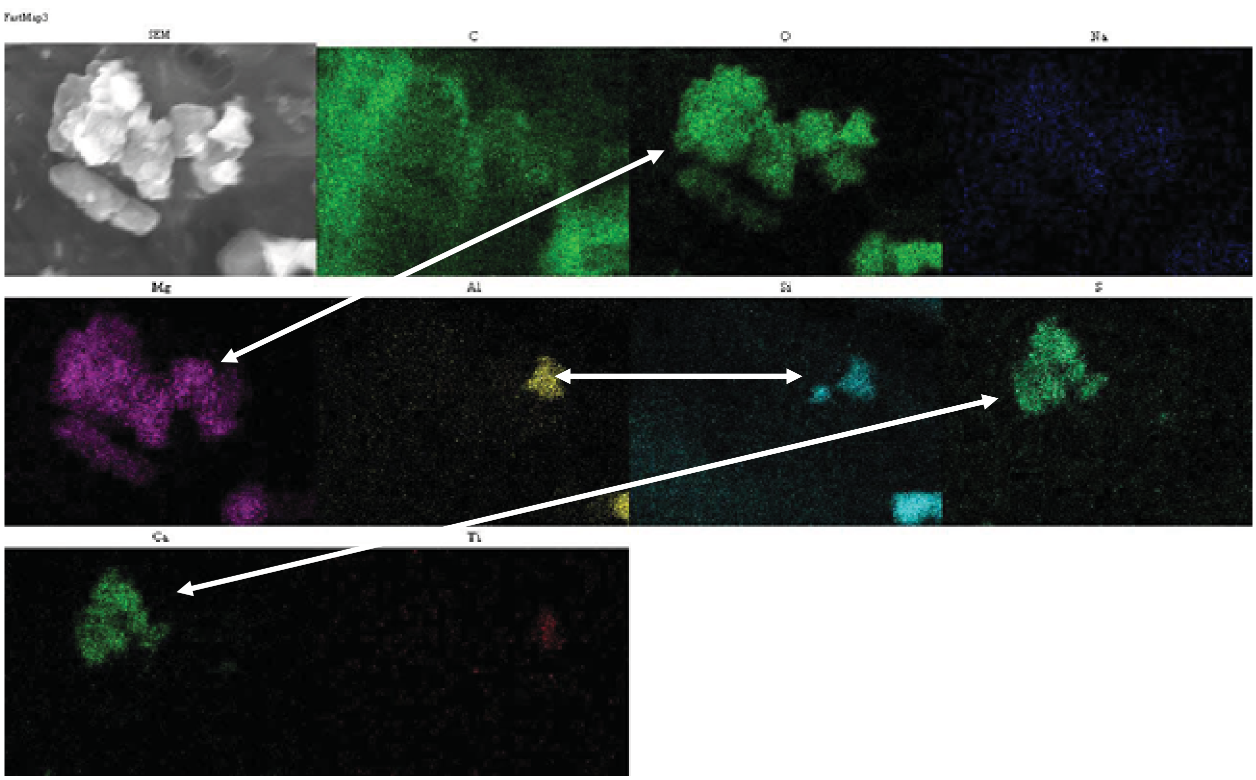
Uncoated side, showing pollen (daisy?), SEM, 15,000X



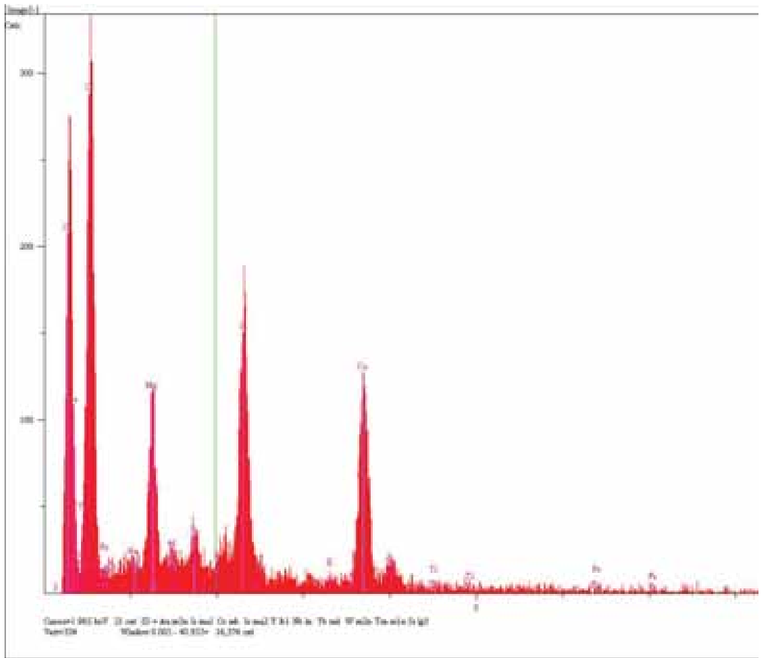
Daisy pollen, courtesy Dennis Kunkel Microscopy

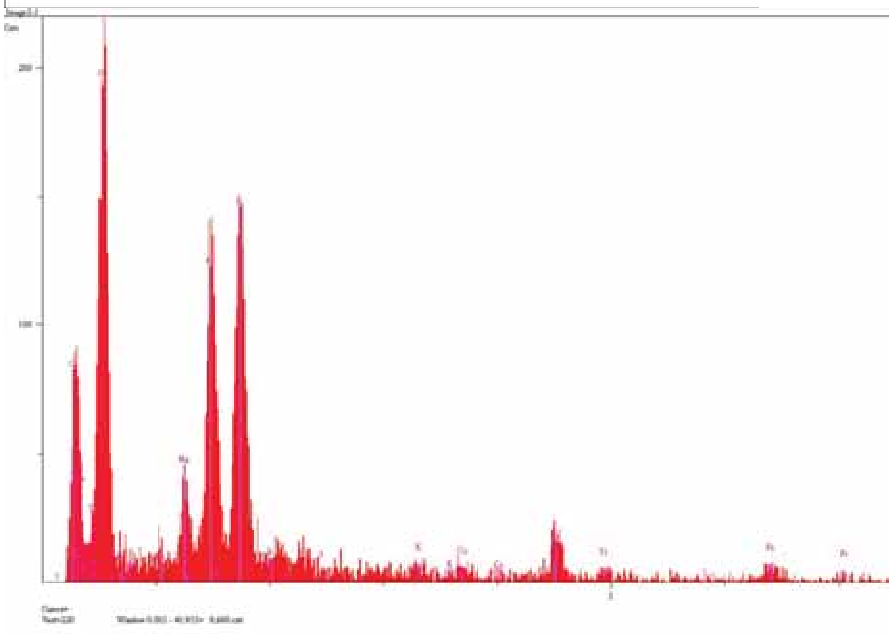


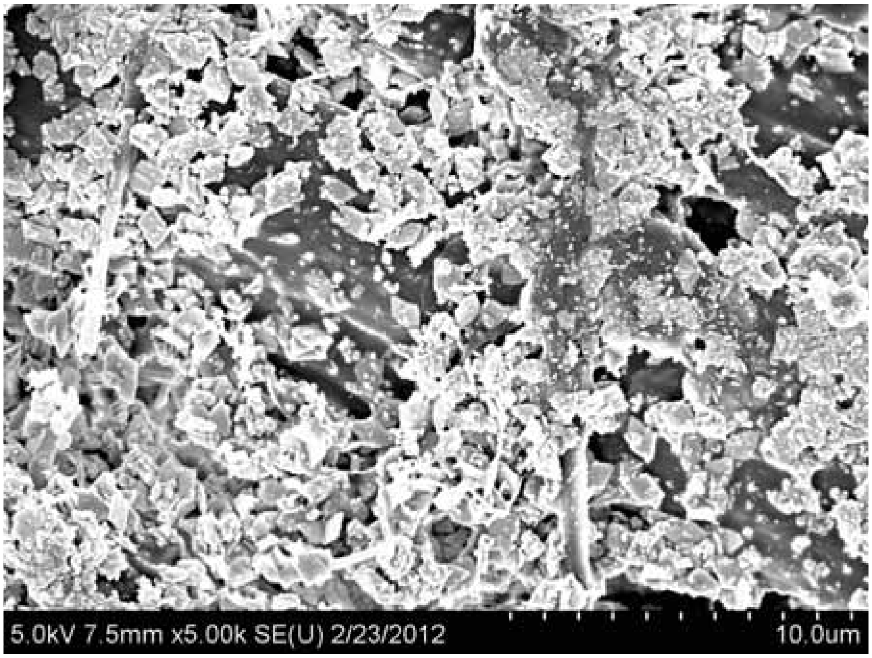
Uncoated side showing typical crystal structures found throughout, SEM, 15100X



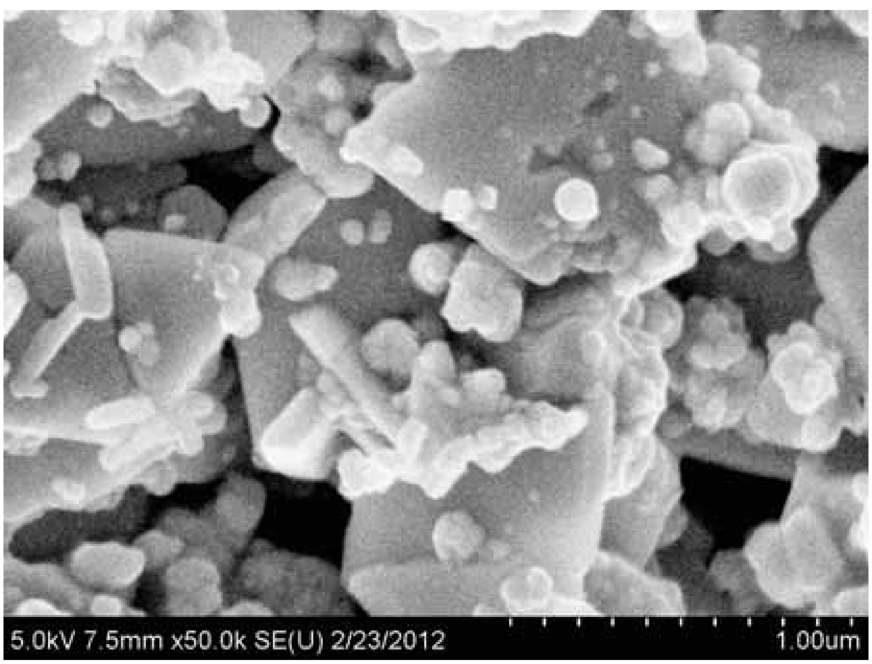
X-Ray mapping of crystal formation. Magnesium hydroxide, calcium sulfate, and hydrous aluminum silicate.



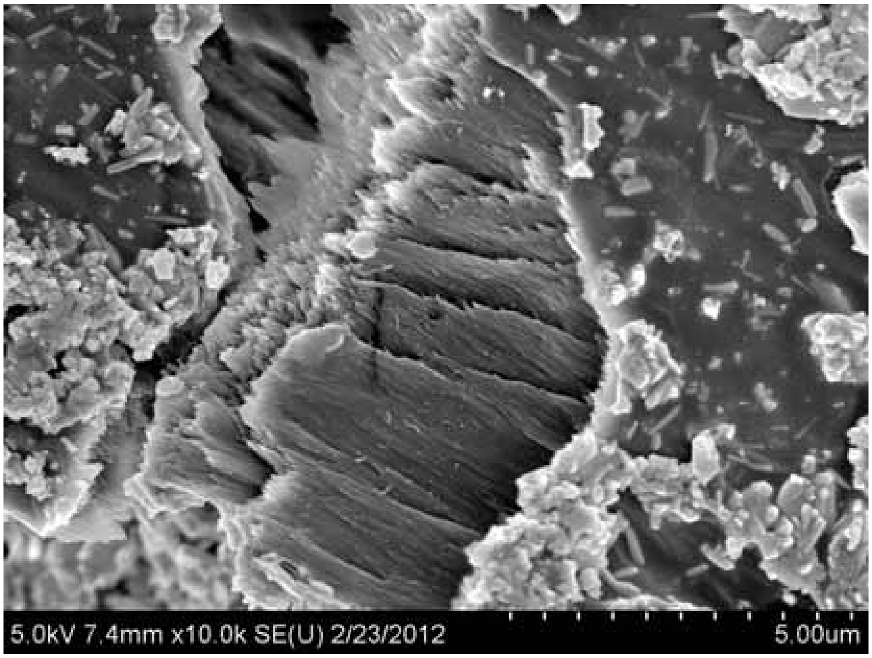




Coated side, showing PbCrO4 and PbSO4 crystals, SEM, 5000X



Coated side, SEM, 50,000X



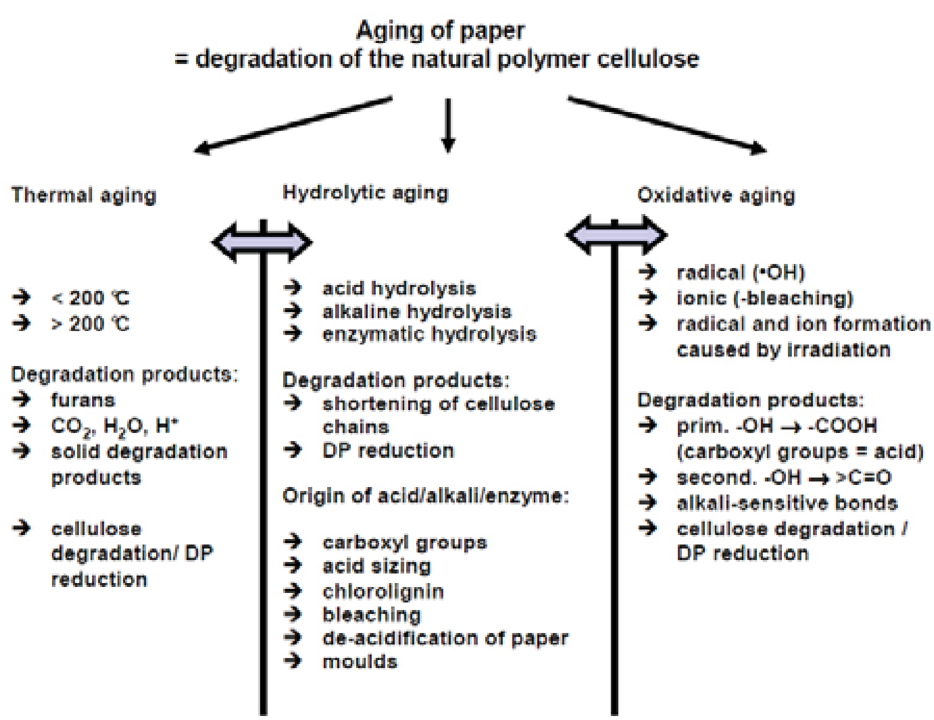
Coated side, fiber breaking through coating giving thickness of coating layer in fracture, SEM, 10,000X

Image in laser microscope Keyence VK-X100K, 2000X

Results:

EDXA analysis shows the pigmented side to be rich in the pigment chrome yellow (PbCrO4) called lead chromate, and lead white (PbSO4). The addition of a significant quantity of lead white would lighten the rich gold color of Chrome Yellow to a shade similar to Sun Yellow. The first recorded use of *chrome yellow* as a color name in English was in 1818[1]. At high magnification, its crystalline nature can be seen as small, highly birefracting monoclinic prisms, which give this pigment its very high visibility and brightness. The binder appeared to be a varnish binder, and was insoluble in water. The coating is quite thin, not more than 1-2 microns throughout. Such a thin coating may indicate the pigment was rubbed on rather than brushed or dipped. Chloride was distributed throughout, and was associated with the pigment.

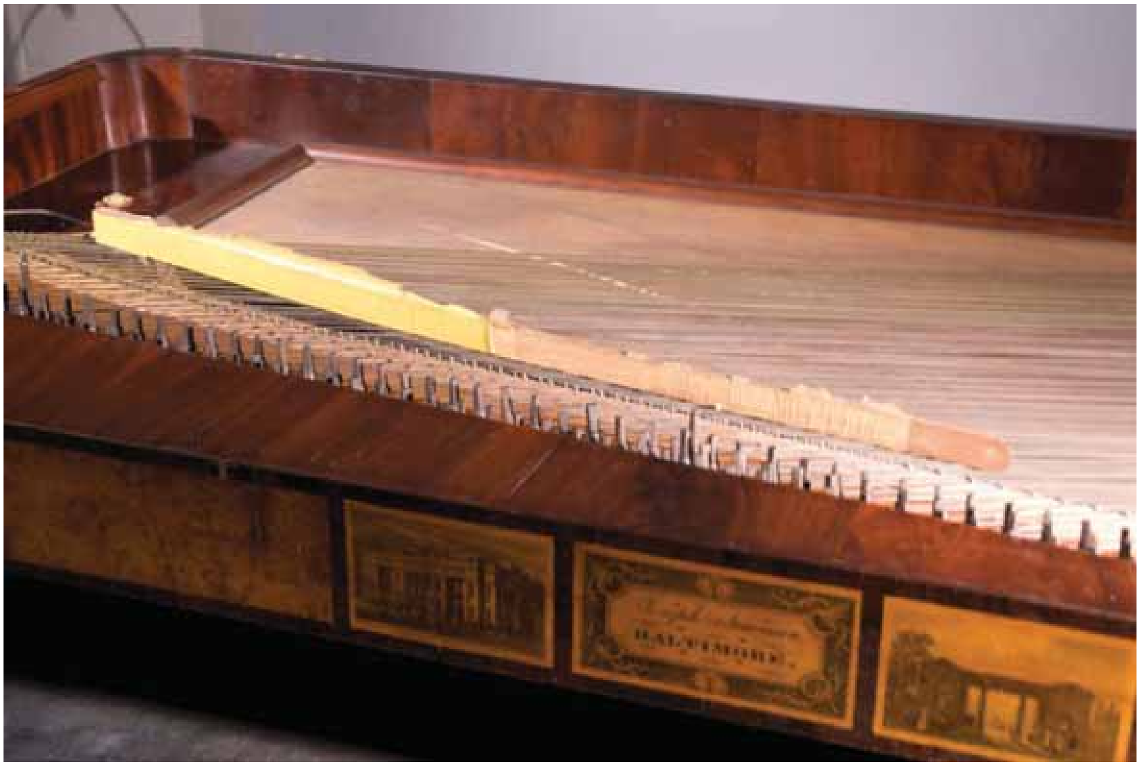
Calcium was seen in randomly distributed concentrations throughout the uncoated side which features the fibers. Calcium sulfate (gypsum) may have been used as part of the pulp process, and the calcium seen was not closely associated with pigment. Aluminum and unassociated silicon (hydrous aluminum silicate) was found in isolated spots, and is likely from dirt and debris accumulation over the years. Magnesium hydroxide, with sodium, associated as an impurity, may have been substituted for potassium aluminum sulfate as a mordant and deflocculant during the paper making process. The failure to find appreciable amounts of potassium aluminum sulfate, or the more acidic aluminum sulfate, was unsurprising once the fiber was correctly identified as Flax, which does not generally make use of digesting agents. Flax is also high in lignin, pectin, fat, and wax[2]. Use of linen for making paper often creates acidic condition that causes degradation of the cellulose structure and failure of the paper with time as below:



It was not possible to analyze for starch or hide glue as a stiffening agent to the paper, and highly pulped linen paper can be quite stiff all by itself. The gypsum found may have been part of a sizing that was applied for toughness, and the wide dispersion of aluminum silicate may indicate that ground glass was incorporated for stiffness as well. The J. Newman pianoforte dates from the 1830s, so the use of lead chromate as a pigment is consistent with the date of the instrument, since it was in broad use by then.

The bassoon stop is composed of a wooden batten with a formed stiff paper glued on top such that a hollow stiff thin surface can be brought up to just contact the tenor and bass strings. On contact near the nut, the string vibrates against this surface and gives out a burr, not unlike a kazoo effect, and the tone was fancied to be similar to the buzz of a bassoon. With this effect going in contrast to the conventional sound of the unaltered treble carrying the melody, and more "orchestral" effects from the piano could be achieved. The composer Czerny wrote while this stop was still popular that it was a childish toy which a serious player would disdain to use[3]. It is not in any general use for historical instrument recordings at this time.

Joseph Newman square pianoforte



Bassoon stop sitting on top of strings for display

Close-up of worn end of bassoon stop

Bassoon stop located for operation.

Dec. 5, 2012

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[1] (Gettens, Rutherford John; Stout, George Leslie (1966), "*Painting Materials: A Short Encyclopaedia",* Courier Dover Publications. pp. 106. ISBN 9780486215976.

[2] Canadian Conservation Institute - ©Minister of Public Works and Government Services Canada, 2008
Cat. No. NM-95-57/13-11-2008E
ISSN 0714-6221

[3] (Ella Sevskaya), "Beethoven in Context; Performance styles on the fortepiano c. 1790-1815", http://www.quilisma.com/pages/Catalogue/QUIL303/notes_quil303.htm