



Introduction

Springtime (1935.21) is a large (174.3 cm x 127.9 cm) oil on canvas painting from c.1890 by American artist Daniel Ridgway Knight (1839-1924), and part of the collection of the AKG Art Museum. Often known simply as Ridgway Knight, the artist painted many scenes of sentimentalized peasant women in French rural landscapes. *Springtime* was executed during the artist's time in Paris in the late 19th century and depicts a young woman in the countryside picking blossoms. The painting was analyzed by multi-modal imaging, x-ray fluorescence, polarized light microscopy

of cross-sections and dispersed pigment samples, and scanning electron microscopy. The results yield additional information about Knight's working techniques, as well as his pigment and material choices. The results were compared to the little-known working habits of Knight and his contemporaries and to analyses of two other Knight paintings located at the Detroit Institute of Art and the Brooklyn Museum. The painting underwent a successful conservation treatment to remove the discolored varnish to return it to an exhibitable condition.



Fig. 1: *Springtime* (AKG Art Museum 1935.21) (174.3 cm x 127.9 cm) oil on canvas c.1890 by Ridgway Knight. After Treatment.



Fig. 2: Knight in his glass studio in Poissy. Courtesy of the Frick Collection/Frick Art Reference Library Archives.

Analytical Methods

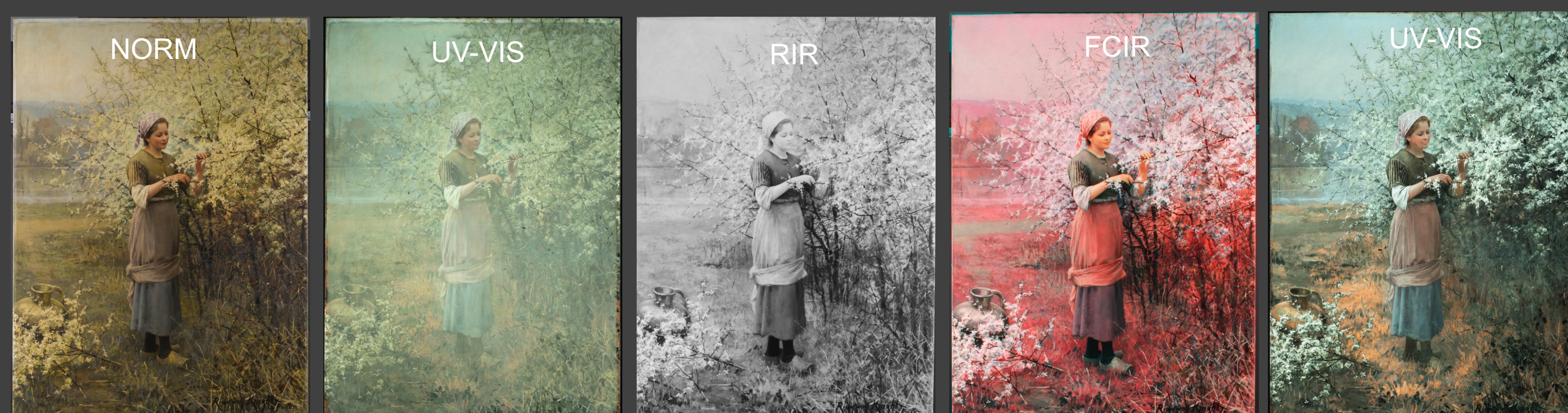
- Multi-modal Imaging (MMI)**
MMI was executed using a modified digital camera. Techniques included: normal illumination (NORM); long-wave ultraviolet-induced visible fluorescence (UV-VIS), and reflected near-infrared (RIR). Image processing was completed with AIC PhD target using AIC standards.
- Cross-section Analysis, Polarized Light Microscopy (PLM)**
Cross-sections were examined with a Zeiss Axio Imager A1m microscope. Pigment samples for dispersion were obtained from the tacking edges. A Leica DM750PL microscope with ICC50 W camera was used to perform PLM.
- X-ray fluorescence (XRF)**
X-ray fluorescence spectra was collected using a Bruker Artax 400 energy dispersive x-ray spectrometer operated at 40 kV and 800 uA, Silicon Drift Detector with a resolution of 146.4eV. Spectra was collected over 60 s live time for 21 locations.
- Scanning Electron Microscopy (SEM-EDS)**
Secondary electron and backscatter electron images were obtained using a TESCAN Vega3 XMU tungsten variable pressure scanning electron microscope. X-ray spectra were collected using an accelerating voltage of 15 kV. Data was processed with an Oxford Instruments 50 mm² X-Max[®] Silicon Drift Detector and AZtecEnergy analysis software.



Figs. 3, 4: Similar model and clothing used in both paintings; (left) detail of peasant girl in Ridgway Knight, *The Water Carriers*, 1892, Detroit Institute of Arts; and (right) detail of peasant girl in Ridgway Knight, *Springtime*, AKG Art Museum.

Results and Discussion

Multi-modal Imaging



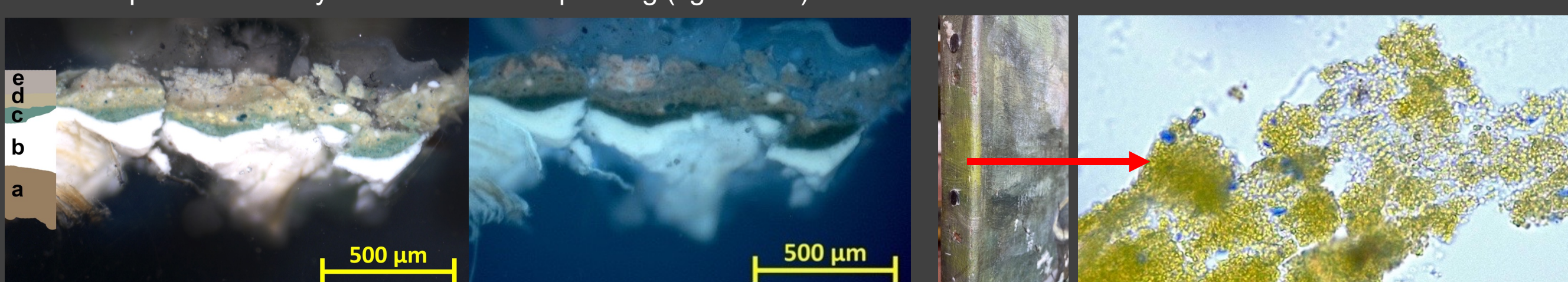
- aged and yellowed varnish imparted a lurid yellow-orange tone to the entire surface, obscuring the colors.
- UV imaging revealed the green fluorescence characteristic of a natural resin varnish (image taken before treatment).
- IR imaging revealed some underdrawing, typical of Knight's technique of composition planning. Slight adjustments to hands and face are present.
- False color infrared (FCIR) highlighted the different areas of the composition in relation to pigments used by Knight.
- UV imaging taken after treatment revealed the fiery orange fluorescence characteristic of madder used in the foliage.



Fig. 10: detail of impasto applied in final stages of painting creating a physical presence of the blossoms. Figs. 11-12: RIR detail showing under-drawing highlighted with blue (left), and same image with underdrawing lines overlaid in red (right). Fig. 13: Detail, reflected UVA image showing orange fluorescence of madder used as a pigment.

Cross-section Analysis, Polarized Light Microscopy

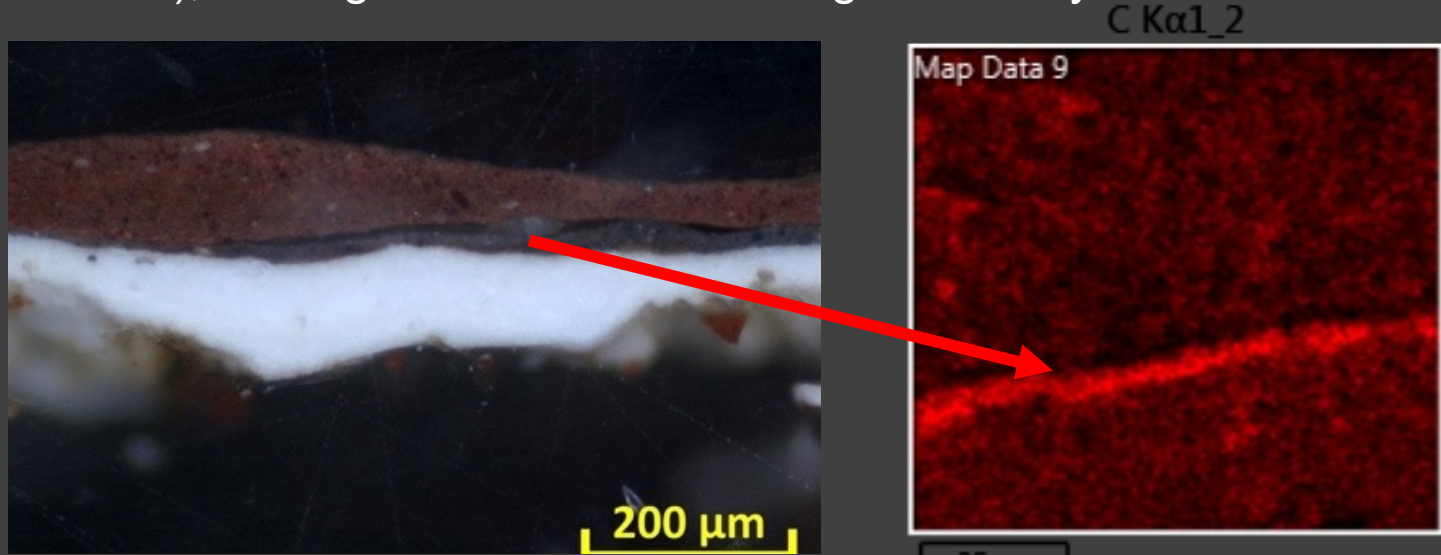
- Cross-sections and PLM assisted in indicating the pigment choices that Ridgway Knight made for his painting.
- It also provided the layer structure of the painting (figs. 14-19).



Figs. 14-15: Cross section, darkfield illumination (left) and UV illumination (right), indicating two layers containing a mixture of pigments including madder, ochres, lead white (e, d), a lower green layer containing emerald green (b), and a lead white ground (a), along with linen canvas fibers (a). Figs. 16-17: Vibrant green paint on tacking margin (left), and PLM of sample indicating cadmium yellow and cobalt blue pigment particles.

Scanning Electron Microscopy

- SEM-EDS provided elemental information of the cross-sections (figs. 18-19), leading to additional knowledge of the layer structure.



Figs. 18-19: cross section (left) showing black painted layer over a white ground, SEM-EDS (right), showing a strong presence of carbon in the black layer, indicating the pigment carbon black was used directly over the white ground.

X-ray fluorescence

- XRF indicated the presence of antimony, arsenic, calcium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, nickel, potassium, and zinc.
- In conjunction with results of cross-sectional analysis, SEM-EDS, PLM and MMI, the pigments used in the palette were determined (figs. 20-21, table 1).



Fig. 20: Knight in his studio painting *The Shepherds*, with a palette, long paint brushes and a live model.



Fig. 21: Diagram representing the main pigments used by Knight

SUMMARY OF PIGMENTS AND CORRESPONDING ANALYTICAL METHODS FOR <i>SPRINGTIME</i>	
Pigment	Analytical Methods
Vermillion	XRF, cross sec, PLM, MMI
Madder Lake	XRF, cross sec, PLM, MMI
Red Ochre	XRF, cross-sec
Yellow Ochre	XRF, cross sec
Cadmium Yellow	XRF, PLM, SEM-EDS
Naples Yellow	XRF, SEM-EDS
Viridian	XRF, SEM-EDS
Emerald Green	XRF, cross-sec, PLM
Cobalt Blue	XRF, PLM
Lead White	XRF, cross-sec, SEM-EDS
Zinc White	XRF
Umber	XRF, PLM
Carbon Black	Cross-sec, SEM-EDS, MMI

Table 1: Summary of pigments and analytical methods.

Comparison to Other Paintings by Knight

- Two paintings-one at the Brooklyn Museum (*The Well*) and one at the Detroit Institute of Art (*The Water Carriers*) -showed similar working techniques and similar pigments to *Springtime* (figs. 22-28).
- All three paintings exhibited similar underdrawing, highlighting Knight's skill as an illustrator and his preference to plan his composition directly on the canvas. Materials for at least one painting were purchased from a Parisian colorman as seen on a canvas stamp (fig. 25).
- Pigments identified in *The Water Carriers* by XRF (21 locations) and fiber optics reflectance spectroscopy (executed at the DIA) indicated an identical palette to *Springtime*.

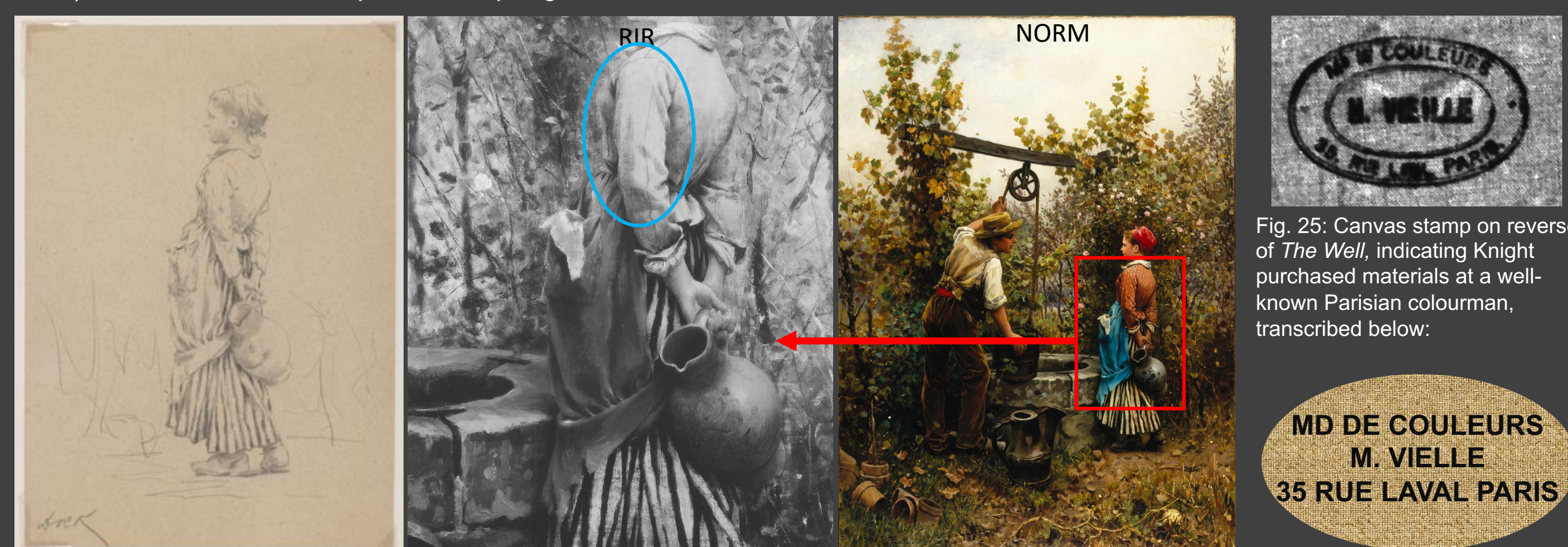
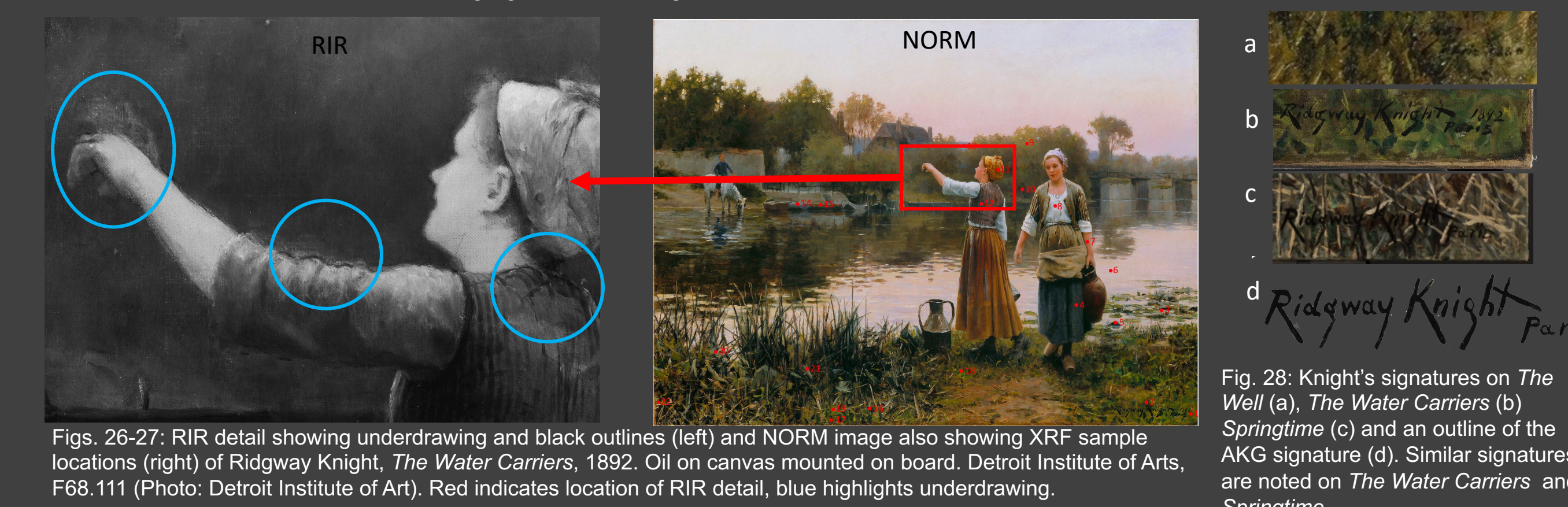


Fig. 22: Preparatory drawing for *The Well*, Brooklyn Museum. Figs. 23-24: (left) RIR detail showing underdrawing and black outlines and (right) NORM image Ridgway Knight, *The Well*, 1880. Oil on canvas, (99.9 x 73.5 cm), Brooklyn Museum, 41.980.62 (Photo: Brooklyn Museum). Red indicates location of RIR detail, blue highlights underdrawing. Fig. 25: Canvas stamp on reverse of *The Well*, indicating Knight purchased materials at a well-known Parisian colourman, transcribed below:

MD DE COULEURS
M. VIELLE
35 RUE LAVAL PARIS



Figs. 26-27: RIR detail showing underdrawing and black outlines (left) and NORM image also showing XRF sample locations (right) of Ridgway Knight, *The Water Carriers*, 1892. Oil on canvas mounted on board, Detroit Institute of Arts, F68.111 (Photo: Detroit Institute of Art). Red indicates location of RIR detail, blue highlights underdrawing. Fig. 28: Knight's signatures on *The Well* (a), *The Water Carriers* (b) *Springtime* (c) and an outline of the AKG signature (d). Similar signatures are noted on *The Water Carriers* and *Springtime*.

Treatment

- Aqueous cleaning using a pH and conductivity tailored water (pH 6.5, 6000 µS).
- Varnish removal using isopropanol and ethanol based solvent solutions.
- Varnish application (Laropal A81 with Tinuvin 292 applied by brush).
- Inpainting with stable dry pigments and AYAA:AYAC (2:1), application of new acid-free backing boards to reverse of stretcher.



Figs. 29-31: Painting as imaged before treatment (left), during varnish removal (center) and after treatment (right).

Conclusions:

- Knight made use of extensive preparatory sketches and underdrawing prior to executing his final paintings. This working method is in line with French Academy style of painting.
- Knight staged many of the paintings, reused props, and the same model is visible in many of his compositions. He often worked from live models in his studio or outdoors.
- The pigments in Knight's palette include lead white, emerald green, cobalt blue, vermilion, madder lake, cadmium yellow, Naples yellow, carbon black, zinc white, and earth colors. The presence of Arsenic throughout both *Springtime* and *The Water Carriers* indicated that Emerald green was used more widely than Viridian (perhaps due to its affordability). This is also noted in works of other artists (ex: Cezanne) at the time.
- This study provides material technical information that serves to better the understanding of Knight's working methods.
- The treatment of *Springtime* allowed the painting to be exhibited in a conserved state that more closely resembles the painting as it was initially painted.

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