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A Technical and Scientific Study of Two A.Y. Jackson Paintboxes

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Two paintboxes that once belonged to Canadian artist A.Y. Jackson were examined and their contents analyzed. One box is in the collection of the Ottawa Art Gallery (OAG) and the other in the collection of the Canadian Museum of Civilization (CMC). These two paintboxes represent two different periods of Jackson's life. The OAG paintbox was used by the artist from 1936 until 1950. The CMC paintbox was used during his years in the Ottawa area from 1955 until 1968, and possibly prior to 1955 during his time in Toronto. The OAG paintbox consists of a base with a compartment that functioned as a palette and a small compartment for brushes and tools; the top of the paintbox functions as an easel and can hold up to two panels. The CMC paintbox contains tubes of oil paint and a separate palette with remnants of paint. Similar pigments were found in the oil paint left on both the OAG and CMC palettes: ultramarine blue, cerulean blue, viridian, yellow iron oxide, chrome yellow, cadmium yellow, cadmium red, orange iron oxide, titanium white, and zinc white. In addition, Prussian blue, chromium oxide green, and an organic red pigment were found on the OAG palette, while chrome green (i.e., a mixture of Prussian blue and chrome yellow), lead white, alizarin, and Vandyke brown were found on the CMC palette. Three tubes in the CMC paintbox contained pigments that were not identified on the palette: two tubes containing cobalt blue and one containing emerald green.

Deux boîtes de couleurs ayant appartenu à l'artiste canadien A.Y. Jackson ont été examinées et leur contenu analysé. Une boîte fait partie de la collection de la Galerie d'art d'Ottawa (GAO), l'autre de celle du Musée canadien des civilisations (MCC). Ces boîtes représentent deux périodes de la vie de Jackson. La boîte de couleurs de la GAO a été utilisée par l'artiste de 1936 à 1950. Celle du MCC a été utilisée lorsque Jackson vivait dans la région d'Ottawa de 1955 à 1968, et peut-être avant 1955 lorsqu'il vivait à Toronto. La partie inférieure de la boîte de la GAO comprend un compartiment qui servait de palette et un compartiment plus petit pour les pinceaux et les outils; la partie supérieure sert de chevalet et peut recevoir deux panneaux. La boîte du MCC contient des tubes de peinture et une palette séparée sur laquelle il reste de la peinture. Plusieurs pigments identiques ont été identifiés sur les palettes des deux boîtes : outremer, bleu céruléum, vert émeraude, oxyde de fer jaune, jaune de chrome, jaune de cadmium, rouge de cadmium, oxyde de fer orange, blanc de titane et blanc de zinc. De plus, du bleu de Prusse, du vert oxyde de chrome et un pigment organique rouge ont été trouvés sur la palette de la boîte de la GAO, et du vert de chrome (un mélange de bleu de Prusse et de jaune de chrome), du blanc de plomb, de l'alizarine et de la terre de Cassel sur celle de la boîte du MCC. Trois tubes de peinture dans la boîte du MCC contenaient des pigments qui n'ont pas été identifiés sur la palette, soit deux tubes contenant du bleu de cobalt et un tube contenant du vert Véronèse.

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Introduction

A.Y. Jackson (1882–1974) is one of Canada's best known painters who observed and defined the Canadian landscape. Jackson's career as a painter spanned a lifetime and he produced some of the most beautiful and inspiring works on his numerous sketching trips across Canada. Jackson produced a wealth of drawings and small oil sketches on wood panels during these trips.

In order for Jackson to paint in often harsh outdoor conditions, he required tools and equipment, such as paintboxes, that could be easily transported and used in all weather conditions (**Figures 1 and 2**). Early in his career, he designed a small, lightweight and versatile paintbox that held two birch panels measuring 8½ x 10½ inches (21.6 x 26.7 cm). The bottom of the paintbox was prepared as a palette before he left on his sketching trips.² This paintbox design influenced his sketching companion

Tom Thomson, who, in the winter of 1914, duplicated the Jackson paintbox for himself.³ These early references to his interest in paintbox design suggest that Jackson was constantly thinking of ways to improve his working methods and tools.

Recently, the opportunity of examining two paintboxes that once belonged to A.Y. Jackson presented itself. One box was in the collection of the Ottawa Art Gallery (OAG). The other box had been recently purchased at auction as part of the estate of Dr. Naomi Jackson Groves, a niece of A.Y. Jackson who passed away in 2001, and is currently in the collection of the Canadian Museum of Civilization (CMC). These two paintboxes are of particular interest since they represent two different periods of Jackson's life. The paintbox in the collection of the OAG was used by Jackson from 1936-1950 and the paintbox in the collection of the CMC was used during his years in the Ottawa area from 1955 until 1968, and possibly prior to 1955 during his time in Toronto.



Figure 1. A.Y. Jackson sketching in the Canadian Rocky Mountains in 1914.¹ Photograph: McMichael Canadian Art Collection Archives, Kleinburg.

The study of these two paintboxes was undertaken as the information gleaned would contribute to a better understanding and appreciation of the materials and techniques used by A.Y. Jackson. This research would also expand the Canadian Conservation Institute's database of twentieth-century Canadian artists' materials.

The Artist and Some Technical Aspects of His Practice

Born in Montreal, A.Y. Jackson spent time during his youth sketching the surrounding countryside in watercolour. He took evening classes in painting from William Brymner at the Art Association of Montreal before travelling to Europe in 1905 where he first took up painting in oils.⁴ He studied at the Art Institute of Chicago in 1906 but the following year he returned to Europe to study at the Académie Julian in Paris until 1909. He travelled to Europe again to paint in 1911–1913. In 1915, he enlisted in the Canadian Expeditionary Force and in 1917 he was appointed to record the events of the First World War by the Canadian War Memorials Fund.⁵ Jackson returned to Canada in 1919, following his military service, and settled in Toronto but made numerous sketching trips to Quebec, Halifax, the Algoma District, the lower St. Lawrence River, the Arctic, and the Rocky



Figure 2. Jackson painting at Go Home Bay, c. 1964. Photograph: Arts and Letters Club, Toronto.

Mountains. He was a founding and leading member of the Group of Seven and was a tireless promoter of the importance of establishing a “national art” for Canada. He moved to the Ottawa area in 1955 and following a stroke in 1968, to an apartment adjoining the McMichael Canadian Art Collection in Kleinburg, Ontario. A.Y. Jackson died in Woodbridge, Ontario, on April 5, 1974.

As mentioned earlier, A.Y. Jackson took great interest in the practical aspects of his painting and designed paintboxes that suited his needs. In 1964, he donated a paintbox to O. J. Firestone, who was an art collector and a personal friend from 1954 to the time of Jackson's death. Firestone provided many details concerning material aspects of Jackson's practice of painting in his book entitled *The Other A.Y. Jackson*.⁶ He reported that Jackson filled his paintboxes with high quality artists' materials including a variety of paints and brushes even though he lived prudently for most of his life.⁷ To reduce the costs of his materials, Jackson purchased custom cut wood panels in bulk from sawmills in Eganville and Grenville, Ontario.⁷ Earlier, when in Toronto, birch panels for Thomson and himself were ordered from a woodworking plant in Kitchener, Ontario.⁸ These panels could be easily stored and transported within the easel component of his paintboxes.

During his long career as an artist, Jackson developed or adopted certain techniques to facilitate his oil painting. For example, in order to prevent direct contact between the wet painted surfaces of his panels in the paintbox, he implemented a method developed by his friend Dr. Frederick Banting. This involved placing pieces of wooden matchsticks between the panels to keep them from touching. When the matchsticks were removed he would simply touch up the areas where the paint had been disturbed.⁹ Back in his studio, Jackson would transfer the sketch on panel to a larger canvas by placing the sketch just above or beside the canvas on the easel so that he could easily observe the sketch. He would also create a grid on the sketch with white thread so that he could visually transfer the sketch to canvas.¹⁰

Description of the Paintboxes

Ottawa Art Gallery Paintbox

The Ottawa Art Gallery (OAG) paintbox (**Figure 3**) was acquired directly from Jackson in 1964 by O. J. Firestone. When Jackson gave the box to Firestone, he inscribed the top panel of the box with “sketch box used by A.Y. Jackson for fifteen years, 1936-1950” (**Figure 4**).¹¹

In 1972, the Firestone Art Collection, which included the Jackson paintbox, was donated to the Ontario Heritage Foundation. In 1992, the Foundation transferred ownership of the Firestone collection to the City of Ottawa and it was moved to the Ottawa Art Gallery.

The OAG paintbox is a simple structure consisting of a wooden base with one compartment that functioned as a palette and a smaller compartment that held brushes and tools. The overall dimensions of the box are $14\frac{3}{8}$ inches (36.5 cm) wide by $11\frac{1}{2}$ inches (29.2 cm) deep and $1\frac{1}{2}$ inches (3.8 cm) high. The top of the paintbox functions as an easel and can hold up to two panels, each measuring $10\frac{1}{2}$ x $13\frac{1}{2}$ inches (26.7 x 34.3 cm). This size corroborates written information about a change in the size of Jackson’s panels in the mid 1930s.¹² As mentioned in the introduction, his earlier panels were smaller, measuring $8\frac{1}{2}$ x $10\frac{1}{2}$ inches (21.6 x 26.7 cm), and were very portable for canoe trips. Even after the 1930s, he continued to use the smaller $8\frac{1}{2}$ x $10\frac{1}{2}$ inch format as well as the new $10\frac{1}{2}$ x $13\frac{1}{2}$ inch format. According to Firestone, the OAG paintbox was designed by Jackson himself and not used after 1950.¹¹

To use the paintbox, a wood panel is slid into the inner slot of the easel and is supported by two diagonal brackets at the bottom of each corner of the lid (the right bracket is now missing). Two small metal clips are then rotated over the panel to further support it in the easel. The bottom of the paintbox contained Jackson’s paints and acted as a palette. It consists of layer upon layer of dried oil paint and it has, over time, formed thick strata of paint on the bottom of the box. It is known from written accounts of Jackson’s outdoor sketching techniques that he would carry the paintbox in his rucksack and that the box contained two small birch panels, one of which formed the cover.⁴

Jackson placed his warm colours along the top edge and cooler colours along the left side of his palette. The rubbed area in the centre of the palette is evidence of where he mixed his colours and, when the area became muddy, he presumably rubbed off the paint with a rag.



Figure 3. The OAG paintbox. Photograph: Canadian Conservation Institute.

Canadian Museum of Civilization Paintbox

The Canadian Museum of Civilization (CMC) paintbox (**Figure 5**) was part of the Estate of Dr. Naomi Jackson Groves that was put up for auction by Walker’s Fine Art & Estate Auctioneers in



Figure 4. Top view of the OAG paintbox with panel forming the cover, showing Jackson’s inscription. Photograph: Canadian Conservation Institute.



Figure 5. The CMC paintbox. Photograph: Canadian Conservation Institute.



Figure 6. In this photograph dated 1946, showing art student Flo Strong of Ottawa observing A.Y. Jackson at work, the artist uses a paintbox similar to the CMC paintbox. The palette is resting in the box. Source: Library and Archives Canada. Credit: Jack Long, National Film Board of Canada, Photothèque Collection, PA-128907.

Ottawa in 2004. The paintbox was included in a lot that included other items, some bearing the monogram “A. Y. J.” The lot was purchased by the Canadian Conservation Institute.¹³ The paintbox and other items were subsequently acquired by the CMC.

As pointed out by Wainwright,¹³ the exact time A.Y. Jackson started using this paintbox is not known. Based on information provided by Anna Brennan, Literary Trustee for the Estate of the late Dr. Naomi Jackson Groves,¹⁴ the paintbox was transferred to Dr. Jackson Groves in 1968, when she emptied A.Y. Jackson’s apartment after he suffered a stroke and moved to Kleinburg, Ontario. Anna Brennan also specified that the paintbox was kept in Dr. Jackson Groves’ basement. Jackson worked in the Ottawa area starting in 1955 after moving from Toronto, but it is not known if he brought this paintbox from Toronto or bought it in Ottawa. Jackson’s use of a paintbox of this type is documented in a 1946 photograph showing him using a paintbox that looks very much like the CMC paintbox (Figure 6).

The CMC paintbox is a commercial Grumbacher box (Figure 7). It is much larger than the OAG paintbox, measuring 17½ inches (44.5 cm) wide by 13 inches (33.0 cm) deep and 3½ inches (8.9 cm) high. The box has six supply compartments and a retractable easel built into the lid. It can hold two panels measuring approximately 12 x 16 inches (30.5 x 40.6 cm) (Figure 8).

Sanford Corporation, which bought Grumbacher in 1999, kept very little archival information about the company. It had a catalogue from 1970 but did not have any earlier catalogues in its archives. The earliest Grumbacher catalogue that was available for this research dated from 1958 and was in the special collections of the library of the National Gallery of Canada. A paintbox similar to Jackson’s was depicted in the catalogue.¹⁵

The paintbox contains a number of painting materials and tools that were probably collected throughout the time that Jackson used the paintbox, including tubes of paint, pieces of black charcoal, a rag with paint residue, brushes, a pencil, and a palette knife (Figure 9). The paintbox has a separate palette made of ¼ inch (0.3 cm) thick veneered wood and measures 12¼ x



Figure 7. Detail on the inside of the top cover of the CMC paintbox, showing the Grumbacher logo. Photograph: Canadian Conservation Institute.



Figure 8. The CMC paintbox, open. Photograph: Canadian Conservation Institute.

16⁷/₁₆ inches (30.8 x 41.8 cm) (**Figure 10**). It rests on a recessed ledge in the bottom compartment of the box. The back of the palette shows a large stain where the paint rag has been in contact with the palette.

When comparing the palettes of the two paintboxes, one finds that the very nature of the palette dictated where Jackson mixed his colours. The OAG palette, which was simply the bottom of the paintbox, had colour-mixing occurring in the centre, where paint has been rubbed off with a rag. With the hand-held palette of the CMC Grumbacher paintbox, colour-mixing occurred in the lower right, closest to the artist, where there is evidence of paint having been rubbed off. In addition, paint on the CMC palette is not as clearly arranged as on the OAG palette, and there is an indication of quite a lot of mixing.



Figure 9. Interior of the CMC paintbox showing the six compartments and their contents. Photograph: Canadian Conservation Institute.

Analysis of Paint from the Paintboxes

Samples of paint from the two paintboxes were analyzed by x-ray spectrometry, x-ray diffraction, Fourier transform infrared spectroscopy, polarized light microscopy, and gas chromatography-mass spectrometry as described in the Appendix. Results obtained from the analytical techniques used were considered together in determining the composition of a paint sample. Pigments and binding media identified in the samples are presented in **Tables I to III**. Fillers are not included in these tables so that the exact makeup of the paint samples is not disclosed, as this information could potentially be used fraudulently. Complete data are available to other researchers on request and can be obtained by contacting the Canadian Conservation Institute.

OAG Paintbox

Jackson's niece, Naomi Jackson Groves, reported Jackson's method of organizing his paints on the bottom section of the box:

“. . . the paint was already squeezed around the edges, starting in the lower left corner with cerulean blue, then French ultramarine, viridian green, and yellow ochre; in the upper left corner an immense glob of flake white; along the top, chrome or cadmium yellow, cadmiums orange and red; rose madder or Thalo red rose, and finally burnt sienna.”⁴

Analysis of samples from the OAG paint box showed that these pigments were indeed used and placed as described by Naomi Jackson Groves, for the most part, as shown in **Figure 11** and **Table I**. However, analysis of three samples of white paint failed to reveal the presence of lead white. Titanium white was found in two samples, while the third sample consisted of a mixture of titanium white with zinc white. As this box was used for fifteen years, it is possible that Jackson used lead white earlier in the period when he used the paintbox and that the samples analyzed correspond to a more recent usage. A paint containing a red organic pigment was sampled from an area



Figure 10. The CMC palette. Photograph: Canadian Conservation Institute.

Table I: Composition of Samples from the OAG Paintbox.

Sample Colour ^a	Pigment(s)	Medium
dark blue	ultramarine blue	linseed oil
light blue	cerulean blue	safflower oil (or a mixture of linseed oil and poppyseed oil)
dark blue	ultramarine blue	safflower oil (or a mixture of linseed oil and poppyseed oil)
greenish blue	cerulean blue	safflower oil (or a mixture of linseed oil and poppyseed oil)
dark green	viridian	linseed oil
dark yellow	yellow iron oxide	poppyseed oil
white	titanium white	drying oil not possible to identify due to added zinc stearate
	titanium white, zinc white	drying oil not determined
	titanium white	drying oil not determined
yellow	chrome yellow	poppyseed oil
orange	cadmium red	linseed oil
bright red	cadmium red, zinc white, possibly cadmium yellow	linseed oil
burgundy	cadmium red, red organic pigment (thioindigoid class), possibly another red organic pigment, trace ultramarine blue, trace viridian, trace charcoal black	linseed oil, pine resin
brown	orange iron oxide	linseed oil
bright green	Prussian blue, cadmium yellow, probably chromium oxide green	drying oil not possible to identify due to added zinc stearate

^aSample locations shown in **Figure 11**. Samples are listed clockwise from the bottom left corner to the top right corner of the palette.

Table II: Composition of Samples from the Paint Tubes in the CMC Paintbox.**Figure 11.** Sample locations on the OAG palette marked with white arrows. Photograph: Barbara Klempan.

Colourman	Colour Name	Pigment(s)	Medium
Winsor & Newton	Ultramarine deep	ultramarine blue	linseed oil
Winsor & Newton	Chrome green	chrome green (mixture of Prussian blue and chrome yellow)	safflower oil (or a mixture of linseed oil and poppyseed oil)
(Illegible)	(Unknown red)	cadmium red	linseed oil
Talens	Chrome green light	chrome green (mixture of Prussian blue and chrome yellow)	linseed oil
Winsor & Newton	green... Véronèse...	emerald green	poppyseed oil
Winsor & Newton	Vandyke brown Brun Van Dyke	Vandyke brown	linseed oil
Winsor & Newton	Cobalt blue Bleu de cobalt	cobalt blue	mixture of poppyseed oil (main) and linseed oil (minor)
Winsor & Newton	Burnt sienna	orange iron oxide	linseed oil
(Illegible)	(Unknown burgundy)	alizarin	linseed oil, <i>Pinaceae</i> resin
(Illegible)	(Unknown blue)	cobalt blue	poppyseed oil
Winsor & Newton	Naples yellow Jaune de Naples	yellow iron oxide, lead white, zinc white, possibly cadmium yellow	safflower oil (or a mixture of linseed oil and poppyseed oil)
Winsor & Newton	Cerulean blue	cerulean blue	poppyseed oil
Winsor & Newton	Cadmium yellow Jaune de cadmium	cadmium yellow	poppyseed oil
Grumbacher	(Unknown green)	viridian	linseed oil
Grumbacher	Cadmium...	cadmium red	linseed oil
Winsor & Newton	Flake white	lead white, zinc white	safflower oil
Grumbacher	Cadmium yellow	cadmium yellow	linseed oil
Winsor & Newton	Yellow ochre	yellow iron oxide	linseed oil
Grumbacher	Ultramarine blue	ultramarine blue	safflower oil (or a mixture of linseed oil and poppyseed oil)

of burgundy paint where Naomi Jackson Groves mentioned rose madder or Thalo Red Rose. However, the pigment was identified as belonging to the thioindigoid class of pigments whereas rose madder and Thalo Red Rose are anthraquinone and quinacridone, respectively. The exact composition of the organic red pigment was not determined as the spectra did not match any known pigments in the CCI reference collection. The burgundy paint also contained cadmium red and traces of other pigments.

In addition to the colours mentioned by Naomi Jackson Groves, a dab of bright green paint located along the top right edge of the paintbox was found to consist of a mixture of Prussian blue, cadmium yellow, and probably chromium oxide green.

It was possible to identify the drying oil in eight out of 13 paint samples that were analyzed by gas chromatography-mass spectrometry (GC-MS). This is determined by GC-MS analysis based on the palmitate/stearate (P/S) ratio, a value that remains constant. As drying oils age, their abundant unsaturated fatty acids react with oxygen to gradually form a polymerised matrix. Saturated fatty acids such as palmitic acid and stearic acid, however, do not oxidize and, therefore, remain in a constant ratio relative to each other.¹⁶ Typically, the P/S ratio of linseed oil is less than 2.0, the P/S ratio of poppyseed oil is greater than 3.0, and the P/S ratio of safflower oil falls within the intermediate



Figure 12. Grumbacher tubes found in the CMC paintbox: an old tube (on the left) and a more recent tube. Photograph: Canadian Conservation Institute.

Table III: Composition of Samples from the CMC Palette.

Sample Colour ^a	Pigment(s)	Medium
green	chrome green (mixture of Prussian blue and chrome yellow)	safflower oil (or a mixture of linseed oil and poppyseed oil)
white	lead white, zinc white	poppyseed oil
red	cadmium red	linseed oil
green-yellow	chrome yellow, titanium white	not possible to determine due to added zinc stearate
blue	cerulean blue	poppyseed oil
dark blue	ultramarine blue	safflower oil (or a mixture of linseed oil and poppyseed oil)
dark green	viridian, some charcoal black	possibly linseed oil
light blue	lead white, zinc white, trace viridian, trace ultramarine	linseed oil
burgundy	alizarin	linseed oil
brown	orange iron oxide	linseed oil
orange	cadmium red	linseed oil
black	Vandyke brown	linseed oil
orange-yellow	cadmium yellow	poppyseed oil
yellow	cadmium yellow	linseed oil
creamy yellow	yellow iron oxide, lead white, zinc white	poppyseed oil
black	Vandyke brown	linseed oil

^aSample locations shown in **Figure 13**.



Figure 13. Sample locations on the CMC palette marked with white arrows. Photograph: Canadian Conservation Institute.

range of 2.0–3.0. However, a mixture of linseed oil and poppyseed oil may also produce a P/S ratio within this range. Therefore, it is not possible to distinguish between safflower oil and a mixture of linseed oil and poppyseed oil based on the P/S ratio. This was the case for three paint samples. Finally, in two samples, the presence of zinc stearate as an additive made it impossible to determine the type of oil, as it increased the abundance of stearate measured in the sample which lowered the calculated P/S ratio.

CMC Paintbox

The tubes in the CMC paintbox were mostly Winsor & Newton and Grumbacher oil paints. There was one tube from Talens and three tubes had labels that were illegible. Based on information provided by the respective paint manufacturers, the Winsor & Newton tubes would date from the early 1960s to the early 1970s,¹⁷ and the Talens tube may date from anytime between 1940 and 1970.¹⁸

The Grumbacher paint tubes are “Pre-tested” colours, which are advertised as “artist-selected” colours in their 1958 catalogue. There is also a superior range of oil colours manufactured by Grumbacher in the 1950s called “Finest”. There were two types of Grumbacher tubes in the paintbox: most tubes looked old, but five looked more recent and had a different label design (**Figure 12**). On the more recent tubes the text “Pre-tested” is enclosed in a circle of the colour of the paint contained in the tube, while on the older tubes the text is written on a diagonal on the tube.

The more recent Pre-tested tubes with the circle design were only manufactured in the mid 1970s.¹⁹ It is possible that these tubes belonged to Jackson when he was living in Kleinburg, and that Jackson’s niece placed these later tubes in the box after his death in 1974. Another possibility would be that the tubes belonged to Dr. Jackson Groves herself, as she also painted, which raises the possibility of her having used the paintbox. However, this is unlikely as she would have been well aware of “the importance of retaining mementoes, materials, works of art etc. that had belonged to her uncle during his long career,” as mentioned by Anna Brennan.¹⁴ These tubes will not be included in the following discussion, as they are not contemporaneous to the palette.

The pigment and medium composition of samples from the paint tubes and from the palette are given in **Tables II** and **III**, respectively. Sample locations on the CMC palette are shown in **Figure 13**. The composition of half of the samples taken from the palette matches exactly the composition of paint in Winsor & Newton and Grumbacher tubes and in one unidentified tube. This shows that both the palette and tube colours were indeed used together. Four paint samples from the palette had a composition that was very similar to that of paint in tubes, with small differences which may be attributable to contamination. For example, the dark green paint sample from the palette was found to consist of viridian in linseed oil, as did the paint from a tube with an illegible label, but also contained some charcoal black. There were also three tubes in the box that contained pigments that

were not identified on the palette: two tubes containing cobalt blue and one containing emerald green.

Analysis of paint from the tubes usually confirmed the composition as indicated on the label, in cases where the label or part of the label was legible. One notable exception was a Winsor & Newton tube labelled “Naples Yellow,” which did not consist of lead antimonate yellow, but rather of a mixture of yellow iron oxide, lead white, zinc white, and possibly cadmium yellow, one of the mixtures currently sold under the name Naples yellow.²⁰ Another Winsor & Newton tube labelled “Flake White” was found to contain zinc white in addition to lead white.

As mentioned earlier, the identity of the drying oil medium in an aged oil paint is usually determined by the P/S ratio, and this is problematic in the case of safflower oil, which cannot be distinguished from mixtures of linseed oil and poppyseed oil using GC-MS. In the case of fresh oil paint, for which the drying process has not yet begun and in which, therefore, all fatty acids, saturated and unsaturated, are present, safflower oil can easily be distinguished based on the measurement of total fatty acids, both unsaturated and saturated. Two paint tubes contained paint that was fresh enough to allow the identification of safflower oil in one case, and a mixture of linseed oil and poppyseed oil in another case.

Similar pigments were found in the oil paint on both the OAG and CMC palettes: ultramarine blue, cerulean blue, viridian, yellow iron oxide, chrome yellow, cadmium yellow, cadmium red, orange iron oxide, titanium white, and zinc white. Some of the samples have exactly the same composition, which indicates that the same paint was used on both palettes. However, the composition of others is quite different. Additional pigments were found on the CMC palette: chrome green (i.e., a mixture of Prussian blue and chrome yellow), lead white, alizarin, and Vandyke brown.

Conclusions

The two paintboxes studied here were very different in design and in size. The small, lightweight OAG paintbox was designed specifically for painting in remote areas accessible only by foot or canoe. It could be easily transported in Jackson’s rucksack, and contained a limited number of colours and a few tools. The CMC paintbox, on the other hand, is larger and was likely used for more stationary field trips such as outdoor painting classes, such as the one depicted in **Figure 6**. This box contained a broader selection of materials and tools.

The technical study of these two particular paintboxes provided us with important information for the future study of Jackson’s paintings in relation to his paintboxes. Perhaps existing paintings and paintboxes can be matched in the future to directly link his artistic practice with his equipment, materials, and tools.

Analysis of paint from both paintboxes provided invaluable information about Jackson’s paints that adds to the data gathered on the materials and techniques of twentieth-century Canadian artists. Although the period at which each paintbox was used is

quite broad, the chemical composition of the paints remaining in each box provided insights into Jackson's choices of materials for painting.

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Appendix: Experimental

Samples were analyzed by x-ray spectrometry, x-ray diffraction (XRD), Fourier transform infrared (FTIR) spectroscopy, and gas chromatography-mass spectrometry (GC-MS). Some samples were also examined by polarized light microscopy (PLM). Different portions of the sample were used for each analytical technique.

X-ray spectrometry was performed using a Hitachi S-3500N variable pressure scanning electron microscope (SEM) integrated with an Oxford light element, lithium-drifted silicon x-ray detector, an Inca Energy+ x-ray microanalysis system, and an Inca Wave 500 4-crystal spectrometer. The SEM was operated at an accelerating voltage of 20 kV in high vacuum mode, using a secondary electron detector. The samples were adhered on carbon planchets using either double-sided carbon tape or a solution of cellulose nitrate in amyl acetate. The samples were not carbon-coated and were analyzed in bulk.

The XRD patterns were obtained with a Rigaku RTP 300 RC generator equipped with a rotating anode and cobalt target, using a microdiffractometer. The patterns were measured for two hours at 45 kV and 160 mA.

For analysis by FTIR spectroscopy, samples were analyzed using a Bruker Hyperion 2000 microscope interfaced to a Tensor 27 spectrometer. A portion of the sample was positioned on a diamond microsample cell and analyzed in transmission mode.

The samples were methylated in Meth Prep II (m-(trifluoromethyl)phenyl trimethylammonium hydroxide, TMTFTH, 0.2 N in methanol) and toluene and analyzed by GC-MS using an Agilent 6890 gas chromatograph interfaced to an Agilent 5973 mass spectrometer.