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Information about artists' paints available in Toronto during the first decades of the twentieth century was acquired through the examination of archival material and the analysis of historic paints from the paint box of Kathleen Munn and from a Winsor & Newton specimen tint book. The archival and material evidence revealed that the lead sulfate-zinc white paint commonly used by Tom Thomson and members of the Group of Seven was New Flake White from the Cambridge Colours paint brand. The research also highlighted the prevalence of hydromagnesite (magnesium carbonate hydroxide) in Winsor & Newton paints. This filler, which has been identified in paint from early twentieth-century works by several Canadian painters, is characteristic of Winsor & Newton and is not present in the Cambridge Colours. The information obtained gives useful context to previous research on Tom Thomson's painting materials, and will also inform future scientific studies of painters active in Toronto during this period, including Group of Seven artists.

L'étude de documents d'archives et l'analyse de peintures historiques provenant de la boîte de peinture de Kathleen Munn et d'un livre d'échantillons de la compagnie Winsor & Newton ont fourni de l'information au sujet des peintures pour artiste disponibles à Toronto au cours des premières décennies du XX^{e} siècle. L'étude des documents et l'analyse des matériaux ont révélé que la peinture blanche à base de sulfate de plomb et de blanc de zinc régulièrement utilisée par Tom Thomson et les membres du Groupe des Sept était le produit « New Flake White » de la marque Cambridge Colours. L'analyse a également mis en évidence l'utilisation fréquente d'hydromagnésite (carbonate hydroxyde de magnésium) dans les peintures provenant de la compagnie Winsor & Newton. Cette matière de charge, qui a été identifiée dans plusieurs œuvres réalisées par des peintres canadiens datant du début du XX^{e} siècle, est caractéristique des peintures de Winsor & Newton et n'est pas présente dans les peintures de Cambridge Colours. L'information obtenue met en contexte la recherche précédente sur les matériaux pour artiste de Tom Thomson et servira également lors d'études scientifiques à venir concernant des peintres qui étaient actifs à Toronto durant cette période, y compris les artistes du Groupe des Sept.

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Introduction

A thorough study of the painting materials and techniques of Tom Thomson has been undertaken[1-3] and similar research on J.E.H. MacDonald's materials is in progress. However, little is known about the brands of paint that Tom Thomson and the Group of Seven artists used and which dealers supplied them with materials. To date, there is only scattered information[4] about the paint brands available in Toronto from the first decade of the century, when these like-minded artists began to paint and exhibit together, to the end of their formal association in the early 1930s. Although a number of paint boxes that once belonged to members of the Group of Seven exist, to our knowledge, none from the early twentieth-century that have been documented contain contemporaneous paint tubes.[5] To acquire more information about early twentieth-century artists' paints in Toronto, historic paints from the paint box of Kathleen Munn (**Figure 1**) and a Winsor & Newton specimen tint book (**Figure 2**) were examined, and related archival material was studied.

Figure 1. Paint tubes from Kathleen Munn's paint box, Art Gallery of Ontario, [LA.SC Temp.2]. Photograph: © Government of Canada, Canadian Conservation Institute.

Kathleen Munn's paint box and its contents were recently acquired by the Art Gallery of Ontario (AGO). The contents include a valuable set of reference paint tubes that represent materials available in the first decades of the twentieth century in Toronto. Munn (1887–1974) was active as a painter from about 1909 to 1940. She exhibited, starting in 1909, at the Ontario Society of Artists (OSA), the Royal Canadian Academy of Arts (RCA) and the Canadian National Exhibition (CNE), and was included in two Group of Seven exhibitions in 1928 and 1930.[6]

The Munn paint box contains 53 paint tubes, most with legible or partially legible labels. All the tubes with legible labels are from two paint manufacturers, Winsor & Newton and Cambridge Colours by Madderton & Co. For the twelve Winsor & Newton tubes chosen for the study, Rathbone Place labels indicate that they predate the company's move to Wealdstone in 1938.[7] Madderton & Co. stopped producing Cambridge Colours in 1939[8] and so the Cambridge tubes in the paint box were manufactured prior to this date. Since Munn was not active as a painter until about 1909, it can be concluded that the paint tubes chosen for study date from between 1909 and 1939.

The second source of historic paints is a Winsor & Newton specimen tint book published in Britain sometime between 1908 and 1919.[9] The specimen tint book provides samples of the full range of Winsor & Newton oil and watercolour paints, along with price information. These specimen tints were produced as accurate representations of available paint colours; the composition of the pigments and fillers is assumed to be the same as would be found in tube paints of the same date. The specimen tint book samples are very likely older than the Winsor & Newton tubes in the Munn paint box and could provide evidence of changes in composition of the paint brand that took place in the first part of the century.

Archival material related to paint brands and dealers in Toronto, with emphasis on Winsor & Newton and Cambridge Colours (the brands found in the Kathleen Munn paint box), is presented in the first part of this paper. Although not an exhaustive review, the catalogues and advertisements consulted provide an overview of popular paint brands and the dealers that supplied them in Toronto in the late nineteenth and early twentieth centuries. The results of the analysis of the historic paint tubes and specimen tints are then summarized.

Archival Evidence: Suppliers of Artists' Paints in Toronto

By the turn of the twentieth century, many major brands of artists' oil paints were being imported to Canada and sold by artists' supply companies in Toronto. Advertisements for artists' materials from manufacturers like Winsor & Newton, Rowney, Reeves, Talens, Grumbacher and Madderton & Co., among others, are easy to find in Toronto-based publications in the first decades of the century. The archival material consulted includes catalogues from paint manufacturers, suppliers' price lists and advertisements in selected publications (Toronto exhibition catalogues, publications from

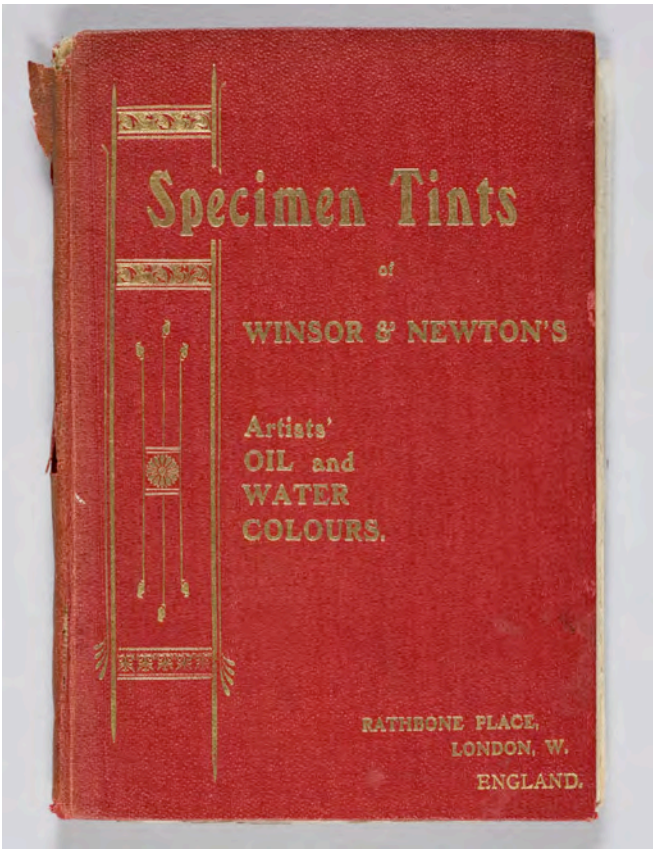


Figure 2. Front cover and plate 3 from Winsor & Newton specimen tint book published sometime between 1908 and 1919. Photograph: © Government of Canada, Canadian Conservation Institute.

the Ontario College of Art, and a few trade magazines). A summary of documents consulted and the information obtained is given in **Table A** in the **Appendix**, and described in more detail below.

From about 1900, major dealers and wholesale agents for artists' materials in Toronto included The E. Harris Co. Ltd. at 71 King Street East, George Ridout & Co. at 77 York Street, The Artists' Supply Co. also at 77 York Street, and The Art Metropole, first located at 131 Yonge Street.[4,10] While these establishments sold various brands of paint, some specialized in certain brands or were the sole agents for particular manufacturers. A 1906 advertisement for The Artists' Supply Co. highlights that they were the Canadian wholesaler for the line of Cambridge Colours produced by Madderton & Co. in Essex, England.[11] Catalogues from The E. Harris Co. (dated 1900)[12] and The Art Metropole (dated 1906)[13] show that both these companies were major agents for Winsor & Newton at the turn of the century.

Winsor & Newton, The E. Harris Co. and The Art Metropole

Winsor & Newton was founded in London, England in 1832 and became one of the foremost British paint manufacturers. From early in their history, the company sold a wide range of colours: a British Winsor & Newton catalogue from 1849 lists over 100 oil colours sold in tubes.[14] Winsor & Newton paints were imported to Toronto well before the beginning of the twentieth century and were advertised, for example, in the 1885 catalogue of the Ontario Society of Artists.[15] At the turn of the twentieth century, two important Toronto agents for the brand were The E. Harris Co. and The Art Metropole.

The E. Harris Co. was established in Toronto in 1850.[12] **Table A** in the **Appendix** lists a number of advertisements for this company in Toronto-based publications from the late nineteenth and early twentieth centuries. While an 1885 advertisement for The E. Harris Co. lists Rowney and Winsor & Newton paints,[16] many other advertisements only describe the company generally as "Wholesale and Retail Artists' Colormen" without mention of specific paint brands. **Figure 3** shows one such advertisement, found in the Ontario Society of Artists catalogue from 1891.[17] **Figure 4** shows another notable advertisement for The E. Harris Co. from the 1919 edition of *The Lamps*,[18] published by the Arts and Letters Club, that was designed by Group of Seven member J.E.H. MacDonald.[19]

An illustrated catalogue and price list from The E. Harris Co. Ltd., published in Toronto in 1900, was available for consultation.[12] This catalogue confirms that at the turn of the century, the company sold both Winsor & Newton and Rowney oil paints. The Winsor & Newton paints are given more prominence in the catalogue. As well as a complete price list of oil and watercolours available, the catalogue reproduces Winsor & Newton's articles on colour permanence and admixtures, and describes their process for grinding pigments. The Rowney colours are mentioned more briefly and no price lists are given. In a footnote, the catalogue states that they sell "a selected list of Rowney's Oil Colours in Studio Size Tubes, as used by Wyly Grier, Esq. R.C.A., and W.J. Beatty, Esq. A.R.C.A. and others. This list we shall be pleased to send on request."[20] Advertisements in Ontario College of Art (OCA) student publications from 1927 to 1939 that were consulted show that while The E. Harris Co. continued to sell Winsor & Newton oil paints during the 1930s, they also supplied other brands such as Schmincke and Reeves.[21,22]

The Art Metropole was established in 1888[23] and, like The E. Harris Co., was an important supplier of artists' materials in Toronto at the beginning of the twentieth century.

Figure 3. Advertisement for The E. Harris Co. in the Ontario Society of Artists 1891 exhibition catalogue, back advertising matter, 5th plate.

Figure 4. Advertisement for The E. Harris Co. designed by J.E.H. MacDonald as printed in *The Lamps,* 1919, p. 2.

A selection of publications with advertisements for The Art Metropole from the late nineteenth to early twentieth centuries is shown in the **Appendix**, **Table A.** In most of the early advertisements that were consulted, the company did not specify particular paint brands. **Figure 5** shows an advertisement for The Art Metropole in the OSA catalogue from 1891 which states that they supply materials to "professional artists, amateur artists and the trade."[10] The Art Metropole also advertised to students: in the 1902–1903 *Prospectus* of the Central Ontario School of Art and Design (COSAD) in Toronto, for example, they specify that their paints would be sold at special rates to students.[24]

A detailed catalogue and price list published in Toronto by The Art Metropole in 1906 was available for consultation.[13] The catalogue is 148 pages in length with price lists in Canadian dollars for a wide range of artists' materials. In the section on oil paints, they indicate that Winsor & Newton is their recommended choice for professional artists.[25] In addition to Winsor & Newton oil paints, they list Heyl's oil colours from Germany but indicate that this brand is not of equivalent quality.[26] The catalogue also includes information from Winsor & Newton on the permanence of their paints and The Art Metropole highlights to their readers that "these facts are of immense importance to Artists who are ambitious that their productions should have lasting value . . . we have at least some such amongst us."[27] Advertisements from 1927 to 1939 (listed in the **Appendix**, **Table A**) show that Winsor & Newton remained the main oil paint brand of The Art Metropole during this period. **Figure 6** shows one such advertisement from the 1929 edition of the OCA student publication *The Tangent.*[28]

It is of interest to note that the manager of The Art Metropole, Alex G. Cumming, was well known to Toronto artists of the time and, in fact, shared the Studio Building with a number of the Group of Seven painters for several years. In his *Memoirs of an Art Dealer*, Blair Laing says that:

> By 1910, he [Cumming] was manager of Toronto's leading artist supply and colour merchants, the Art Metropole on Temperance Street [sic], in which position he got to know nearly all the artists of the time. Early in 1915 . . . he managed to get Lawren Harris, the principal owner of the [Studio] building to consent to his moving in. . . . Cumming lived in the Studio Building for more than three years, until late in 1918.[29]

That Cumming lived in the Studio Building is confirmed in Stacey and Bishop's chronology of J.E.H. MacDonald, where they note that Cumming was listed as a resident there in both 1917 and 1918.[30] Based on the preference of The Art Metropole firm for Winsor & Newton paints, this may well have been the brand that Cumming, as the store manager, sold to members of the Group of Seven. Since certain of the artists were often short on cash, sometimes no money changed hands. Laing tells a story of Cumming acquiring several paintings by Tom Thomson "by direct barter or trade of oil colours and other painting supplies with the artist himself." [31]

Cambridge Colours and The Artists' Supply Co.

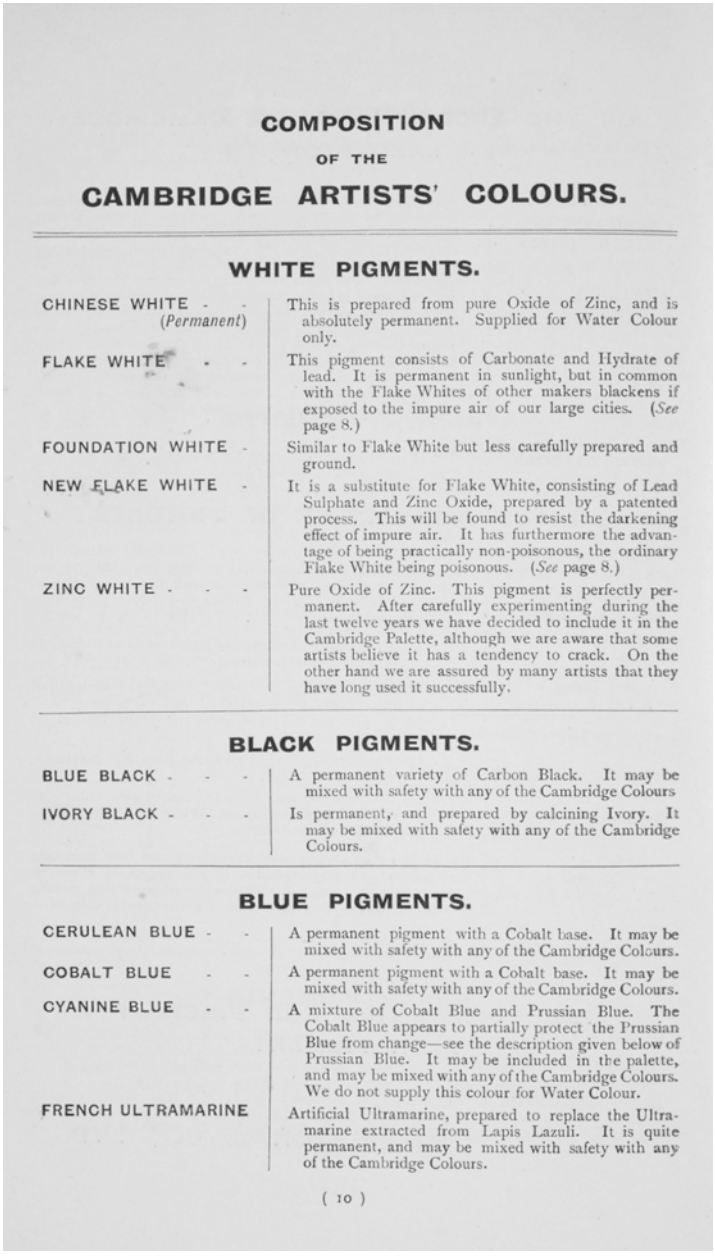
The Cambridge Colours paint brand was manufactured by the British firm Madderton & Co., founded in 1891 in Loughton, Essex, England by the chemist A.P. Laurie.[8] Cambridge

Figure 5. Advertisement for The Art Metropole in the Ontario Society of Artists 1891 exhibition catalogue, back advertising matter, 4th plate.

Figure 6. Advertisement for The Art Metropole as printed in the Ontario College of Art's *The Tangent*, 1929, p. 50.

Colours are less well known than Winsor & Newton paints and were only produced by Madderton & Co. from 1891 until 1939, when the manufacturer ceased operation. The remaining stock of Cambridge Colours was sold by Winsor & Newton from 1939 until 1943.[8]

A 1908 British catalogue for Cambridge Colours entitled *Permanent Colours for Artists* was available for consultation.[32] The catalogue lists the full range of 54 oil colours that they provided. It also gives the chemical composition of the pigments and states that Madderton & Co. synthesized most pigments themselves in their laboratory in Loughton. Two pages from the catalogue are reproduced in **Figure 7**. The Cambridge Colours palette was more restricted than that of Winsor & Newton; they emphasized the purity and stability of their paints and specified that they chose not to supply certain pigments, including chrome yellows (**Figure 7**, **right**), van Dyke brown, emerald green and crimson lake, either because of perceived lack of permanence or problems with admixtures. In regards to white pigments for oil painting, they listed Flake White (pure lead white), Foundation White (also lead white, but less carefully prepared and ground), Zinc White and a pigment they called New Flake White (**Figure 7**, **left**). New Flake White was a patented formula made from a mixture of lead sulfate and zinc white. It was first manufactured by Madderton & Co. in 1894 as a less toxic replacement for lead white and, according to the company, with the added advantage of darkening less over time.[8,33,34]



COMPOSITION
OF THE
CAMBRIDGE ARTISTS' COLOURS.

WHITE PIGMENTS.

CHINESE WHITE (*Permanent*)	This is prepared from pure Oxide of Zinc, and is absolutely permanent. Supplied for Water Colour only.
FLAKE WHITE	This pigment consists of Carbonate and Hydrate of lead. It is permanent in sunlight, but in common with the Flake Whites of other makers blackens if exposed to the impure air of our large cities. (*See* page 8.)
FOUNDATION WHITE	Similar to Flake White but less carefully prepared and ground.
NEW FLAKE WHITE	It is a substitute for Flake White, consisting of Lead Sulphate and Zinc Oxide, prepared by a patented process. This will be found to resist the darkening effect of impure air. It has furthermore the advantage of being practically non-poisonous, the ordinary Flake White being poisonous. (*See* page 8.)
ZINC WHITE	Pure Oxide of Zinc. This pigment is perfectly permanent. After carefully experimenting during the last twelve years we have decided to include it in the Cambridge Palette, although we are aware that some artists believe it has a tendency to crack. On the other hand we are assured by many artists that they have long used it successfully.

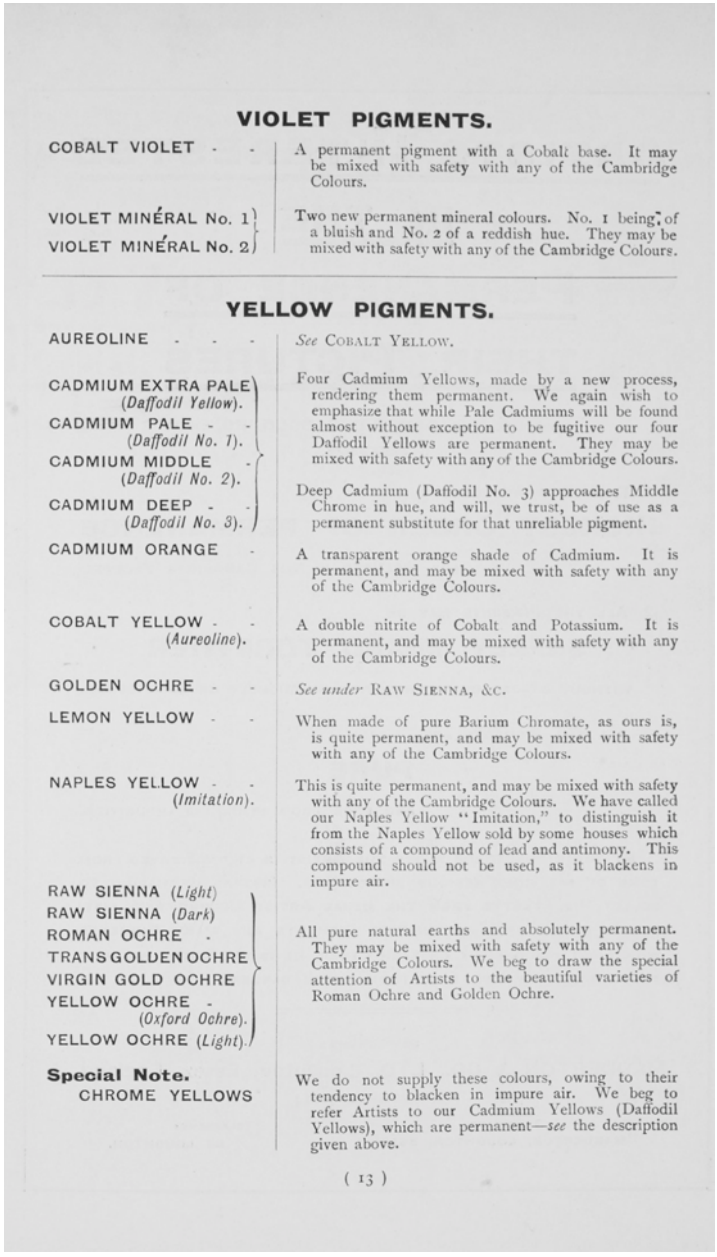
BLACK PIGMENTS.

BLUE BLACK	A permanent variety of Carbon Black. It may be mixed with safety with any of the Cambridge Colours
IVORY BLACK	Is permanent, and prepared by calcining Ivory. It may be mixed with safety with any of the Cambridge Colours.

BLUE PIGMENTS.

CERULEAN BLUE	A permanent pigment with a Cobalt base. It may be mixed with safety with any of the Cambridge Colours.
COBALT BLUE	A permanent pigment with a Cobalt base. It may be mixed with safety with any of the Cambridge Colours.
CYANINE BLUE	A mixture of Cobalt Blue and Prussian Blue. The Cobalt Blue appears to partially protect the Prussian Blue from change—see the description given below of Prussian Blue. It may be included in the palette, and may be mixed with any of the Cambridge Colours. We do not supply this colour for Water Colour.
FRENCH ULTRAMARINE	Artificial Ultramarine, prepared to replace the Ultramarine extracted from Lapis Lazuli. It is quite permanent, and may be mixed with safety with any of the Cambridge Colours.

(10)



VIOLET PIGMENTS.

COBALT VIOLET	A permanent pigment with a Cobalt base. It may be mixed with safety with any of the Cambridge Colours.
VIOLET MINÉRAL No. 1 VIOLET MINÉRAL No. 2	Two new permanent mineral colours. No. 1 being of a bluish and No. 2 of a reddish hue. They may be mixed with safety with any of the Cambridge Colours.

YELLOW PIGMENTS.

AUREOLINE	*See* COBALT YELLOW.
CADMIUM EXTRA PALE (*Daffodil Yellow*). CADMIUM PALE (*Daffodil No. 1*).	Four Cadmium Yellows, made by a new process, rendering them permanent. We again wish to emphasize that while Pale Cadmiums will be found almost without exception to be fugitive our four Daffodil Yellows are permanent. They may be mixed with safety with any of the Cambridge Colours.
CADMIUM MIDDLE (*Daffodil No. 2*). CADMIUM DEEP (*Daffodil No. 3*).	Deep Cadmium (Daffodil No. 3) approaches Middle Chrome in hue, and will, we trust, be of use as a permanent substitute for that unreliable pigment.
CADMIUM ORANGE	A transparent orange shade of Cadmium. It is permanent, and may be mixed with safety with any of the Cambridge Colours.
COBALT YELLOW (*Aureoline*).	A double nitrite of Cobalt and Potassium. It is permanent, and may be mixed with safety with any of the Cambridge Colours.
GOLDEN OCHRE	*See under* RAW SIENNA, &C.
LEMON YELLOW	When made of pure Barium Chromate, as ours is, is quite permanent, and may be mixed with safety with any of the Cambridge Colours.
NAPLES YELLOW (*Imitation*).	This is quite permanent, and may be mixed with safety with any of the Cambridge Colours. We have called our Naples Yellow "Imitation," to distinguish it from the Naples Yellow sold by some houses which consists of a compound of lead and antimony. This compound should not be used, as it blackens in impure air.
RAW SIENNA (*Light*) RAW SIENNA (*Dark*) ROMAN OCHRE TRANSGOLDEN OCHRE VIRGIN GOLD OCHRE YELLOW OCHRE (*Oxford Ochre*). YELLOW OCHRE (*Light*).	All pure natural earths and absolutely permanent. They may be mixed with safety with any of the Cambridge Colours. We beg to draw the special attention of Artists to the beautiful varieties of Roman Ochre and Golden Ochre.
Special Note. CHROME YELLOWS	We do not supply these colours, owing to their tendency to blacken in impure air. We beg to refer Artists to our Cadmium Yellows (Daffodil Yellows), which are permanent—*see* the description given above.

(13)

Figure 7. List and composition of white, black and blue pigments, including New Flake White (left, p. 10), and of violet and yellow pigments (right, p. 13) from *Permanent Colours for Artists* published in 1908 by Madderton & Co. Photograph: © Government of Canada, Canadian Conservation Institute.

The Cambridge Colours paint brand appears to have been imported to Toronto solely by The Artists' Supply Co. This Toronto firm was founded later than The Art Metropole and The E. Harris Co., and is first listed in the Toronto City Directory in 1906.[4] Their primary activity at the beginning of the century was to act as the wholesale agent in Canada for Cambridge Colours. As wholesalers for the brand, The Artists' Supply Co. specified in their advertisements that Cambridge Colours could be ordered through their catalogue by individuals or dealers.

Cambridge Colours were well advertised and seem to have been an important brand of oil paint for artists in Toronto in the first decades of the twentieth century. The earliest advertisement for Cambridge Colours by The Artists' Supply Co. in the archival material consulted is found in the 1906 edition of the Canadian National Exhibition catalogue (**Figure 8**).[11] Full page announcements for Cambridge Colours also ran in the 1908 to 1910 CNE exhibition catalogues. These advertisements provided a list of British turn-of-the-century artists who favoured the brand (**Figure 9**)[35-37] and, in fact, a number of these same painters participated in the exhibitions. Toronto based painters, including future members of the Group of Seven, starting with J.E.H. MacDonald in 1908,[38] also exhibited at this venue and would most likely have seen these conspicuous advertisements.

A number of issues of the *Prospectus* of the Central Ontario School of Art and Design (and later the Ontario College of Art) that were available for consultation also advertised Cambridge Colours (**Appendix**, **Table A**). In the 1908–1909 COSAD *Prospectus*, an advertisement stated that "artists interested in permanent pigments now use the Cambridge Colours only."[39] The school reopened as the Ontario College of Art in the fall of 1912 and its first *Prospectus* (for the 1912–1913 academic year) contains a full page advertisement for Cambridge Colours.[40] The advice to students to "ask your leading Artist friend about them" suggests that at this time they were used by professional painters in Toronto, or at the very least, that The Artists' Supply Co. aspired to this. The only other advertisement in the 1912 Prospectus is for Wm. Tyrell & Co.,[41] who carried primarily art books and also, perhaps not coincidentally, the Cambridge Colours paint brand. The advertisement for Cambridge Colours in the *Prospectus* for the following year (1913–1914) explicitly listed several North American painters using the brand, including Canadian artists Owen Staples and Franklin Brownell (**Figure 10**).[42] The Artists Supply Co. continued to advertise Cambridge Colours throughout the 1920s and 1930s, although by the 1930s they also offered other paint brands (see the **Appendix**, **Table A**). Advertisements for Cambridge Colours from The Artists' Supply Co. appear as late as 1939,[43] the same year that Madderton & Co. stopped production.

Canadian price lists for Cambridge Colours, published by the Artists' Supply Co. in 1926 and 1934, were available for consultation. They show an almost identical range of pigments to the previously noted 1908 British catalogue.[44,45] An important difference, however, is the range of white pigments available. In 1908, although traditional Flake White (lead white) is listed, the catalogue states that "as we are purists on the question of colours, we have sometimes seriously considered whether we were justified in still retaining Flake White in the Cambridge Palette."[33] And indeed, by the time that the 1926 Artists Supply Co. price list was printed, Flake White was no longer offered; only Zinc White, Foundation White and New Flake White were available. New Flake White, specific to Cambridge Colours, appears to have been an important pigment in their colour line. By 1926, it was the only Cambridge Colours pigment provided in three consistencies – stiff, medium and thin – produced by altering the pigment to medium ratio.[44]


Permanent Colours for Artists

CAMBRIDGE ARTISTS' OIL AND WATER COLOURS

A Selected Palette of Tested Pigments

THE DISTINCTIVE CHARACTERISTICS ARE

(1) Only pigments of the **HIGHEST ORDER OF PERMANENCE** are included in the Cambridge Palette.

(2) All the pigments may be **SAFELY MIXED TOGETHER** without danger of their acting injuriously on each other.

(3) All the pigments are **PURE** and free from injurious impurities.

ASK YOUR DEALER FOR CATALOGUE, OR

Andrew Caldow, 366 Yonge Street, Toronto
Duncan Bros., 434 " " "
Chas. Potter, 85 " " "

WHOLESALE AGENTS FOR CANADA

ARTISTS' SUPPLY CO.

77 YORK STREET, : : : TORONTO

Figure 8. Advertisement for Cambridge Colours in the Canadian National Exhibition's *Catalogue of the Fine Arts Department*, 1906 (back advertising matter, p. [42]).

As described earlier, an 1895 book by Madderton founder A.P. Laurie and a 1908 Madderton & Co. catalogue show that New Flake White had a distinctive composition, a mixture of lead sulfate and zinc white (**Figure 7**, **left**).[33,34] Previously published results on the materials of Tom Thomson as well as an investigation of paintings and sketches by Thomson and members of the Group of Seven have shown that this type of lead sulfate-zinc white pigment was a characteristic component in the palette of these artists.[1,2] Research at that time showed that white pigments based on lead sulfate-zinc white were not supplied by other major paint manufacturers, including Winsor & Newton, LeFranc and Talens.[2] Because the Munn paintbox was not available and study of archival documents had not yet been undertaken, the source of the white pigment remained unknown. It was referred to as "Freeman's White" because the earliest mention found for a lead sulfate-zinc white pigment was an 1882 patent by Joseph Benjamin Freeman.[1,2,46] The archival evidence presented above strongly suggests that the source of the white pigment used by Tom Thomson and the Group of Seven is, in fact, Cambridge Colours New Flake White, imported to Toronto by The Artists' Supply Company.

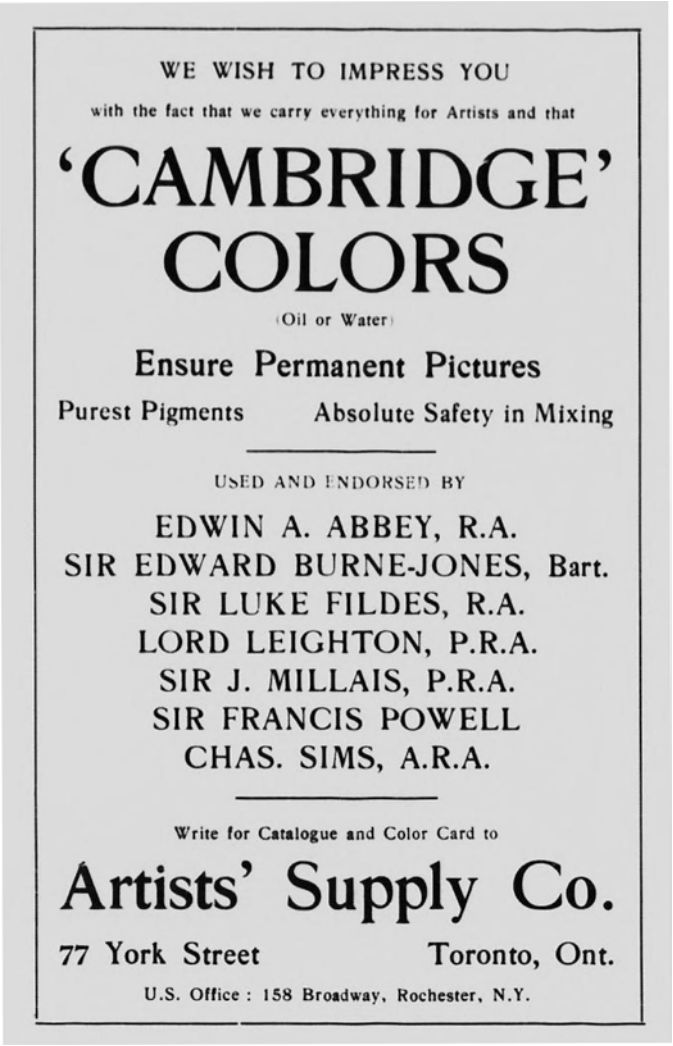


Figure 9. Advertisement for Cambridge Colours in the Canadian National Exhibition's *Catalogue of Department of Fine Arts*, 1908 (back advertising matter, p. [44]) listing some turn-of-the-century British artists who used their paint.

Figure 10. Advertisement for Cambridge Colours in 1913–1914 *Prospectus* for the Ontario College of Art, p. [33].

The Cambridge Colours brand is mentioned in an artists' questionnaire for A.Y. Jackson's 1914 painting *Maple and Birches* from the Art Gallery of Toronto (which later became the AGO). In these notes, Jackson lists "probably Cambridge and LeFranc" as the source of the paints he used on this work.[47] Although the questionnaire might not be completely accurate for this painting since it was completed by Jackson in late 1942 or early 1943, it shows that Cambridge Colours was a brand that Jackson was aware of and used.[48] That Jackson also used the popular French paint brand LeFranc is not surprising since he was from Montreal and studied in both Montreal and France.

Material Evidence: Composition of Artists' Paints from Winsor & Newton and Cambridge Colours

The pigments and fillers in the Winsor & Newton and Cambridge paint tubes from the Kathleen Munn paint box and the Winsor & Newton specimen tint book were analyzed using a combination of some or all of the following techniques: Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy combined with energy dispersive spectrometry (SEM-EDS), x-ray diffraction (XRD), polarized light microscopy (PLM) and gas chromatography-mass spectrometry (GC-MS). Experimental details are presented in the **Appendix**. The results are tabulated and discussed below.

Winsor & Newton Paint Tubes and Specimen Tint Book

The results for the analysis of pigments and fillers for 12 of the Winsor & Newton tubes with Rathbone Place labels, known to predate 1938, in the Munn paint box are presented in **Table I**. The results of the analysis of pigments and fillers for 14 oil colours in the Winsor & Newton specimen tint book, selected for comparison with the paint tubes, are given in **Table II.**

Table I: Results of Analysis* for pre-1938 Winsor & Newton Paint Tubes from Kathleen Munn's Paint Box.

Name	Pigment Composition***
Vermilion	vermilion, hydromagnesite
Indian Red	red iron oxide (hematite)
Transparent Red Ochre	red iron oxide, kaolin, quartz
Gold Ochre	yellow iron oxide, kaolin
Cadmium Yellow	cadmium yellow (greenockite), hydromagnesite
Cadmium Yellow Pale (2 tubes)	cadmium yellow (hawleyite), hydromagnesite
Cadmium Yellow Pale (1 tube)	cadmium yellow (hawleyite), magnesium sulfate hydrate (epsomite)
Cobalt Blue	cobalt blue, hydromagnesite
unidentified blue (illegible label)**	cerulean blue (likely magnesium-cobalt-tin oxide), hydromagnesite
Dark Cobalt Violet	cobalt violet (phosphate type), hydromagnesite
Burnt Sienna	red iron oxide (hematite), kaolin, hydromagnesite
Ivory Black	ivory/bone black, calcium carbonate

*The binding medium in all the paint tubes was drying oil and many samples also contained aluminum fatty acid salts. Although not mentioned in Winsor & Newton catalogues of the period, metal fatty acid salts were a common additive used to stabilize paint in tubes.[49] Fatty acid salts can also be produced from reactions between pigments and the oil medium. For simplicity, the binding medium and fatty acid salts are not listed in the table.

**This tube had an illegible label and so may not predate 1938; it was included because it was the only tube paint composed of cerulean blue.

**The chemical formulae of the pigments are given in the note for Table III.

While the pigments identified in the paint tubes and specimen tints match the general compositions listed in the Winsor & Newton 1924 catalogue,[50] chemical analysis allowed more detailed information to be obtained. These results provide useful comparative data for studies of the materials used in works by Canadian artists of the period.

Cerulean blue is described in the catalogue as "stannate of cobalt," but analysis of the tube paint and specimen tint using XRD and SEM-EDS indicates that the pigment is likely a magnesium-tin-cobalt oxide. Analysis also showed compositional differences among the cadmium yellow pigments. The pale cadmium yellows contain cadmium sulfide with the hawleyite structure, while most of the darker shades contain cadmium sulfide with the greenockite structure. An exception is the deep cadmium yellow from the specimen tint, which was poorly crystallized but likely has the hawleyite structure. The Aurora yellow on the specimen tint, described by Winsor & Newton as a special type of cadmium yellow that is "absolutely permanent,"[51] contains well-crystallized cadmium sulfide with the greenockite structure. One of the cadmium colours contained a hydrated magnesium sulfate (epsomite) and a number of others showed evidence of sulfates in the infrared spectra, although the specific compound present could not be determined.

The Winsor & Newton iron oxide pigments that were analyzed (gold ochre, burnt sienna and red ochre) contain kaolin and in some cases quartz, associated with the iron oxide pigments. These are common accessory minerals in natural iron earth pigments. Winsor & Newton's Indian red, which they list simply as "a variety of iron oxide," does not contain these accessory minerals. The name "Indian red" often refers to a synthetic pigment made from calcined iron sulfate.[52]

Of particular interest in the Winsor & Newton paints is the fact that hydromagnesite (magnesium carbonate hydroxide) was found in many of the tube paints and several of the specimen tints. The use of hydromagnesite as a filler in Winsor & Newton paints has been established and the company is known to have used this additive until the 1970s.[53] Hydromagnesite is a light, fluffy powder that was premixed into drying oil to create a stiff paste that was added to the oil paints during manufacture.[54]

In the pre-1938 paint tubes, this additive was found in seven of the 12 paints that were examined. Hydromagnesite was identified in vermilion, cobalt blue, cerulean blue, cobalt violet, burnt sienna and all but one of the cadmium yellow paints. In the specimen tints, which predate 1919, hydromagnesite was only identified in the vermilion, cobalt blue and barium yellow paints. The results show that Winsor & Newton was using hydromagnesite to some extent by the first decades of the twentieth century and suggest that its use became more prevalent as the century progressed.

Hydromagnesite has been previously identified in a scientific study of the paintings of David Milne (1882–1953), an artist who is known to have used Winsor & Newton paints.[55] This filler was identified in one of the earliest Milne

Table II: Results of Analysis* for Selected Winsor & Newton Specimen Tints (1908–1919).

Name	Pigment Composition***
Vermilion	vermilion, hydromagnesite
Rose Madder	alizarin lake (on aluminum sulfate base)
Indian Red	red iron oxide (hematite)
Gold Ochre	yellow iron oxide (goethite), kaolin
Deep Cadmium Yellow	cadmium yellow (probably hawleyite)
Middle Cadmium Yellow	cadmium yellow (greenockite), trace lead white
Pale Cadmium Yellow	cadmium yellow (hawleyite)
Aurora Yellow	cadmium yellow (greenockite)
Pale Lemon Yellow	barium yellow, hydromagnesite
Chrome Yellow	chrome yellow (chromate-sulfate type), barium sulfate
Cerulean Blue	cerulean blue (likely magnesium-cobalt-tin oxide), tin oxide
French Ultramarine	ultramarine blue
Cobalt Blue	cobalt blue, hydromagnesite
Burnt Sienna	red iron oxide (hematite), silicates

*The medium of the specimen tints, which was probably formulated specifically for these paint outs, comprises natural resins (copal and *Pinaceae* resin) and wax in addition to drying oil. Fatty acid salts were also identified in some of the samples. The composition of the medium in the specimen tints is likely different from that of commercial tube paints. For simplicity, the binding medium and fatty acid salts are not listed in the table.

***The chemical formulae of the pigments are given in the note for Table III.

Table III: Results of Analysis* for Cambridge Colours Paint Tubes from Kathleen Munn's Paint Box.

Name	Pigment Composition***
New Flake White	lead sulfate, zinc white
Zinc White	zinc white
Rose Madder	alizarin lake (on aluminum phosphate base)
Indian Red	red iron oxide (hematite)
Transparent Golden Ochre	yellow iron oxide (goethite), silicates
unidentified yellow (illegible label)	cadmium yellow (cadmium zinc sulfide), calcium carbonate, a magnesium compound (possibly magnesium sulfate)
Terre Verte	green earth, viridian
Old Terre Verte	green earth, calcium carbonate
French Ultramarine	ultramarine blue
unidentified blue (illegible label)	cobalt blue
unidentified dark brown (illegible label)	burnt umber (contains iron and manganese oxides), silicates
Lamp Black	carbon-based black
Blue Black	carbon-based black

*As in the case of the Winsor & Newton tubes, the binding medium in all samples was based on drying oil and many of the samples also contained metal fatty acid salts. For simplicity, the binding medium and fatty acid salts are not listed in the table.

***alizarin = $C_{14}H_8O_4$; barium sulphate = $BaSO_4$; barium yellow = $BaCrO_4$; burnt umber = mixed iron and manganese oxides; cadmium yellow = CdS (hawleyite or greenockite structure); cadmium yellow = cadmium zinc sulfide, $Cd_{1-x}Zn_xS$; calcium carbonate = $CaCO_3$; carbon-based black = C; cerulean blue = magnesium-cobalt-tin oxide type, $Mg_{2-y}Co_ySnO_4$; chrome yellow (chromate-sulfate type) = $PbCrO_4 \cdot nPbSO_4$; cobalt blue = $CoO \cdot Al_2O_3$; cobalt violet (phosphate type) = $Co_3(PO_4)_2$; epsomite = $MgSO_4 \cdot 7H_2O$; green earth = iron containing mica, variable composition; hydromagnesite = $Mg_5(CO_3)_4(OH)_2 \cdot 4H_2O$; ivory/bone black = C + $Ca_5(PO_4)_3(OH)$; kaolin = $Al_2Si_2O_5(OH)_4$; lead sulfate = $PbSO_4$; lead white = $(PbCO_3)_2 \cdot Pb(OH)_2$ and $PbCO_3$; red iron oxide (hematite) = Fe_2O_3; tin oxide = SnO_2; ultramarine blue = $Na_6Ca_2Al_6Si_6O_{24}(SO_4)_2$; vermilion = HgS; viridian = $Cr_2O_3 \cdot nH_2O$; yellow iron oxide (goethite) = FeOOH; zinc white = ZnO

painting studied (dating from 1912). The results of analysis of Winsor & Newton tubes from Milne's paint box indicated the use of hydromagnesite in a similar range of colours to the Winsor & Newton tubes and specimen tints studied here. In Milne's paint box, hydromagnesite was associated with vermilion, cadmium-based colours, ultramarine and some iron oxides.[55]

Fillers and specific paint mixtures were not included in the published study on Tom Thomson's materials, to avoid making available information that could be used fraudulently.[1,3] Without providing specific occurrences, it is justifiable to mention here that hydromagnesite was indeed found in certain of Thomson's paints,[56] suggesting that he employed the Winsor & Newton brand. Hydromagnesite has also been identified in some of J.E.H. MacDonald's paints as part of an ongoing study of his materials and techniques.[57]

Cambridge Colours Paint Tubes from Madderton & Co.

The results of analysis of 13 Cambridge Colours paint tubes from Madderton & Co. found in the Munn paintbox, are presented in **Table III**. Analysis showed that the chemical compositions listed in the 1908 Cambridge Catalogue[32] are accurate. For example, in accordance with the catalogue list, the tube of Old Terre Verte was pigmented with green earth alone, while Terre Verte was a mixture of green earth with a small amount of viridian. It is of interest to note that none of the Cambridge Colours contain a hydromagnesite filler and, based on this, certain of the colours are distinguishable from the Winsor & Newton paints.

Similar to Winsor & Newton, the Cambridge Indian Red is a pure iron oxide without accessory minerals. This is likely a synthetic pigment since Cambridge describes it as "an oxide of iron pigment, which, when carefully purified, is absolutely permanent" whereas the other iron oxide pigments are described as "natural earths."[58] Synthetic iron oxides produced from calcining iron sulfate required careful purification to ensure that no sulfates remained in the final product.[52]

Only one cadmium yellow paint from Madderton & Co. was present in the Munn paintbox and unfortunately it had an illegible label. However, based on its composition and colour, it is likely one of the lighter shades they produced (referred to as "Daffodil Yellows"). It has a different composition from the Winsor & Newton cadmium yellows and contains the following components: cadmium zinc sulfide, calcium carbonate and a magnesium compound, possibly a magnesium sulfate. This may correspond to the light shade of cadmium yellow described by Madderton & Co. founder A.P. Laurie in his book *The Painter's Methods and Materials*. He says "if cadmium sulphide is precipitated with sulphide of zinc, or hydrate of zinc, or of magnesia, and is then heated to a temperature of 500° to 600°C for a couple of hours, a beautiful pale yellow is obtained which resists exposure to light."[59] In another of his books, *Facts about Processes, Pigments and Vehicles*, he states that "there are two pale cadmiums in the market, however, both made by a secret process, viz. Winsor and Newton's Aurora Yellow and Madderton & Co.'s Daffodil, which are quite permanent."[60] Although Laurie believed the cadmium yellows to be permanent, recent studies have shown examples of their deterioration.[61] In two works from the 1930s by Arthur Lismer, deteriorated yellow and green paints exhibiting efflorescence were found to be pigmented with cadmium sulfide and cadmium zinc sulfide respectively.[62]

The composition of the New Flake White as a lead sulfate-zinc white mixture was confirmed by analysis of the two Cambridge Colours tubes labelled "New Flake White." The FTIR spectrum of the New Flake White is almost identical to spectra of lead sulfate-zinc white paints identified in works by Tom Thomson and the Group of Seven in previous research,[2] supporting the archival evidence that the source of their white paint is the New Flake White Cambridge Colour produced by Madderton & Co. The upper FTIR spectrum in **Figure 11** is that of the Cambridge Colours New Flake White and the lower spectrum is that of a white paint residue on J.E.H. MacDonald's paint box composed of lead sulfate and zinc white. The spectra are virtually identical except in 1600–1500 cm^{-1} region related to absorptions of the metal fatty acid salts present, which evolve as the paint dries and ages.

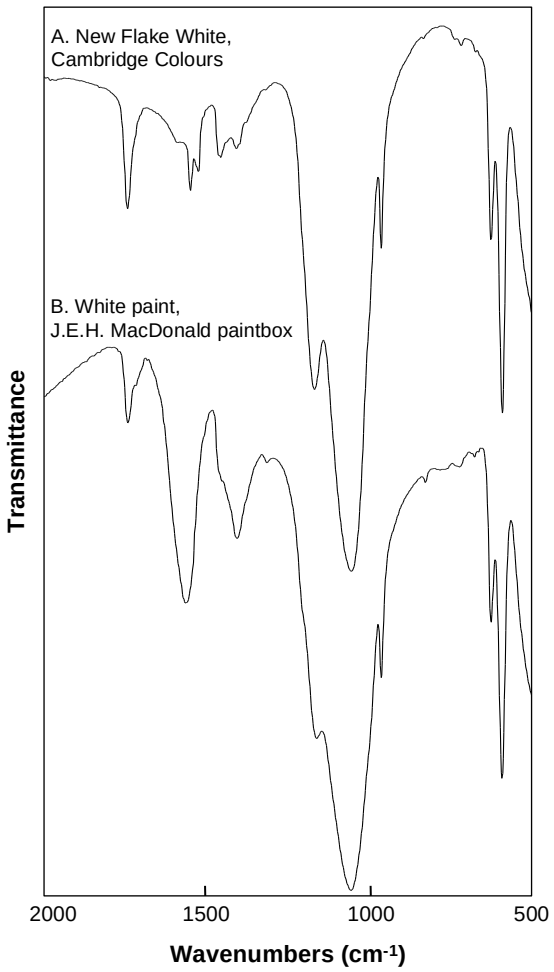


Figure 11. FTIR spectra of "New Flake White" from Cambridge Colours (A) and white paint from J.E.H. MacDonald's paint box (B).

Conclusions

This study provides information about artists' paints available in Toronto during the first decades of the twentieth century through the examination of archival material and the analysis of paints from the paint box of Kathleen Munn and a Winsor & Newton specimen tint book. The information obtained gives useful context to previous research on the materials of Tom Thomson and the Group of Seven and will also inform future studies of painters active in Toronto during this period.

Examination of archival material has shown that Winsor & Newton was the main oil paint brand of leading Toronto paint dealers The Art Metropole and The E. Harris Co. during the first decades of the twentieth century. Extant catalogues, historic paint tubes and specimen tint books illustrate the wide range of Winsor & Newton oil colours available during this period. The pigments identified in the historic paint tubes from Kathleen Munn's paint box and specimen tints match the general compositions listed in the Winsor & Newton 1924 catalogue. However, chemical analysis provided more detailed information. Of particular interest is that hydromagnesite (magnesium carbonate hydroxide) was used as a filler in Winsor & Newton paints from the early part of the century but was not present in any of the Cambridge Colours paints. Hydromagnesite has been identified on paintings by Tom Thomson, J.E.H. MacDonald and David Milne. David Milne is known to have used Windsor & Newton paints. The results presented in this paper suggest that Thomson and MacDonald also used this brand.

Cambridge Colours by Madderton & Co. were sold in Toronto by the Artists' Supply Company. This firm prominently advertised Cambridge Colours in publications of the Ontario College of Art and in Toronto exhibition catalogues from 1906 until 1939, the year that Madderton stopped production. New Flake White, composed of a lead sulfate-zinc white mixture, was produced by Madderton from 1894. Its composition was confirmed in the historic Cambridge Colours paint tubes from Kathleen Munn's paint box. Previous investigation of paint materials in works by Tom Thomson and the Group of Seven have shown that this pigment was an important part of the palette of these artists from 1912 to 1943, although at the time of the study the source of the pigment was unknown. The presence of this particular white paint on works by the Group of Seven can now be directly linked to the use of Cambridge Colours from the Artists' Supply Company. Future research will include the analysis of white pigments used on works by artists contemporaneous with the Group of Seven to determine the extent to which Cambridge Colours New Flake White was employed by painters of the period and if there is a geographical or temporal pattern to its use during the first decades of the twentieth century.

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Appendix

Experimental Details

Samples were mounted on a low pressure diamond anvil micro-sample cell and analyzed by FTIR using a Bruker Hyperion 2000 microscope interfaced to a Tensor 27 spectrometer. The samples were analyzed in transmission mode by co-adding 150 scans and using a 4 cm^{-1} resolution. Spectra were collected from 4000 to 430 cm^{-1} using a wide band MCT detector or from 4000 to 580 cm^{-1} using a mid-band MCT detector.

SEM-EDS was undertaken using an Hitachi S-3500N scanning electron microscope integrated with a lithium-drifted silicon, light element x-ray detector and an Oxford Inca x-ray microanalysis system. The SEM was operated at an accelerating voltage of 20 kV and a working distance of 15 mm. Using this technique, elemental analysis of small volumes, down to a few cubic micrometres, were obtained for elements from boron (B) to uranium (U) with a sensitivity of about 1%.

XRD patterns were obtained with a Bruker D8 Discover with GADDS (General Area Detector Diffraction Solution) equipped with a rotating anode and cobalt target. The patterns were measured at 40 kV and 85 mA, using a 0.5 mm collimator.

For PLM, samples were dispersed in Cargille Melt-mount™ and observed using a Leica DMRX polarizing light microscope. Pigments were identified based on their optical and morphological properties.

GC-MS analysis was performed using an Agilent 6890 gas chromatograph interfaced to an Agilent 5973 quadrupole mass spectrometer. Samples were extracted and derivatized using methylation, by treating the samples with a 1:1 solution of 15 µL of Meth-Prep™ II (m-(trifluoromethyl)phenyl trimethyl ammonium hydroxide, TMTFTH, 0.2 N in methanol; Grace Davison Discovery Science) and 15 µL toluene for 60 minutes at 60°C.

Table A: List of Archival Materials Consulted.

Documents Consulted	Date	Summary of Findings
Paint Manufacturer and Supplier Catalogues		
Winsor & Newton Catalogues, published by Winsor & Newton, London, England (consulted 1885, 1886, 1896, 1900, 1907, 1910, 1915, 1920, 1924, 1925, 1928, 1934, 1937)	various	List a wide range of oil colours in tubes with prices in British currency. Catalogues from 1896 and 1924 give information on permanence.
Illustrated Catalogue and Price List of Artists' Materials, published by The E. Harris Company, Toronto, Canada, 1900	1900	Offers both Winsor & Newton and Rowney oil paints. The Winsor & Newton paints are given more prominence including a complete price list in Canadian dollars. The Rowney colours are mentioned more briefly.
Catalogue and Price List of Colors and Materials for Artists, Architects, Decorators, Designers, and Draughtsmen, published by The Art Metropole, Limited, Toronto, Canada, December 1906	1906	Prices in Canadian dollars for a wide range of artists' materials. Winsor & Newton is their recommended oil paint. Also lists Heyl's oil colours from Germany but indicates that they are not of equivalent quality.
Permanent Colours for Artists, published by Madderton & Co., Ltd, Loughton, Essex, England, 1908	1908	Lists the full range of 54 oil colours manufactured and the chemical composition of the pigments (see **Figure 7**). The palette is more restricted than Winsor & Newton since the company chose not to supply certain pigments, including chrome yellows, van Dyke brown, emerald green and crimson lake. Lists four white pigments for oil painting, including New Flake White (lead sulfate-zinc white).
Price List of Cambridge and Madderton Oil Colours, published by Artists' Supply Company, Toronto, Canada (consulted 1926 and 1934 lists)	1926 and 1934	Canadian price lists for Cambridge Colours from The Artists' Supply Co. which show almost identical range of pigments to the 1908 British catalogue except that Flake White (lead white) is no longer offered. New Flake White (lead sulfate-zinc white) is the only pigment provided in varying consistencies.
Advertisements in Toronto Exhibition Catalogues		
Ontario Society of Artists exhibition catalogues [titles vary], Toronto (consulted 1878, 1883, 1885, 1890, 1891, 1892, 1897, 1898, 1911–1914, 1920–1922; all issues containing advertisements are listed)	1885	Advertisement for Winsor & Newton paints, sold by James W. Paton, 84 Yonge Street (p. 29); advertisement for The E. Harris Co. listing Rowney and Winsor & Newton (p. 25).
	1891	Advertisements for The Art Metropole (back advertising matter, 4th plate, **Figure 5**) and The E. Harris Co. (back advertising matter, 5th plate, **Figure 3**), no specific brands listed.
Canadian National Exhibition: Catalogue of Department of Fine Arts, Toronto (consulted 1904–1920 inclusive; all issues containing advertisements are listed)	1906	Advertisements for The E. Harris Co. (p. [4]) and The Art Metropole (p. [44]), no specific brands listed; for Cambridge Colours from The Artists' Supply Co. (p. [42], **Figure 8**).
	1908	Advertisements for The E. Harris Co. (p. [46]) and The Art Metropole (p. [48]), no specific brands listed; for Cambridge Colours from The Artists' Supply Co. with a list of British painters using the brand (p. [44], **Figure 9**).
	1909	Advertisements for The E. Harris Co. (p. [45]) and The Art Metropole (p.[47]), no specific brands listed; for Cambridge Colours from The Artists' Supply Co. (p. [43]) with a list of British painters using the brand, and lists Canadian Art Limited, 95 King St. E. as a dealer.
	1910	Same advertisements for The Art Metropole (p. [47]) and for Cambridge Colours from The Artists' Supply Co. (p. [45]) as in 1909. No advertisement for The E. Harris Co.

Note: Research focused on selected documents likely to contain information related to paint brands and dealers in Toronto, with emphasis on Winsor & Newton and Cambridge Colours. For advertisements on unnumbered pages, the **page numbers in brackets** were assigned by counting from the nearest numbered page.

Table A: List of Archival Materials Consulted (con't)**.**

Documents Consulted	Date	Summary of Findings
Advertisements in COSAD and OCA Prospectus		
Central Ontario School of Art and Industrial Design, Annual Prospectus, COSAD, Toronto (consulted 1902–1904,1908–1909 and 1911–1912; all issues containing advertisements are listed; 1904–1908 not available)	1902–1903	Advertisement for The Art Metropole (inside front cover) and for The E. Harris Co. (inside back cover) no specific paint brands mentioned; for George Ridout & Co. as the sole agent for Rembrandt paints from Talens in Holland (back cover).
	1903–1904	Advertisement for The Art Metropole as in 1902–1903 (inside front cover); for The E. Harris Co. showing a Winsor & Newton paint tube (inside back cover); for George Ridout & Co. as the sole agent for Rembrandt paints from Talens in Holland with several Toronto painters who endorsed the brand listed, including McG. Knowles and F.M. Bell-Smith (back cover).
	1908–1909	Advertisement for Cambridge Colours from The Artists' Supply Co. stating "artists interested in permanent pigments now use the Cambridge Colours only" (inside back cover); for The E. Harris Co. (outside back cover) and The Art Metropole (inside front cover), no brands listed.
Prospectus of the Ontario College of Art, Toronto, University Press, Toronto (consulted 1912–1938; no advertisements after 1914)	1912–1913	Full page advertisement for Cambridge Colours from The Artists' Supply Co. listing Wm. Tyrell & Co. as a dealer (p. [23]); for Wm. Tyrell & Co. with no mention of art supplies (inside front cover).
	1913–1914	Full page advertisement for Cambridge Colours from The Artists' Supply Co. listing North American painters using the brand (p. [33], **Figure 10**).
Advertisements in Magazines and OCA Publications		
The Bookseller and Stationer, vol. 18, no. 9, September 1902, MacLean Publishing Co. Ltd., Montreal and Toronto	1902	Advertisement states that The Art Metropole was established in 1888 (pp. 24–25).
The Lamps, The Arts and Letters Club, Toronto (consulted 1908, 1910, 1911, 1912, 1919, 1932, 1938, 1939; only the 1919 issue has advertisements)	1919	Advertisement for The E. Harris Co., designed by J.E.H. MacDonald (p. 2, **Figure 4**).
The OCA Students' Annual, Ontario College of Art, Toronto, 1927	1927	Advertisement for The Art Metropole listing Winsor & Newton (p. iii); for The Artists' Supply Co. listing Cambridge Colours (p. iv); for The E. Harris Co. listing Winsor & Newton, Rowney, Reeves and Clifford Milburn (back cover).
The Tangent, The Students' Club, Ontario College of Art, Toronto (consulted 1929–1939; only advertisements from The Art Metropole, The E. Harris Co. and The Artists' Supply Co. are noted; other paint dealers advertised include Eaton's, Simpson's, Reeves and Grumbacher)	1929	Advertisement for The Art Metropole listing Winsor & Newton (p. 50, **Figure 6**); for The Artists' Supply Co. listing Cambridge Colours (back cover).
	1930–1931	Advertisement for The Art Metropole listing Winsor & Newton (1930, p. 42; 1931, p. 51); for The Artists' Supply Co. listing Cambridge, Madderton and Rembrandt (1930 and 1931, back cover); for The E. Harris Co., no brands listed (1930 only, p. 43).
	1932–1933	Advertisement for The Artists' Supply Co. listing Cambridge, Madderton, Rembrandt (and Orpi in 1933 only) (1932 and 1933, back cover); for The E. Harris Co. listing Winsor & Newton and Schmincke (1932, p. 47; 1933, p. 51).
	1934–1939	Advertisement for The Art Metropole as a branch of Hugh Owens listing Winsor & Newton (1934, p. 48; 1935, p. 58; 1936, p. 60; 1937, p. [25]; 1938, p. [50]; 1939, p. [49]); for The E. Harris Co. listing Winsor & Newton, Schmincke and Reeves (1934, p. 50; 1935, p. 60; 1936, p. 67; 1937, p. [23]; 1938, p. [46]; 1939, p. [45]); for The Artists' Supply Co. listing Cambridge, Madderton, Orpi (and Rembrandt in 1934 only) (1934, p. 52; 1935, p. 65; 1936, p. 57; 1937, p. [26]; 1938, p. [42]; 1939, p. [43]).

Note: Research focused on selected documents likely to contain information related to paint brands and dealers in Toronto, with emphasis on Winsor & Newton and Cambridge Colours. For advertisements on unnumbered pages, the **page numbers in brackets** were assigned by counting from the nearest numbered page.

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3. Webster-Cook, S. and A. Ruggles, "Technical Studies on Thomson's Materials and Working Method," in: *Tom Thomson*, edited by Dennis Reid (Vancouver/Toronto: Douglas & McIntyre, 2002), pp. 145–152.

4. Klempan provides some history on paint suppliers in Toronto during the first half of the twentieth century, but her article focuses primarily on the development of the mid-century manufacturer Canadian Art Laboratory. Klempan, B., "Early Manufacture of Artists' Materials in Canada: A History of Canadian Art Laboratory," *Journal of the Canadian Association for Conservation*, vol. 37, 2012, pp. 41–51.

5. The McMichael Canadian Art Collection (MCAC) has a paint box made for J.E.H. MacDonald by his son thought to have been used from about 1920 until his death in 1932. The box shows extensive residues of dried oil paint, particularly along the edges of the lid where the painting support would have been held. There were also two tubes of paint in the MacDonald box when it was acquired; these paints, however, postdate the artist's death. (See Klempan, "Early Manufacture of Artists' Materials in Canada," pp. 46–47.) The MCAC and the National Gallery of Canada (NGC) also have paint boxes and some supplies from other Group of Seven members, but to our knowledge, no well-dated early oil paint tubes. Two of A.Y. Jackson's paint boxes have been studied, and one of these contains tubes of paint from both Winsor & Newton and Grumbacher. However, this paint box, in the collection of the Canadian Museum of History (CMH), was used by Jackson from about 1955 to 1968, long after the dissolution of the Group of Seven. See Klempan, B. and M.-C. Corbeil, "A Technical and Scientific Study of Two A.Y. Jackson Paintboxes," *Journal of the Canadian Association for Conservation*, vol. 34, 2009, pp. 29–38.

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9. Winsor & Newton, *Specimen Tints of Winsor & Newton's Artists' Oil and Watercolours* (London: Winsor & Newton, n.d.). The specimen tint book is in the private collection of Eric Hagan (Canadian Conservation Institute). Examination of extant Winsor & Newton catalogues showed that the pigment lists and prices in the specimen tint book match catalogues from 1910 and 1915 but not 1907 or 1920. No catalogues between 1907 and 1910 or 1915 and 1920 were available for comparison, so at present the book can only be dated to the period 1908–1919.

10. The first address for the Art Metropole comes from an advertisement printed in a 1891 OSA exhibition catalogue. Ontario Society of Artists, *Illustrated Catalogue of the Nineteenth Annual Exhibition of the Ontario Society of Artists* (Toronto: OSA, 1891), back advertising matter, 4th plate.

11. Printed in the Canadian National Exhibition catalogue, *Catalogue of the Fine Art Department under the Management of the Ontario Society of Artists*, 27 August – 8 September 1906 (Toronto: CNE, 1906), back advertising matter, p. [42].

12. The E. Harris Company, *Illustrated Catalogue and Price List of Artists' Materials* (Toronto: The E. Harris Company, 1900), 64 pp.

13. The Art Metropole, *Catalogue and Price List of Colors and Materials for Artists, Architects, Decorators, Designers, and Draughtsmen* (Toronto: The Art Metropole, December 1906), 148 pp.

14. Winsor & Newton, *Winsor & Newton Catalogue* (London: Winsor & Newton, 1849).

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16. Ontario Society of Artists, *Winter 1885 Exhibition Catalogue*, p. 25.

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Lettering (Ottawa: Archives of Canadian Art, an imprint of Carleton University Press, 1996), p. 45.

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29. Laing, B., *Memoirs of an Art Dealer*, vol. 1 (Toronto: McClelland and Stewart, 1978), p. 24.

30. Stacey and Bishop, *J.E.H. MacDonald Designer*, 1996, pp. 119–120.

31. Laing, *Memoirs of an Art Dealer*, 1978, p. 25.

32. Madderton & Co., *Permanent Colours for Artists* (Loughton, Essex: Madderton & Co., December 1908), 28 pp.

33. Madderton & Co., *Permanent Colours for Artists*, 1908, p. 10.

34. Laurie, A.P., *Facts about Processes, Pigments and Vehicles* (London: Macmillan and Co., 1895), pp. 48–52, 132.

35. Canadian National Exhibition, *Canadian National Exhibition: Catalogue of Department of Fine Arts*, 29 August – 14 September 1908 (Toronto: CNE, 1908), back advertising matter, p. [44].

36. Canadian National Exhibition, *Canadian National Exhibition*: *Catalogue of Department of Fine Arts*, 30 August – 13 September 1909 (Toronto: CNE, 1909), back advertising matter, p. [43].

37. Canadian National Exhibition, *Canadian National Exhibition*: *Catalogue of Department of Fine Arts*, 27 August – 12 September 1910 (Toronto: CNE, 1910), back advertising matter, p. [45].

38. Canadian National Exhibition, *Catalogue of Department of Fine Arts*, 1908, p. 35.

39. Central Ontario School of Art and Industrial Design, *Annual Prospectus 1908–1909* (Toronto: COSAD, 1908), inside back cover.

40. Ontario College of Art, *Prospectus of the Ontario College of Art, Toronto, for Session 1912–1913* (Toronto: University Press, 1912), back advertising matter, p. [23]. The advertisement lists Wm. Tyrell & Co. as a dealer.

41. Ontario College Art, *Prospectus*, 1912, inside front cover.

42. Ontario College of Art, *Prospectus of the Ontario College of Art, Toronto, for Session 1913–1914* (Toronto: University Press, 1913), back advertising matter, p. [33].

43. The Students' Club of the Ontario College of Art, *The Tangent*, 1939, back advertising matter, p. [43].

44. Artists' Supply Company, *1926 Price List of Cambridge and Madderton Oil Colours* (Toronto: Artists' Supply Company, 1926), 4 pp.

45. Artists' Supply Company, *1934 Price List of Cambridge and Madderton Oil Colours* (Toronto: Artists' Supply Company, 1934), 4 pp.

46. While the name "Freeman's White" was used by Corbeil et al., the authors also noted Laurie's reference to "New Flake White" and "Cambridge White" as alternate names for this white pigment. However, at the time of this research the link to Cambridge Colours imported to Canada by the Artists' Supply Company had not yet been uncovered. Corbeil et al., "The Use of a White Pigment Patented by Freeman," 1999, Table 1, p. 365.

47. Art Gallery of Toronto artist information sheet for *Maple and Birches* (AGO accession number 2704), completed by A.Y. Jackson in 1942 or 1943.

48. Webster-Cook and Ruggles interpreted "Cambridge" on the Art Gallery of Toronto artist information sheet as referring to Winsor & Newton paint ("Technical Studies on Thomson's Materials and Working Method," pp. 145–152). In fact, the archival evidence described in the present work shows that it refers to Cambridge Colours by Madderton & Co.

49. Mayer, R., *The Artists' Handbook*, 4th ed., revised and updated (New York: Viking, 1981), p. 138.

50. Winsor & Newton, *Winsor & Newton Catalogue* (London: Winsor & Newton, 1924). In this catalogue, Winsor & Newton reissued a notice on the chemical composition and permanence of their pigments (first published in 1892) with updated information on permanence (pp. xii–xix). Pigments were divided into *Class I, division I* (absolutely permanent), *Class I, division II* (durable), *Class II* (moderately durable) and *Class III* (fugitive). During the early twentieth century, there was much discussion about the permanence of a number of pigments, such as the chrome yellows, cadmium yellows and some organic lakes. According to this catalogue, the deep cadmium yellows were considered durable (*Class I, division II*) and the light cadmium yellows as moderately durable (*Class II*). Aurora Yellow, a special cadmium sulfide pigment introduced by Winsor & Newton in 1889 was listed as absolutely permanent (*Class I*). The chrome yellows were considered moderately durable.

51. Winsor & Newton, *Winsor & Newton Catalogue*, 1924, p. xv.

52. Helwig, K., "Iron Oxide Pigments: Natural and Synthetic," in: *Artists' Pigments: A Handbook of their History and Characteristics*, vol. 4, edited by Barbara H. Berrie (Washington: National Gallery of Art, 2007), pp. 44, 57.

53. Cooper, A, A. Burnstock, K.J. van den Berg and B. Ormsby, "Water Sensitive Oil Paints in the Twentieth Century: A Study of the Distribution of Water-Soluble Degradation Products in Modern Oil Paint Films," in: *Issues in Contemporary Oil Paint*, edited by K.J. van den Berg, A. Burnstock, M. de Keijzer, J. Krueger, T. Learner, A. de Tagle and G. Heydenreich, (Switzerland: Springer, 2014), pp. 295–310.

54. Garrett, I. (Technical Director – retired, Winsor & Newton and the ColArt Group, London, UK), personal communication, April 2015.

55. Sirois, P.J., C. Stewart, K. Helwig, E. Moffatt and K.M. Legate, "A Technical Study of the Materials and Methods Used by David B. Milne in his Oil Paintings," *Journal of the Canadian Association for Conservation*, vol. 32, 2007, pp. 17–33.

56. Unpublished data on Tom Thomson's materials (Ottawa: Canadian Conservation Institute).

57. Unpublished data on J.E.H. MacDonald's materials (Ottawa: Canadian Conservation Institute).

58. Madderton & Co., *Permanent Colours for Artists*, 1908, p. 12.

59. Laurie, A.P., *The Painter's Methods and Materials* (New York: Dover, 1967), p. 88.

60. Laurie, A.P., *Facts about Processes, Pigments and Vehicles*, 1895, p. 52.

61. Leone, B., A. Burnstock, C. Jones, P. Hallebeek, J. Boon and K. Keune, "The Deterioration of Cadmium Sulphide Yellow Artists' Pigments," in: *Preprints, 14th Triennial Meeting, ICOM Committee for Conservation*, vol. 2, The Hague, 12–16 September 2005, edited by Isabelle Verger (London: James & James, 2005), pp. 803–813.

62. Sirois, J. and E. Moffatt, *Analysis of Efflorescence from Two Paintings by Lismer: Untitled, 1935 and Georgian Bay, 1935* (Ottawa: Canadian Conservation Institute, 1995). Unpublished CCI report, ARS 3477.