



# Revolution in Paint

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A supplement  
to the exhibition

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*Revolution in Paint*

NORTH CAROLINA

Museum of Art

*“Thus the battle really is  
between traditional art and  
the new art, between old  
painting, and the new  
painting.”*

—Edmond Duranty, art critic, 1876

By the first impressionist exhibition in 1874, there had been more than 200 years of government control of the arts in France. For 300 years artists had adhered to traditions established in the Renaissance. And to cap it off, oil paint itself had barely changed in 400 years.

It was time for a revolution!

Young painters Claude Monet, Alfred Sisley, Camille Pissarro, and others felt frustrated by the confining traditions of academic painting. Influenced by a few maverick painters that preceded them, and inspired by an unprecedented number of newly invented paint pigments, these artists invented a new style that we call impressionism.

The birth of modern science and the Industrial Revolution in 18<sup>th</sup>-century Europe supplied an unprecedented expansion in the artist's palette. More than 20 intense yellow, green, blue, red, and orange pigments were invented between 1800 and 1870. The impressionists took advantage of the new pigments' inherent chromatic and physical properties to forego the laborious techniques of traditional academic painting for a quicker and more direct painting style.

But yet another invention helped make the impressionist revolution possible. A frustrated South Carolina painter named John G. Rand invented the collapsible metal paint tube—and suddenly paint became portable. Now the impressionists could abandon the studio and its confining academic painting techniques. Moving outdoors, they could seize the flickering light and capture the pulsing life around them.

Today the prismatic colors, impasto, and quick summary style of impressionist painting receive nearly universal praise, but when these revolutionary works of art were first exhibited in the 1870s, they prompted quite the opposite response: they were ridiculed and condemned by both critics and the public.

The North Carolina Museum of Art has mounted a major international loan exhibition, *Monet in Normandy* (October 15, 2006–January 14, 2007), featuring 50 paintings by the great French impressionist master Claude Monet. In conjunction with this exhibition, the Museum's conservation and curatorial departments have developed a focus exhibition called *Revolution in Paint* (September 17, 2006–February 11, 2007). This exhibition is based on a simple premise: a radical change in artist's pigments during the 19<sup>th</sup> century enabled a revolution in painting. A different palette of paint made

it physically possible for the impressionists to paint differently from their predecessors. A comparison of the materials and painting techniques of the academic painters and the impressionists will help to remind us of the radical and unconventional nature of a new school of painting that would survive the harsh criticism of its day and come to captivate a world audience. This document is a supplement to the exhibition and is meant to give background on the focus and techniques of impressionism as well as traditional academic painting.

*Revolution in Paint* is made possible by the generous support of SunCom Wireless, Inc.

*“Some people burst out laughing at the sight of these things, but they just leave me heartsick. The self-declared artists style themselves the intransigents, the impressionists; they take canvas, paint, and brushes, throw some color on at random, and sign the result.”*

—Albert Wolff, art critic, 1876

*“The unhappy impressionist can protest that his sincerity is absolute . . . But the public and the critics condemn him . . . For them, only one fact pertains: the things that the impressionists put on their canvases do not correspond to those found on the canvases of previous painters. It is different, and so it is bad.”*

—Theodore Duret, art critic, 1878

# *Revolution in Paint*

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## The Ascendancy of Drawing, the French Academy, and Early-19<sup>th</sup>-Century Academic Training



Adolphe-William Bouguereau, *L'Art et La Littérature*, 1867, oil on canvas, 78 $\frac{1}{2}$  x 42 $\frac{1}{2}$ , Collection of the Arnot Art Museum, Museum Purchase, 1977

### The Ascendancy of Drawing

*“Drawing does not consist merely of line: drawing is also expression, the inner form, the plane, modeling. See what remains after that. Drawing includes three and a half quarters of the content of painting . . . everything, except the hue.”*

—Jean-Auguste-Dominique Ingres, artist, mid-19<sup>th</sup> century

Oil revolutionized painting in the 15<sup>th</sup> century. Sweeping down from Northern Europe into Italy, oil paint came to supplant nearly all other paint mediums in just a few decades, a dominance that would go unchallenged for nearly 500 years. The reason? The slow-drying oil medium and its optical properties gave artists an incredible control over their paint, allowing for realism that was unparalleled in two-dimensional art. But this leap in painting tech-

nology had an unforeseen consequence for the paint itself. Color, supplied by the pigment in the paint, slowly gave way to drawing as the focus of painters. In the words of Leonardo da Vinci, “Which is of greater importance: that the form should abound in beautiful colors, or display high relief? Colors honor only those who manufacture them.” By *relief* he means the depiction of sculptural relief, an illusion of three-dimensional form in a painting. Clearly, for Leonardo, color pales in importance to the believable depiction of depth and sculptural form.

The Renaissance greats established that this power of illusion was created by the artist's skill in drawing, the skill to accurately reproduce shape and carefully render relationships of light and dark (*chiaroscuro*). But they also established that drawing records the artist's abstract ideas, the intellectual side of art. Perspective, proportion, and the underlying geometry of their compositions required rigorous mathematical and conceptual organization. Although many Renaissance artists were great colorists, drawing came to be seen as the most intellectual of painting skills: the power to turn the flat two-dimensional surface of a canvas into the illusion of three dimensions. Bright color, on the other hand, although it remained useful in a decorative sense, became increasingly associated with common sensual experiences, something that appealed to the baser human instincts. Although there would be ups and downs in its popularity, color and paint would remain second to drawing until the advent of the impressionists.

Drawing came to be much more than simply recording what was seen; it was a way to distill and modify reality using the artist's intellect as well as facility. Following the example of ancient classical Greek and Roman sculpture, the old masters focused on the human figure. They recreated the human body in a highly controlled, reasoned manner, using the figure to express the most profound ideas and emotions. With this dramatic new emphasis on drawing, Italian artists formed the first academies in the 15<sup>th</sup> century to improve their drawing skills. These were not so much schools as they were clubs, a place for artists to gather after a day's work, drawing from models which were paid for by pooling their funds.

### The French Academy

*“The first modern academies . . . enshrined the fundamental humanist beliefs that the human figure provided the key to the divine order and that knowledge of pure beauty could only be derived through the study of the ancient Greek and Roman statuary.”*

—William R. Johnston, art historian, 2000

The French Academy, created in 1648, was one of the earliest national academies to be formed outside of Italy. Influenced by the first Italian academies, the French Academy institutionalized both the artistic focus on the figure as well as drawing as the basis of all the visual arts. In 1664, during the reign of Louis XIV, the Academy was brought under the control of the government. Louis used the Academy to foster a French style of art that he preferred, but also to make political propaganda to reinforce his position. Artists had to fall in line with the Academy and the king's preferences if they expected to receive royal patronage. Being a Royal Academician and receiving government commissions resulted in higher prestige and visibility, in turn drawing other clientele and financial success. These practices continued under subsequent monarchs and revolutionary governments through the 19<sup>th</sup> century.

Through the years the Academy went through many changes in both form and leadership. In the 17<sup>th</sup> century the Academicians, the highest level of membership who shaped the rules and goals of the Academy, were quite diverse, and there was no limit to their number. Many artists reached this level in their 20s and 30s, and there were even a few women members, all of which contributed to a more open liberal atmosphere. By the 19<sup>th</sup> century the number of Academicians became limited to a small group who kept their status for life. This created an inherently older and more conservative body. The Academy became ever more rigid and devoted to tradition, the antique, and the old masters, at times slavishly following their example.

Between the time of its inception and the dawning of impressionism in the middle of the 19<sup>th</sup> century, the Academy became an extraordinarily powerful institution that dominated nearly every aspect of a French artist's career.

Young artists were indoctrinated into the strict rules and expectations of the Academy from the beginning of their training. The Academicians were the professors at the Academy's school, the *École des Beaux-Arts*. Their strict training regimen quelled individualism, turning out students steeped in tradition. By controlling training, the Academy dictated style, perpetuating the status quo.

The Academy continued its control by limiting the artist's access to financial support (buying clientele). Practically the only way an artist could publicly show his work, find buyers, and make a living was through the government's nearly annual Salon exhibition. Most French artists, as well as artists from other countries, would submit art to this exhibition in hopes of official acceptance and awards, which raised their public visibility and usually resulted in financial success. The juries for the Salon were dominated by Academicians, who rejected any work that they deemed substandard or outside their own ideas of what constituted art.

Ultimately, for the French artist, all roads led through the Academy. The Academy dictated subject matter, style, and technique throughout the artist's career. From training, to exhibition, to financial and critical success, painters simply could not expect to succeed without working within the academic system and creating art that met its expectations.

## Early-19<sup>th</sup>-Century Academic Training

In the *École des Beaux-Arts*, the students' main activity was drawing. As Dominique Ingres, the most influential French artist of the mid-19<sup>th</sup> century, put it, ". . . drawing is everything, the whole of art lies there." First students copied engravings after old master paintings, then plaster casts of ancient and Renaissance sculpture. This work was meant to sharpen their skills of observation and facility with drawing media, but also to absorb the lessons of great artists of the past.

French artists idolized the Italian old masters. In Ingres's words, "Our task is not to invent but to continue . . . following the examples of the masters." The French aimed to absorb and

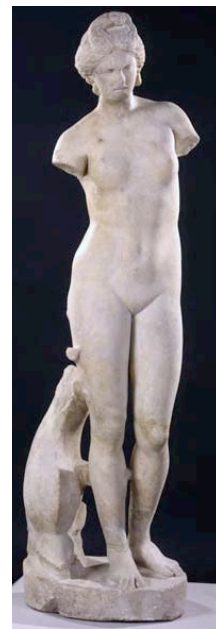
then reassemble the work of the Renaissance artists, mixing it with their own talent to create original work. Study in Italy, with its immersion in ancient history and art, was seen as absolutely necessary to a serious artist. The most fortunate won the Prix de Rome, the annual prize for the most talented and skillful student of the *École des Beaux-Arts*, which included a fellowship to the French Academy in Rome and practically guaranteed a successful career.

Eventually the *École* student would move on to drawing live models. The model was always illuminated with a strong directional light, producing strong shadows and clearly delineating the figure in terms of light and dark forms. The students were expected to apply the example of classical sculpture and the old masters, accurately reproducing the pose but downplaying any individual characteristics to produce an idealized form. Around 1862, master painter Charles Gleyre instructed his atelier student Claude Monet that "When you do a figure study, always have the antique in mind." Students made so many of these figure drawings that they came to be called *academies*. *École* students also studied mythology and history, which was considered the most important subject matter for painting (followed by portraiture, with still life and landscape the lowliest of subjects).

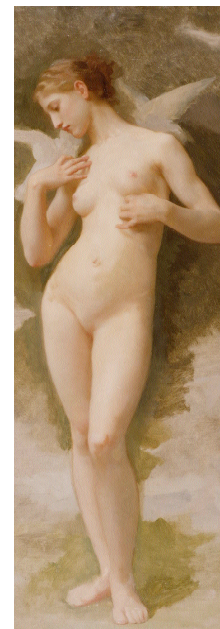
*"I have a long way to go before I can draw decently, and I haven't touched color yet, nor do I expect to until I can draw very well."*

—Jean-Frédéric Bazille, future founding impressionist painter, about 1863

*École* painting students were not taught to paint. No time was spent learning about paint materials or painting technique (until reforms in 1863). Students were expected to learn painting outside the *École* in a private atelier of a master painter, frequently an Academician (which added to their influence as well as their income). But in fact, most time in the atelier was also devoted to drawing the figure and preparing for competitions such as the Prix de Rome. The act of painting was perceived as a relatively mechanical application of paint, not much different from the application of pencil or chalk. Ingres's attitude appears to have been the norm: "The material



Aphrodite of Cyrene, 1st Century, Marble, H. 67½ in., Purchased with funds from the State of North Carolina and from the North Carolina State Art Society (Robert F. Phifer Bequest)



Adolphe-William Bouguereau, *Venus with Doves*, about 1879, oil on canvas, 32¼ x 18¼ in., Ackland Art Museum, University of North Carolina at Chapel Hill, Ackland Fund, 77.3.1



Jefferson David Chalfant, *Bouguereau's Atelier at the Académie Julian, Paris, 1891*, oil on wood panel, 11¼ x 14¼ in., Fine Arts Museums of San Francisco, Gift of Mr. and Mrs. John D. Rockefeller 3<sup>rd</sup>, 1979.7.26



Léon Cogniet, *Male Nude from the Back*, September 25, 1812, black and white chalk on blue paper, 23¾ x 18¼ in., Ackland Art Museum, University of North Carolina at Chapel Hill, Ackland Fund, 86.4

processes of painting are very easy and can be learnt in a week or so.”

Once an artist had created a detailed drawing, painting was little more than a way to reproduce the drawing in a more solid medium and add decorative color. In fact, bright paint color was purposely subdued so as not to compete with qualities of drawing and design in the painting. “Better gray than garishness,” as Ingres put it.

## Academic Painting Technique and the Traditional Palette



Adolphe-William Bouguereau, *Study of a Woman, for Offering to Love*, oil on canvas, Private collection

### Academic Painting Technique

Paint materials changed very little between the time of the old masters and the 19<sup>th</sup> century. As a result traditional approaches to painting were rarely challenged. The application of paint became relatively standardized by the 19<sup>th</sup> century, which explains the École des Beaux-Arts' exclusion of its study. The academic painter's focus was almost entirely on drawing. Inspired by the idealized forms of classical sculpture, and influenced by the Age of Reason and the sobriety of their time, early 19<sup>th</sup> century artists came to see perfection in craftsmanship as one of the strongest virtues their art could aspire to. Exacting drawing of figures and smooth flawless paint surfaces, with only

the slightest hint of the artist's hand that created it, spoke of intellectual control and became a signifier of great art and artists, both to the artistic establishment and the viewing public.

A painting's creation was based on long and detailed planning. First came the *esquisse*, a small loosely painted sketch that preserved the initial idea and established the basic composition. Each figure and detail within the composition was then studied and refined. An artist might sketch a scene outdoors, but most work took place in the studio, where objects and live models could be posed as needed and studied at length. Poses would be modified, each object and drapery drawn precisely, and an individual portrait made for each figure. This process might take weeks, months, even years as the artist refined his composition. Eventually a complete drawing was transferred to a canvas.

The application of paint was meant to make the artist's imaginary composition as realistic as possible. Academic painters strove for what we might call “photographic realism.” In fact, photography was born in France in the early 19<sup>th</sup> century and quickly became a tool for painters. To make their paintings as solid in appearance as possible, artists applied several layers of paint, which were necessary to totally cover the canvas and abolish any detail that would destroy the illusion, such as bare white gesso. The standard academic approach to painting required three basic layers of paint.

The first layer of paint was a monochrome reddish brown color called *le sauce* (“the gravy”). The sauce was painted on quickly and freely over the whole surface to establish the composition in contrasts of light and dark. At this point the painting would look much like a sepia-toned photograph. Subsequent paint layers accentuated the tonal contrast, or chiaroscuro, creating a sense of depth and sculptural relief.

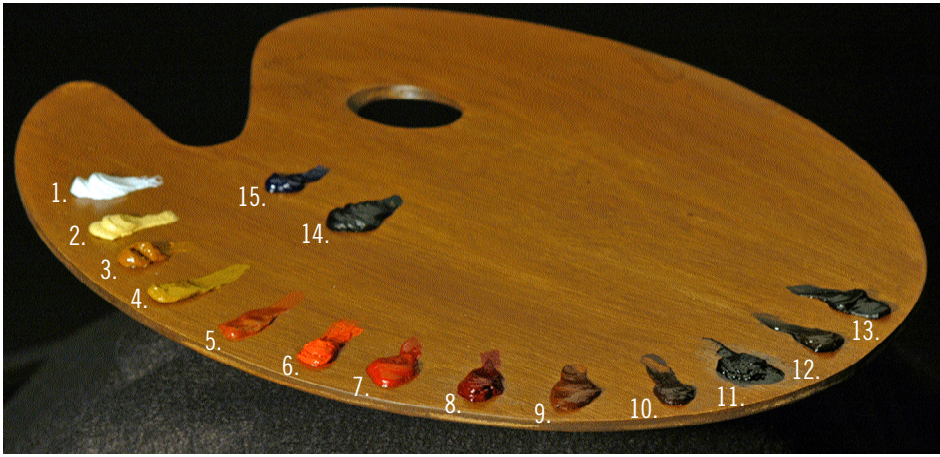
The next layer was called the *ébauche*, which established the local color of objects. This stage of painting is sometimes referred to as “dead coloring” because the artists generally used opaque and inexpensive pigments such as earth tones, white, and black. Although

not as loosely applied as the sauce, *ébauche* paint was applied fairly broadly with little or no detail. No white ground was left showing. During this stage some areas would be painted with a solid opaque tone in preparation for thin glazes of paint that would be applied in the next stage to achieve a certain color or effect, such as the appearance of silk fabric. This was often necessary for strongly colored areas, particularly greens, and dark reds where the only available pigments were too transparent to stand on their own (i.e., verdigris, rose madder).

The *ébauche* layer was then allowed to dry thoroughly. All instances of raised paint such as impasto or brush marking would be scraped smooth.

Then came the third layer, or “second painting,” another complete layer of paint, the second in local color. The artist applied thin glazes of paint, modifying and finishing each area in greater detail, bringing the painting to a very high degree of finish. Varnish, oil, and other special mediums were mixed into the paint to make it more fluid. This helped the paint to level as it dried, reducing brush marking. Tonal transitions in the flesh tones were made as seamless as possible. The highlights were applied last, with slightly raised impasto to give a sense of immediacy to the work. Varnish was often applied between paint layers, as well as a final surface coating, helping to insure a smooth surface.

A painting constructed in this fashion routinely took several months or even years from conception to the final varnish. This approach was ideally suited to turning the historical and mythological inventions of the artist's mind into an illusion of reality, a mixture of the artist's skill and imagination with the old master traditions favored by the Academy. The work was created through extraordinary skill and control, but ultimately it was absolutely calculated and artificial in nature. Any spontaneity that might have been present in the *esquisse* rarely survived to the final finished painting.



Simulated traditional palette, 2006 re-creation of early 1800s palette

## The Traditional Palette

The 19<sup>th</sup>-century French painter's palette of pigments was a strong link with the past. It was practically identical to that of the old masters. It had taken thousands of years to assemble these colored materials for paint; almost all had been found before the advent of oil painting in the 15<sup>th</sup> century. Only two or three significant pigments had been discovered in the 300 years between the Renaissance and the 19<sup>th</sup> century.

For oil painting there were approximately 30 pigments available at the beginning of the 19<sup>th</sup> century. About half of these were seldom used because of their expense, toxicity, propensity to fade, chemical instability, or other problems. Painters were left with about 15 pigments that were relatively reliable and useful. This traditional palette was weak in many areas. For instance, the yellows were quite pale and dull. Only Indian yellow had a strong hue, but it was transparent and was subject to fading. Also there was no trustworthy green pigment. Verdigris, a bluish green, was used on occasion but was chemically unstable and frequently turned brown. As a result most painters mixed blue and yellow pigments to create greens, which of course suffered from a lack of a strong yellow pigment.



Attributed to Michiel van Musscher, *Portrait of an Artist in Her Studio* (detail), about 1680–85, oil on canvas, 44% x 35% in., Gift of Armand and Victor Hammer

In practically every depiction of the palette from the 16<sup>th</sup> to the early 19<sup>th</sup> centuries, the paint has been laid out by tone, from light to dark. This illustrates centuries of reliance on tonal contrast to create the illusion of three-dimensional form—the same tonal contrast that painters learned to establish drawing with chalk or graphite.

The traditional pigments, with date of invention or earliest known use as artists' paint:

1. Lead white, ancient Greece
2. Naples yellow\*, ancient Egypt
3. Indian yellow\*, 16<sup>th</sup> century
4. Yellow ochre, prehistoric
5. Red ochre, prehistoric
6. Vermilion, medieval
7. Rose madder, ancient Egypt
8. Carmine\*, medieval
9. Burnt sienna, Early Renaissance
10. Brown madder\*, 18<sup>th</sup> century
11. Bitumen, medieval
12. Cassel earth, 16<sup>th</sup> century
13. Ivory black, prehistoric
14. Prussian blue, 1710
15. Ultramarine blue, natural, medieval

\*Sample is a modern approximation of the original pigment.

## New Science, New Paint

France in the 18<sup>th</sup> century was in the forefront of the Age of Enlightenment, a time when superstition was being replaced by the application of reason. At the same time the machine age—what we now call the Industrial Revolution—was sweeping Europe. Nearly every aspect of life of was affected. Rational thinking and industrial application gave rise to possibly the most important event in the history

of science: the birth of modern chemistry. There were major leaps in the understanding of chemical interaction and the identification of basic elements. Between 1700 and 1850, a startling 40 new elements were discovered, where only 15 were known before!

The new chemical scientists were hired by industrial businesses such as textile manufacturers to find new and better ways to add color to their products. Brightly colored commodities sold better and for higher prices in the burgeoning market of cheap industrially manufactured goods. New substances were quickly investigated for their potential as pigments. More than 20 intense yellow, green, blue, red, and orange pigments were invented between 1800 and 1870, many based on newly discovered elements such as chrome, cadmium, and cobalt. Each new pigment was quickly picked up by artists' colormen, turned into paint, and sold to artists. New materials often give an artist an opportunity for innovation, but this expansion in the number and variety of pigments was unprecedented in the history of art. An equally dramatic shift in the history of painting was bound to happen.



Crocoite, a natural chrome mineral.  
Photo by Roger Weller, Cochise College, Arizona.

As a rule the new pigments were more opaque and had greater tinting strength than traditional pigments. While some new pigments were only marginally better than similar traditional hues, others represented dramatic improvements, or were completely without precedent. Natural ultramarine blue was unrivaled in 600 years of art in terms of beauty and chemical stability. It was also enormously expensive, which limited its use. The new chemically identical "French" ultramarine was dramatically cheaper, a tenth the cost, and could now be afforded by even the poorest painter. Chrome yellow was the first rich

opaque yellow that wasn't rare, expensive, highly toxic, or quick to fade in light. There had never been a strong chemically stable green. Now there were three: chrome oxide green, emerald green, and viridian.

## An Impressionist Palette

*“Since the appearance of impressionism, the official salons [exhibitions], which used to be brown, have become blue, green, and red.”*

—Claude Monet, about 1915

Pigment with date of invention or earliest known use as artists' paint in Europe:

1. Lead white, ancient Greece
2. Chrome yellow\*, 1820
3. Vermilion, medieval
4. Red ochre, prehistoric
5. Alizarin crimson (synthetic rose madder), 1868
6. French ultramarine, 1826
7. Cobalt blue, 1802
8. Viridian, 1838
9. Emerald green\*, 1814
10. Ivory black, prehistoric

\*Sample is a modern approximation of the original pigment.

## Impressionism: The New Painting

*“The Impressionist sees and renders nature as it is—that is, wholly in the vibration of color. No drawing, light, modeling, perspective, or chiaroscuro, none of those childish classifications.”*

—Jules Laforgue, art critic, 1883



Alfred Sisley, *Apple Trees in Flower*, 1880, oil on canvas, 25¼ x 31¾ in., Chrysler Museum of Art, Norfolk, Va.; Gift of Walter P. Chrysler, Jr



Simulated impressionist's palette, 2006 re-creation based on Monet's palette of the 1870s

The artists who were to become the founding impressionists expected to pursue art within the academic system; they had little choice.

Claude Monet, Alfred Sisley, Pierre-Auguste Renoir, and Frédéric Bazille met in the training atelier of Charles Gleyre. Gleyre was an academic painter of note and ran one of the most popular, and more liberal, ateliers in Paris. Students endured long hours of drawing live models and critiques by Gleyre, looking forward to the day they were allowed to pick up a brush to paint.

It was during their first years together in the early 1860s that the four young artists, frustrated by their rigid training, the constraints of academic tradition, and the stale work of popular artists of their day, slowly started to create their new painting style. The impressionists found their inspiration to break with academic painting in the work of a few preceding nonconformist artists: including Eugène Delacroix, Jean-François Millet, Eugène Boudin, Gustave Courbet, Camille Corot, and Edouard Manet, among others. These artists influenced the impressionists in many different ways. Some focused on landscape and contemporary images of their own day as subject matter. Others left the studio to paint outdoors almost exclusively, while others used strong color and expressive brushwork. Almost all of these artists used a more direct technique of paint application that depended less on the formulaic building of paint layers, but for the most part their palette was still dominated by traditional pigments, particularly brown. Rarely did they use the modern pigments that were invented during their lifetime.

But it was the new pigments that were the catalyst that created an altogether different way of painting. Of course there were many new colors, expanding the painter's palette. But it was how the impressionists used the new pigments, how the pigments allowed the impressionists to work, that changed the history of painting. Not only did the new pigments allow for much quicker painting and different techniques, they also came with a new understanding of the nature of color and light, totally changing the painters' thoughts of what they were representing on their canvas.

Many of the new pigments were quite opaque. On the other hand, a few—such as viridian green and alizarin crimson—were relatively transparent, but their high tinting strength meant that they could be made opaque by mixing with lead white and still retain a strong color. Paintings could be executed much more quickly using opaque paint, rather than the layering of thin paint typical of academic technique. The impressionists could paint a scene in a very short timespan, a matter of days or weeks, rather than months or years. They could more easily capture scenes of their own day, a time when societies' focus was changing from an obsession with the past to the quickly changing present. A time that included newly invented steam-powered ships, trains, and factories.

The birth of modern chemistry and the industrialization of Europe had supplied the new pigments, but it also gave the world a new understanding of color. Early industrial color chemists such as Michel-Eugène Chevreul (1786–1889) experimented and wrote exten-



sively on the nature of light and color. Chevreul was the first to explain the phenomenon of simultaneous contrast or *complementary colors*, where a color appears brighter and stronger when placed next to its complementary color. With primary and secondary colors this occurs with the combinations of red-green,



The color wheel is a tool with the prismatic colors of the rainbow regularly spaced around the perimeter of a circular chart. It clearly shows complementary color pairs and other color relationships. Michel-Eugène Chevreul is credited with making one of the earliest modern color wheels.

yellow-purple, and blue-orange. While painters had instinctively used complementary colors in their work for thousands of years, it was always limited by the available pigments. The medieval painter had a strong red in vermilion, but there was no green pigment even remotely as strong to pair with the red. The new pigments supplied strong primary and secondary colors, particularly yellows, greens, and even purple, giving the impressionists a very balanced palette.

The chemists also extended the work of Isaac Newton (1642–1727), who proved that natural white light contained all other colors of light. Newton demonstrated this by passing sunlight through a prism, splitting it into all the colors of the rainbow. These ideas led the impressionists to fundamentally change their approach to painting.

Traditional painters focused on the development of form in terms of light and dark, a technique called *chiaroscuro*. Models in the studio were lit with a single directional light source that accentuated the figure in strong contrasts of light and shadow. The artists built

an illusion of three dimensions through drawing the hard-edged contours of the model and carefully shading the contrasting forms. Through meticulous tonal modeling and the application of formal pictorial devices such as perspective, they were able to turn the inventions of their minds into concrete reality on their canvas.

As the writings of the color chemists became more widely known in the second half of the 19th century, progressive artists increasingly considered artwork born of the studio, and its dependence on artificially controlled light, as “false” and hopelessly mired in the past. The impressionists sought the “truth” by working outside in natural light. Not only did they find subject matter in the landscapes and everyday life around them, but light became a subject in itself. The impressionist came to see the world as flicking light and color, a jumble of prismatic light reflected to our eye. The pigments on their palette were not just colors; they were the ingredients of light. With new pigments filling the gaps in the old traditional palette, the impressionists had the primary building blocks of light in the form of physical paint. They abandoned the use of strong contrasts of light and dark, choosing instead to juxtapose color to distinguish forms. In 1874, picking up the torch of impressionist ideology, the painter Paul Cézanne exclaims, “Replace tonal modeling by the study of colors.” In addition mixing nearly all their colors with white gave their paintings a lighter tone overall, infusing their paintings with a sense of internal light.

While the number and variety of pigments available to the impressionists were greater than any previous time in the history of art, the impressionists actually used fewer pigments for any one painting than their predecessors. Monet’s paintings in the late 1860s, before impressionism and still influenced by academic painting, contain as many as 13 pigments in one painting, half of them traditional pigments. A decade later, at the height of pure impressionism, the impressionists’ paintings generally contain no more than eight or 10 pigments, and all but one or two are new 19<sup>th</sup>-century pigments. Yet, with the reduction in the number of pigments used, the paintings actually appear more colorful! This is clearly illustrated by *The Artist’s Palette with a Landscape*,

painted by Pissarro in 1879. Here Pissarro shows us that he can paint a fully colored landscape with only six pigments! Arranged along the left and top edges are: emerald green, French ultramarine blue, red lake (possibly the recently invented alizarin crimson), vermilion, chrome or zinc yellow, and lead white. Lead white, vermilion, and possibly the red lake are the only traditional pigments. Pissarro has used his understanding of the prismatic nature of white light and color mixing of primary and secondary colors to create any color he needs to reproduce. The six colors constitute a very balanced representation of the color wheel. Used together their strong tinting strength and opacity made it possible to create almost any desired color simply by mixing.



Camille Pissarro, *The Artist’s Palette with a Landscape*, about 1878, oil on panel (artist’s palette), 9 1/4 x 13 3/4 in., Sterling and Francine Clark Art Institute, Williamstown, Massachusetts, 1955.827

The impressionists abandoned drawing and the hard-edged depiction of objects. In the words of Claude Monet, “I never draw except with brush and paint.” They were no longer interested in the underlying structure of objects. Meticulous drawing was of no use. It simply took too long to record a moment of glittering light. Figures became mere blobs of paint. Clarity and finish were replaced with an intentional lack of detail. Patches of white ground were left exposed, becoming a functioning part of the image— unheard of in academic painting.

The impressionist’s use of broken brushwork and pronounced paint texture was an integral part of their technique. The rough surfaces of their paintings reflect light unevenly, adding to the illusion of shifting transient light. Having dropped many of the formal academic devices in favor of seemingly random compositions, the texture also helped hold the image together visually.

Once again changes in the manufacture of paint itself was the catalyst for this new technique. For centuries oil paint was typically made using linseed oil, which tends to level during drying, reducing texture. During the 18th and 19th centuries painters gladly relinquished the manufacture of paint to the artist's colorman, a new tradesman who made and sold paint to artists. The shelf life of paint became very important. Slower-drying poppy oil came to replace linseed oil, making it more likely that paint would remain usable over the unpredictable time period between the colorman's manufacture, the sale of the paint, and use by the artist. But this had an unintended consequence. Poppy-oil paints tend to retain texture as they dry.

Traditionally, paint was made quite stiff with a minimum of oil medium. It was necessary for the painter to add more oil to make the paint usable. Like painters before them, academic painters continued to add extra medium to their poppy-oil paints to create smooth paint surfaces, which spoke to them of control, precision, and good craftsmanship. They probably didn't notice a difference in their store-bought paints, and weren't aware that a different oil was used. But some painters were looking for a different way to paint, a different way to express themselves. First the Romantic school painters such as Delacroix, then the impressionists used the natural tendencies of the poppy-oil paint to create textured surfaces. Because of their innovations, paint impasto came to be seen as an immediate indication of modernity in a painting. Smooth surfaces became associated with conservative traditionalism.

Working outdoors directly from nature, the impressionists used their new pigments and techniques to capture crisp, scintillating qualities of light rarely seen in painting before their time. But their paintings were nearly the antithesis of the popular painting of their day, the definition of "cutting edge." The public and many critics, accustomed to the subdued color, detail, and polish of academic painting, simply couldn't understand this drastic and sudden change. They criticized impressionism's quick summary technique as nothing more than an *ébauche*, as if the impressionists had quit halfway into creating their painting. To them

impressionist paintings illustrated at best a lack of skill and the initiative in the artists to finish what was begun, or at worst a lack of intelligence and good taste. They didn't realize that the goals of the painter and painting itself had changed.

*"The public ... accustomed to the pitch-black sauces cooked up by the cabin crew of the schools and academies, their stomachs churn at the sight of bright painting."*

—Félix Fénéon, art critic, 1887

## Revolution in Paint Storage

*"Without colors in tubes, there would be no Cézanne, no Monet, no Pissarro, and no impressionism."*

—Pierre-Auguste Renoir, artist, early 20<sup>th</sup> century



Paint bladder, 19<sup>th</sup> century, Harvard Art Museums

Since the advent of oil painting in the 15<sup>th</sup> century, the storage of prepared paint has been an issue for painters. Oil paint becomes unusable in a few days if left out in the open air. Particularly before the 19<sup>th</sup> century, paint was expensive, something that was not to be wasted. Whether stored in pottery cups tightly sealed with oilskin, or submerged under water in seashells, the shelf life of oil paint was very short.

Academic painting technique required that each paint layer dry before proceeding with the next. Any excess paint on the palette would dry out and harden long before it could be used for the next layer. The artist would prepare his palette with only the colors that were needed

to complete a day's work. This usually meant painting one similarly colored area at a time—sky, trees, drapery—each with a different palette of colors. As a result most paintings were developed area by area. A figure would be nearly complete while its drapery would hardly be started. A blue sky would be finished before any green was placed on the trees. It was foolhardy to have all the paint one needed to complete a painting already prepared and on hand, particularly for a large painting. It would spoil before it could be used. Each day the painter, or a studio assistant, would grind together oil and pigments to make the paint that was to be used for that day. Only a few of the dozen or more different colors the painter might need could be ready to use at any one time. Painters made their own paint right up into the 18<sup>th</sup> and 19<sup>th</sup> centuries largely because of this lack of adequate storage technology. It was only with improved storage containers that "store-bought" paint became possible.

The pig's bladder was the best available paint storage container during the 18<sup>th</sup> and early 19<sup>th</sup> century. It was particularly popular with the new "artist's colorman," a vendor who made and sold paint and other painting equipment to professional painters as well as the rapidly growing army of amateur painters who didn't care to grind their own paint. The bladder afforded the best alternative to package, transport, and store small quantities of paint for short periods of time. If unopened and carefully stored, bladder paint could last a few months before it hardened. But bladders were famously messy and often burst unexpectedly. Any handling or moving had to be kept to a minimum. The bladder was opened by piercing with an ivory tack, but it could not be effectively resealed. The remaining contents leaked out or spoiled in a short time. Undependable and messy, very few artists attempted to use paint bladders outside the studio. The convenience of store-bought paint and the drawbacks of the bladder are illustrated in a letter from the painter Eugène Delacroix to his colorman Etienne Haro in 1854:

"May I remind M. Etienne that he promised to put aside for me the bladders of Prussian brown that he recently made. But I would like only one bladder at a time in order to avoid it spurting out."



Paint tube, Lefranc & Cie brand, late 19<sup>th</sup> century, Chrysler Museum of Art, Norfolk, Va.; Gift of Edith Ballinger Price

## The Tube

In 1841 a South Carolina painter named John G. Rand patented a new device for paint storage, the collapsible metal tube. He invented the tube out of frustration, too often seeing his bladder-stored paint spoil before it could be used. The collapsible metal tube was a vast improvement. The metal was impermeable, so the paint couldn't dry out or harden. The tube could be opened and resealed numerous times, so there was very little waste. This invention would of course go on to greater fame as a container for toothpaste, glue, anchovy paste, and other products. The convenience of the new paint tube is captured by this mid-nineteenth-century advertising label:

*“REEVES & SONS’ COLLAPSIBLE AIR-TIGHT METALLIC COLOUR TUBES. A new invention for containing Oil Colours, which supersedes Bladders, and prevents all waste, dirtiness, and smell, and will preserve the Colour any length of time in any climate.”*

The tube offered almost indefinite paint storage; there was no need to limit the amount of paint on hand. Now the painter could have all the paint he or she needed to complete a painting at their immediate disposal without fear it would spoil before it could be used. The painter was no longer limited to working on one small similarly colored area of a painting at a time. Now the painter could work anywhere on the painting's surface at anytime, developing the whole painting at once. In the words of Camille Pissarro, “Don't paint bit by bit, but paint everything at once by placing tones everywhere.” This was absolutely crucial with the impressionists. They needed to work very quick-

ly to capture fleeting effects of light and weather. This required an immediate, intuitive response that could not be limited to one small part of a larger composition.

Tube paints were eminently portable, allowing painters to take their paints anywhere they wished to set up their easel. Earlier painters were limited to making studies with dry drawing materials, or watercolors, but rarely with oil paints. Making a finished oil painting outside the studio was unheard of. For the first time in history the paint tube made it practical to produce a finished painting on-site, whether in the gardens of Giverny or standing on the cliffs along the Norman coast. Even though the impressionists continued to keep personal studios throughout their careers, the studio was associated in their minds with conservative painting. This is illustrated by a typically overzealous comment from Claude Monet in 1880: “My studio! But I never have had one, and personally I don't understand why anybody would want to shut themselves up in some room. Maybe for drawing, sure; but not for painting.”

The paint tube in the *Revolution in Paint* exhibition was made by Lefranc, a brand familiar to most 19<sup>th</sup>-century French painters. Lefranc's roots can be traced to 1720, when the French painter Jean Simeon Chardin asked his spice and pigment merchant, a Lefranc family ancestor, to make his paints. William Bouguereau wrote, “I am pleased to have only good to say about the colors made by Messieurs Lefranc and Cie.” This tube's pigment, cadmium yellow, invented in 1846, became a favorite of the impressionists for its bright hue, strong tint, and opaque nature. But the impressionists did not care for machine-made paint such as Lefranc's. Industrially made paint had suffered numerous problems in the early 19<sup>th</sup> century shortly after its invention. The impressionists were more confident in the quality of old-fashioned hand-ground paints, which they bought in tubes from independent colormen.

It might surprise you to think the impressionists were concerned about the quality of their paint. Today there's the general perception that the impressionists were cavalier about their materials. We picture them furiously painting

away, not giving a care about technique or materials in their headlong rush to capture a transient scene in a splash of color. True, the impressionists did abandon most traditional academic painting techniques. But this was in part prompted by the serious technical problems they observed in the old techniques and materials. For instance, the academic techniques relied a great deal on the application of numerous thin layers of paint, often in transparent glazes. To create a smooth surface, improve transparency where necessary, and facilitate drying, academic painters added complex painting mediums to their paint. These mediums usually included various oils, resins, driers, wax, gums, and other ingredients. All of these materials were implicated in causing premature cracking and paint shrinkage.

Traditional pigments were also a weak link. Bitumen, asphaltum, and Cassel earth (also known as Van Dyke brown) could all cause paint disfigurement. These dark brown resinous paints never dry and harden, but were widely



Sir David Wilkie, *Christopher Columbus in the Convent of la Rabida Explaining His Intended Voyage* (detail), 1834, oil on canvas, 58 1/2 x 74 1/2 in., Gift of Hirschi & Adler Galleries

used to create the warm dark tones in many 18<sup>th</sup> and 19<sup>th</sup> century paintings. This use of poor materials and techniques built problems into the paintings, what art conservators call *inherent vice*. The resulting cracks are clearly illustrated in this detail of the NCMA's painting *Christopher Columbus in the Convent of La Rabida Explaining His Intended Voyage* of 1834 (above). Wide ugly cracks developed quickly, quite independent of the typical cracking caused by aging. The impressionists responded to these problems by abandoning excessive layering and using very little extra

medium. They also stopped using bitumen as well as most other dark brown pigments. The impressionists were particularly concerned about any kind of unwanted discoloration of their lightly colored paintings, especially the yellowing associated with aging varnish. The academic painters routinely used varnish such as dammar and mastic in their paint, between paint layers, and as a final surface coating. This made a beautiful “licked” surface, but was also prone to turning yellow-brown over time (which often blended in nicely with their bitumen paints). The impressionists rarely added varnish to their paint and generally avoided applying a final varnish. Some, like Pissarro, actually wrote on the back of their paintings “Please do not varnish this picture, C. Pissarro.” This directive was necessary because impressionist paintings were often varnished by dealers who hoped the addition of this “academic” material would help to make a sale to more conservative clients. Monet’s agent Durand-Ruel reportedly told him, “Collectors find your canvases too plastery: to sell them, I am obliged to varnish them with bitumen.”

## Analyzing Monet’s Pigments

*“In short I use flake white, cadmium yellow, vermilion, red lake deep, cobalt blue, viridian green, and that’s all.”*

—Claude Monet, about 1905

The exhibition *Revolution in Paint* is based on a simple premise: a radical change in artist’s pigments during the 19th century enabled a revolution in painting. A different palette of paint made it physically possible for the impressionists to construct paintings differently from their predecessors. To make this distinction it’s extremely important to know who was using what pigments and when.

Monet’s blunt statement above doesn’t appear to leave any doubt as to his choice of pigments. It would seem that he’s made our research very easy. But can we take Monet’s words at face value? Does it tell the whole story of the impressionist’s revolutionary painting? If only it were so simple.

A quick look at Monet’s statement shows how misleading it can be. Monet and the impres-

sionists burst onto the scene in 1874. Is Monet saying these are the pigments he used in the early 1870s, or is this what he was using in 1905? Did he use the same pigments for every painting during this 30-year period? The term *red lake deep* couldn’t be more ambiguous. A red lake is a dark red wine-colored pigment. It could be made from rose madder root or cochineal beetles, both of which had been used for hundreds of years, part of the traditional palette. Or it could be a modern synthetic such as mauveine or alizarin crimson, both invented in the middle of the 19<sup>th</sup> century. In fact there were as many as 22 variations of red lake available in the late 19<sup>th</sup> century. To make things even more confusing, artists didn’t necessarily know what they were using. Labels often didn’t accurately describe the ingredients of a paint tube. What do you suppose the pigment would be in *geranium lake*—geraniums? As you can see, knowing exactly which pigments the impressionists used to make their revolutionary paintings turns out to be quite complicated.

*Revolution in Paint* was created as a focus exhibition to complement the Museum’s major exhibition *Monet in Normandy*. Naturally Monet was of particular interest during our research. A great deal has been written about Monet and his extraordinary use of color. The blues, the greens, the violets—his colors are all so vibrant. Legions have tried to duplicate his effects. But to paraphrase an old saying, you can’t judge a paint by its color. Although some knowledge of pigment history and a good eye can narrow down the choices, you have to go much further to identify a pigment with any certainty. The information used to create *Revolution in Paint* came from many sources: direct quotes, artist’s notebooks, eyewitness accounts, colormen catalogs, and contemporary how-to books. But ultimately only modern scientific analysis can pinpoint the pigments on any individual painting.

One particularly good published study of Monet’s pigment choice is *Art in the Making: Impressionism*. The National Gallery of London’s conservation scientists analyzed many of their impressionist paintings in preparation for an exhibition in 1990. Their work shows that within just five Monet paintings 19 different pigments were used, far more than his state-

ment in 1905 suggested. These five paintings were executed between 1869 and 1879, bridging the date of impressionism’s birth and illustrating a striking change in Monet’s palette. Monet used some 13 pigments in *Bathers at La Grenouillère* of 1869, half of which are common to the traditional palette. The 1879 painting *Lavacourt under Snow* uses only eight pigments, all but one or two new to the 19th century, but even this painting’s pigments are different from Monet’s 1905 list.

The National Gallery’s results inspired us to analyze one of our own Monet paintings at the North Carolina Museum of Art, to see how it might compare. Our experience in studying the pigments in the painting *The Cliff, Étretat, Sunset* serves to show the difficulty of such an undertaking. First of all, scientific analysis is expensive. Conservation scientists charge as much as \$500 to \$1,000 to investigate one small paint sample. A full study of the painting would have cost half of the *Revolution in Paint* exhibition budget, which wasn’t an option. Fortunately the analysis was undertaken by three gentlemen who generously donated their time, expertise, and the use of their analytical



Dr. Peter Bush, James Hamm, Dr. Gregory D. Smith, who donated their time and expertise to our Monet pigment analysis.

equipment, greatly reducing the cost of this undertaking: Dr. Peter Bush, Director of the South Campus Instrumentation Center of the State University of New York at Buffalo; James Hamm, Professor of Painting Conservation at Buffalo State College; and Dr. Gregory D. Smith, Andrew W. Mellon Professor of Conservation Science at Buffalo State College. The project was coordinated by Erin Kelly, conservation intern at the NCMA from Buffalo State College, who also compiled and helped interpret the data.

Our analysis required that samples be taken

from the painting. Extremely small specks of paint, smaller than pinheads, were taken from the outside edges of *The Cliff, Étretat, Sunset*. The samples were mounted to clearly show the layers of paint, including the white ground layer.



Claude Monet, *The Cliff, Étretat, Sunset*, 1882-83, oil on canvas, 23 3/8 x 32 3/4 in., Purchased with funds from the State of North Carolina

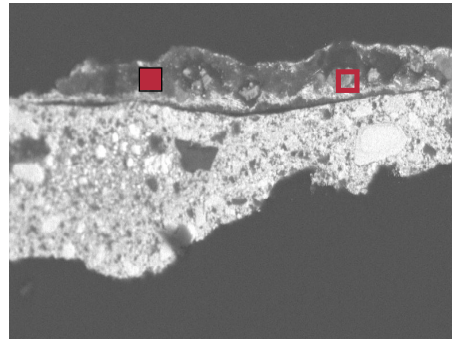
■ Blue paint sample site, not to scale

The cross-sections were then examined with a scanning electron microscope (SEM), which helps to distinguish between individual pigment particles. The shape and size of particles can help to identify pigments, but is not definitive. SEM imaging is necessary to map the sample in preparation for energy-dispersive x-ray spectroscopy analysis (EDX), which can identify elements within small groups of particles. The presence of a particular element can be very strong evidence of certain pigments. The image to the right shows the EDX spectrum of site BA5 within the larger cross-section of the blue paint sample below. Peaks in the spectrum shows that silicon (Si) and aluminum (Al) are present, suggesting the presence of ultramarine blue pigment. The same spectrum shows the presence of lead (Pb), probably from the mixture of lead white paint into the blue, a common impressionist technique. But to complicate matters, site BA4, a hair's breadth away in the same paint stroke, contains cobalt and zinc, elements common to cobalt green, as well as manganese, which suggests the use of manganese violet. With the naked eye, one sees only a blue paint stroke. But the analysis suggests that Monet actually mixed white, blue, green, and possibly violet pigments to create what looks like a simple blue color.

We can also see with the naked eye that Monet used yellow in painting *The Cliff, Étretat, Sunset*. Unfortunately, SEM-EDX analysis of yellow paint samples did not identify an unusual

element associated with a yellow pigment: no chrome for chrome yellow, no cobalt for aureolin, and no cadmium for cadmium yellow. This illustrates another difficulty in pigment analysis: no one test can reliably identify all possible pigments.

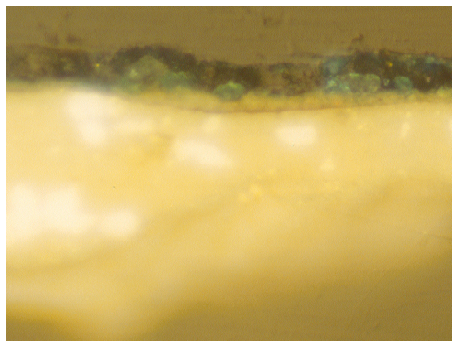
SEM-EDX is an excellent tool for identifying inorganic pigments that contain a rare or individualistic group of elements. We were able to identify lead white, vermilion, cobalt blue, ultramarine blue, Scheele's or emerald green,



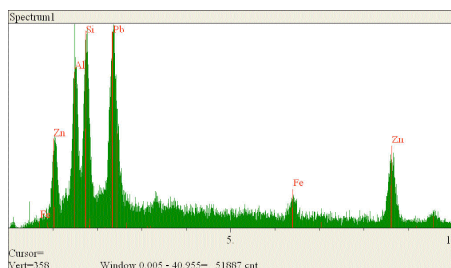
SEM image of blue paint sample.

■ BA5 EDX sample site

□ BA4 EDX sample site



Blue paint sample at approximately 200x magnification.



EDX spectrum for sample BA5

and possibly manganese violet. But what if a pigment is composed of common elements found in nearly every pigment: carbon, hydrogen, and oxygen? This is the case with organic pigments. Organic pigments of many different colors were historically derived from animal and plant sources, but were also first artificially synthesized in 19<sup>th</sup> century chemistry labs. Monet's yellow in *The Cliff, Étretat, Sunset* is most likely an organic pigment, but which one? There were many different organic yellows in use at the time, both traditional and new.

Identification of Monet's yellow, as well as the organic red lakes mentioned earlier, would require a battery of tests using different equipment. Unfortunately this was beyond the scope of our project and resources. Publishable results, such as the National Gallery's, in fact require numerous types of testing. Positive identification by one type of analysis is usually confirmed by a second type of analysis to be certain of the result. Ultimately, the exact identification of pigments for any one painting requires a great deal of equipment, expertise, time, and financial resources.

Even when all the necessary resources come together, mysteries remain. There are numerous complicating factors that interfere with even the best analysis. Is the painting actually by the artist? Fakes, forgeries, and misattributions are common with works of art. Does the paint sample really represent the artist's work? During the long life of a work of art, the original materials can become adulterated by the aging process or restoration, or even reworked by the artist at a later date. In some cases our technology falls short. Distinguishing between the many red lakes is particularly difficult. This leads us back to Monet's 1905 statement. The positive identification of an artist's materials doesn't stand on any one piece of evidence. While scientific analysis appears to throw some doubt on Monet's own words, it's only the combination of all available evidence— anecdotal, analytical, or otherwise—that can bring us closest to the truth.

## Works of art and historic objects in the *Revolution in Paint* exhibition:

Bidauld, Jean-Joseph-Xavier  
French, 1758–1846

*Classical Landscape*

about 1810

Oil on canvas

Collection of Lynne and Mark Hammerschlag

Boudin, Eugène

French, 1824–1898

*Trouville, The Jetties, High Tide*

1876

Oil on canvas

Gift of North Carolina National Bank, 1967  
(67.12.1)

Bouguereau, Adolphe-William

French, 1825–1905

*L'Art et La Littérature*

1867

Oil on canvas

Arnot Art Museum, Museum Purchase, 1977

Bouguereau, Adolphe-William

French, 1825–1905

*Venus with Doves*

about 1879

Oil on canvas

Ackland Art Museum, University of North Carolina at Chapel Hill, Ackland Fund, 77.3.1

Cogniet, Léon

French, 1794–1880

*Male Nude from the Back*

September 25, 1812

Black and white chalk on blue paper

Ackland Art Museum, University of North Carolina at Chapel Hill, Ackland Fund, 86.4

Delacroix, Eugène

French, 1798–1863

*Knight on Horse*

about 1850s

Oil on panel

Collection of Lynne and Mark Hammerschlag

Isabey, Eugène

French, 1803–1886

*Seaside Cliffs*

about 1850-1860

Oil on panel

Collection of Lynne and Mark Hammerschlag

Lefebvre, Jules Joseph

French, 1836–1911

*Une Japonaise (The Language of the Fan)*

1882

Oil on canvas

Gift of Walter P. Chrysler Jr.

Chrysler Museum of Art, Norfolk, Va.,

Gift of Walter P. Chrysler Jr. (71.2058)

Millet, Jean-François

French, 1814–1875

*Peasant Spreading Manure*

1854-1855

Oil on canvas

Purchased with funds from the North Carolina Art Society (Robert F. Phifer Bequest), 1952  
(52.9.128)

*Paint Bladder*

Early 19th century

Harvard Art Museums

*Paint Tube*

Late 19th century

Chrysler Museum of Art, Norfolk, Va., Gift of Edith Ballinger Price

Peyron, Pierre

French, 1744–1814

*The Death of Alcestis*

1794

Oil on canvas

Purchased with funds from gifts by Mr. and Mrs. Jack L. Linsky, Mrs. George Khuner, Cornelius Vanderbilt Whitney, anonymous gift, Lady Marcia Cunliffe-Owen, William Walker Hines, Mrs. Alfred Elliott Dieterich, by exchange, 1991 (91.1)

Pissarro, Camille

French, 1830–1903

*The Saint-Sever Bridge, Rouen: Mist*

1896

Oil on canvas

Gift of Wachovia Bank and Trust Company, N.A., 1967 (67.26.1)

Sisley, Alfred

French, 1839–1899

*Apple Trees in Flower*

1880

Oil on canvas

Gift of Walter P. Chrysler Jr.

Chrysler Museum of Art, Norfolk, Va.,

Gift of Walter P. Chrysler Jr. (77.412)

Vernet, Émile-Jean-Horace

French, 1789–1863

*The Race of the Riderless Horses*

about 1820

Oil on canvas

Purchased with funds given by Mr. and Mrs. Warner L. Atkins, 1984 (84.3)

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