

Forensics and Microscopy in Authenticating Works of Art

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Fingerprints have been used around the world for identifying individuals since 1908. The availability of such evidence on works of art has been overlooked until the authentication of a Turner canvas in 1985. Since that case, a new methodology has been developed and the new discipline of forensic authentication was born. More recently, the concept of fingerprinting encompasses not only the marks left behind by our fingers but also the materials and working methods, widening the available ways to identify an artist. This innovative forensic approach has helped resolve equivocation and identify numerous important works of art as well as opening up a new field of research in art.

About 20 years ago, a client walked into our Montreal conservation laboratory with a large canvas he wanted cleaned and restored. On first glance the painting seemed heavily overpainted and recently so. The client shook his head at the estimate for cleaning it, and said that it was not worth the cost as it was a wreck anyway. He asked whether our company would buy the painting - to which he was told "No, what for?" He insisted, suggesting that we clean half of it and

hang it as a demonstration. We gave in and a deal was struck. Some months later, a small area of the painting was tested to see how it behaved. After removing a small area of overpainting on the sky we were awestruck at the beauty of the original surface coming to light. Excitement grew and considerable effort was put into removing the heavy coat of paint hiding the original surface. It did not take long to realise that it was a great work by a master, a master yet to be identified ...



Fig 1. J.M.W. Turner: *Landscape with Rainbow*, oil on canvas, 36x54 inches. Before cleaning. Private collection.

The Problem and the Solution

It was soon recognised that the most likely candidate was the celebrated British painter J.M.W. Turner. Over the years that followed every conventional route was tried to gain acceptance and recognition for the painting. Every effort failed. Nobody would take a risk on what they admitted was a 'good Turner-esque work'. Then, in the mid 1980s, during a London visit to the Tate Gallery, I noticed that Turner used his fingertips to model paint on one of his well known works: the *Chichester Canal*¹ (Figure 3). In a sudden eureka moment, recalling having seen fingerprints on the painting in the same context



Fig 3. J.M.W. Turner: *Chichester Canal*, oil on canvas, 25 $\frac{1}{4}$ x 53 inches, Tate Britain, London, N00560. The group of trees on the left preserve many clear fingerprints as the fingertip was used to apply and model paint.

around the foliage of a tree, the Tate's conservation lab was contacted and asked if they had close-up photos of the painting. They happened to have good photos that clearly

showed the fingerprints. The requested copies arrived in Montreal soon after and upon first inspection I realised that one fingerprint on the suspected Turner matched a fingerprint on the *Chichester Canal* painting. A

quick call to the Montreal

headquarters of the Royal Canadian Mounted Police (RCMP) and one of their top experts gave a 'thumbs up' on the comparison (Figures 4 and 5).

But what next? Nobody would pay much attention

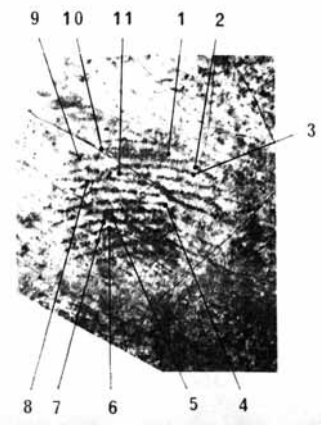


Fig 4. The fingerprint form *Landscape with Rainbow* showing the identifiable characteristics



Fig 2. J.M.W. Turner: *Landscape with Rainbow*, oil on canvas, 36x54 inches. After cleaning and removal of heavy overpainting. The tree on the left was painted in part with the fingertip preserving several clear fingerprints. Private collection.

to the picture, so what is this kind of evidence worth? I reasoned that if such verification is good enough to sentence a criminal² it also should stand

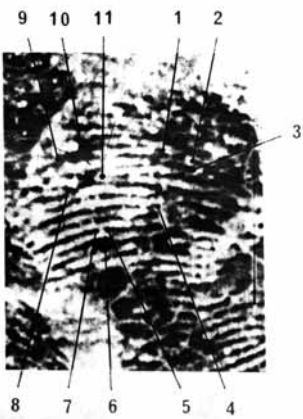


Fig5. The fingerprint from Chichester Canal showing the identifiable characteristics. From a photograph by Tate Photography.

up in a non-criminal investigation such as an attempt to authenticate a painting. Fortunately one Turner scholar, Dr. David Hill, University of Leeds, took notice. His position was that the painting on visual evaluation was an acceptable candidate and if the fingerprint match could be confirmed through another expert, then it would be strong evidence indeed³. He called in John Manners, a top forensic expert from West Yorkshire Police⁴ in the UK, had the painting examined and then had him

examine the comparison print at the Tate. His verdict: the finger that touched and modelled paint on the Tate painting was the same finger that touched the suspected Turner. For the sake of due diligence, we requested that Dr Nicholas Eastaugh in London⁵, examine and compare pigment samples

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and cross sections of the suspected painting, then called "Landscape with Rainbow"⁶. His conclusions were read by Dr Joyce Townsend⁷. The result: both materials and painting methods were highly comparable. With all that evidence combined, the

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painting sold for an honest price at public auction in London⁸.

This was the first success and the beginning of my efforts to develop a methodology that could be applied to other such cases. But how does one start? As far as I knew, this was the first ever use of fingerprints to authenticate a work of art. It made the world media and was front page in many major papers⁹.

Over the years, I studied fingerprint identification and had a wonderful instructor from the RCMP, Staff Sergeant Andre Turcotte, who for 15 years supervised identification work done in the province of Quebec. But, working with fingerprints is a complex matter; much interdisciplinary experience was needed, learned and implemented. By the late 1990s the family-run laboratory closed with my father's retirement and I set out to establish an independent laboratory dedicated entirely to forensic authentication work and related research.

Concept and Methodology

Since any sound assessment of a work of art logically has to rest on identifying what the item actually is, the need to explore all possible clues is basic. Scientific, forensic, historic, stylistic and aesthetic investigations are all integral parts of that process. My approach focuses on methods to authenticate works of art using forensic analysis as art objects often bear physical contact marks left by the artist. Such crucial evidence often goes unnoticed but when present, it can be decisive in

clarifying questions about authorship and dating. The intentional or even accidental use of the hands and fingers in creating a work of art provides the perfect opportunity for using fingerprint identification in naming the artist. The value of fingerprint evidence is extremely high as the probability of the existence of two identical finger impressions from different individuals is nil and no such occurrence has ever been noticed at any time. The science of fingerprint identification is based on that accepted fact and has been relied on since the beginning of the twentieth century worldwide. The unique character of ridges on one's hands has been recognised for thousands of years. The study of ancient pottery for example reveals the utilization of fingerprint impressions left in the clay as a maker's mark and in prehistoric times we find examples of hand prints in cave painting. It was only as recent as 1858 that Sir William Herschel established the use of fingerprints for identification. In 1888, Sir Francis Galton undertook to refine and formulate Herschel's observations. Identification by fingerprint was first adopted in England in 1905 and received general acceptance worldwide in 1908.

My approach rests on strict considerations and rigorous methodology:

- Only prints that are the result of the original creative process are admitted for consideration. These can be impressions left in the paint layer while it was still wet or prints left by the use of a fingertip to model paint or a palm print resulting from applying varnish by hand.
- The reference samples should ideally come from unquestioned works of art with good provenance.

- The conservation histories of the reference works have to be considered to rule out restorers' contributions. Spurious contributors must be eliminated such as assistants who may have touched the painting while still wet.
- Evidence collection, examination and comparison work is based on accepted practice.

Work routinely begins with infrared and ultraviolet imaging, polarised light microscopy (PLM) examination of the pigments, and visual search for forensic evidence such as fingerprints, hair and fibres. These initial and concurrent examinations then form the starting point for the next steps in the investigation. Once basic information is available more specific examinations are carried out to characterise substances as clearly as possible. Most recently, in order to better structure my investigations I adopted the use of an innovative database program called *Lazurite*[®] designed by Dr. Nicholas Eastaugh. Lazurite has now become part of my research and authentication methodology as the program, contrary to other databases, encourages and enforces data structures that are clear, accessible and highly assessable besides being a transparent collaborative instrument in this field.

Microscopy

The evaluation of fingerprints, hair and fibre samples from paintings would be unimaginable without the microscope. With the appropriate instrument, determinations can be made quickly. An example would be a faint fingerprint: is it a plastic or a stamped impression, what substances form it and are those substances integral or foreign to the rest of the painting? Hair samples can also be readily identified as can synthetic substances; the latter in turn can be further characterised using fourier transform infra red spectroscopy (FTIR). All these material aspects form a foundation for questions that need to be asked when determining authorship and dating.

Fingerprints on works of art – more common than recognised

Some artists used the fingertip to soften the marks left by the brush¹¹ by gently tapping or stroking the still-wet surface. In some instances, the fingertip was used for literally 'stamping' the fine network of ridges onto the painting (see Figure 6). This was done after some suitable colour was picked up from the palette. Artists often varnished their own paintings as they were not likely to leave such an important task to assistants thus creating yet another opportunity to leave identifiable marks behind. In the sixteenth century, for example, various oils have been used for varnish. The varnish was spread over the painting and meticulously rubbed into the surface by hand. The contacting



Fig 6. Workshop of Raphael (Perino del Vaga, 1500-1547): detail showing a fine network of fingerprint impressions creating a delicate shading along the edge of the Madonna's face.

Comparison paintings have to be examined up close with a magnifying glass, proper illumination and a stereo microscope.

surface of the hand was usually the palm and the edge of the palm (Figure 7). One example of entire preserved hand prints is found in the Vatican Stanze on Raphael's *School of Athens* fresco. It appears that while working on the fresh surface, the artist and/or assistants negotiating the planks on the scaffolding braced themselves against the wall for balance (see Figure 8).

One of the most striking examples indicating just how frequently fingerprints may be found when methodically searching for them has turned up during my research on Turner's fingerprints. With the kind assistance of the Tate Britain, London, I have examined over 3000 works on paper in the



Fig 8. Raphael: Schools of Athens, fresco, Vatican, detail showing two palm prints left in the still fresh plaster. It is speculated that one the numerous handprints preserved in the fresco is Raphael's.

Turner Bequest. This search yielded over 1000 partial and some full fingerprint impressions.

When usable prints are found on the work of art under investigation, an acceptable speculation for an attribution is attempted.



Fig 7. Perino del Vaga: 'Saint Erasmus polyptych,' Genoa. Detail of the large altarpiece shows the impression of a palm in the painted surface.



Fig 9. Pablo Ruiz Picasso: plaster cast of the artist's right hand, Picasso Museum, Paris.

To test the attribution, reference material is needed. Visits to museums and collections may be required and the comparison paintings have to be examined up close with a magnifying glass, proper illumination and a stereo microscope. Eventually, if usable prints are found, they are photographed employing accepted practice. Comparisons can then be made. If a match is found, the attribution can be confirmed under some caveats.

Strict logic is essential in estimating the value of a match. The possibility of a hand other than the artist has to be considered and investigated. Historical evidence may be essential in this regard and further reference prints may be needed for confirmation. Correct reasoning should consider the possibility of assistants being present and contributing at different dates and possibly different locations. An example would be a fingerprint from a Raphael panel painted in Florence and another from his Roman period. In Florence he worked alone, in Rome he employed a small army. If a match were found in both references, it would strongly suggest that the contributor of the evidence was Raphael. When other such matches are found, the probability increases further.

In some cases exact identification can be possible because the artist has left behind explicit information. Pablo Picasso, for example, has made plaster casts of his hands preserving clear fingerprint information that can be utilized for comparison (see Figure 9).

Another interesting prospect may occur when two sets of prints are compared from two attributions to the same yet-to-be identified artist. If the possibility of two contributors having the same print is nil, then the two paintings can mutually and reciprocally confirm the authorship of the other - whoever the artist may be. When such forensic techniques are accepted and adopted by the art community, many new attributions may be formed, old ones changed and doubtful ones may be resolved.

Dating with fingerprints

Fingerprint evidence can establish dating when no other scientific technique may help. An example is a match established between a fingerprint on a painting that has been argued to be from the 19th century and a fingerprint from a 16th century painting, an altarpiece, whose authorship and dating has never been questioned. The comparison piece

When such forensic techniques are accepted and adopted by the art community, many new attributions may be formed, old ones changed and doubtful ones may be resolved.

has, indeed, hung in the same city for almost 500 years. Radiocarbon dating confirmed the sixteenth century date for the disputed panel; while some sceptical experts sat on the fence claiming that an old piece of wood could have been used for it. Eventually, the fingerprint match proved the radiocarbon results correct and calmed the sceptics (Figures 10, 11 and 12).



Fig 10. Workshop of Raphael (Perino del Vaga): Madonna della Sedia, 87 cm dia., The yellow circle marks the position of the fingerprint that was matched to another fingerprint on another work by Perino in Genoa.

Fingerprints can also record events. Such is the case with injuries that heal over time. Examples of such fingerprints exist and this already opens the door to dating a work of art by examining the healing process, establishing the probable nature of the injury from which a time scale can be inferred.



Fig 11. Perino del Vaga: Saint Erasmus polyptych, tempera on panel, Genoa, the yellow circle indicates the location of the fingerprints which match the fingerprint from the Perino del Vaga panel in figure 10.

Such 'time markers' can provide valuable clues. A good example is a large Turner attribution now under investigation (Figure 13).

Working with Evidence

Both evidence and reference samples are often partial. On an artwork, damage may have been sustained by abrasion or by previous cleanings. The print may be found on top of disruptive or interfering background such as roughly textured canvas or brushstrokes – both analogous to background noise. The photographic process, which is often the first step,

should be planned to make the most of the sample. If, for example, the print is a plastic impression, it would show in relief and raking-light illumination will often enhance such details.

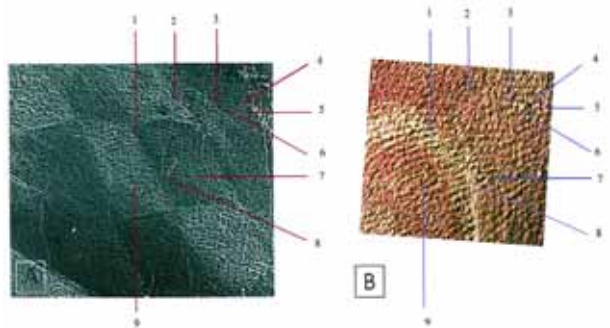


Fig 12. Comparison of the two fingerprints from the paintings in figures 10 and 11. On the left marked A: Madonna della Sedia. On the right B: Saint Erasmus polyptych.

Digital image enhancement is a relatively new tool used to render hard-to-see or hard-to-evaluate fingerprints. One of the principal problems in investigating paintings is that certain aspects of them, in whole or in part, evade visual detection for one reason or another. In fact, most of what we know about any painting is simply because of how it appears to the naked eye. My approach is to



Fig 13. J. M. W. Turner (under study): View of Carthage, oil on canvas, 35x53 inches. Private collection, USA. The massively overpainted picture during cleaning. The small dark square is an uncleaned area showing dark and heavy varnish. Above the boat the thickness of the overpainting is quite visible showing a clear differentiation with the right side already cleaned. A fingerprint left in wet paint was discovered on one of the columns on the right.

examine art in another 'light' through digital image enhancement - a view that exists beyond what the human eye and brain are capable of processing. Science and technology have become an important part of the way we relate to art and in this particular instance of authenticating paintings the reliance on demonstrable evidence and on transparent methodologies will only increase.

Materials 'fingerprinting'

It has to be pointed out however, that fingerprints are not the only possible methods of 'fingerprinting' a work of art. The word 'fingerprinting' is used often to mean that a match can be made to something else such as in genetic fingerprinting which has nothing to do with ridges and bifurcations from a finger and have everything to do with DNA analysis. I am currently engaged in testing for the first time whether several new Jackson Pollock candidates (already having fingerprint matches) that were found to have human hair embedded in the paint layers can be matched to hair samples from Pollock's studio. These comparison hairs were also found embedded in paint on the floor. Here again,

microscopy was the first step in establishing the origin of the hair samples – human or animal (Figures 14 - 17).

Since hair contains little DNA, a technique called



Fig 14. Jackson Pollock: Untitled, oil on canvas, 81x 51 inches. Private collection, USA. The painting preserves a fingerprint matching one on a paint can used by Pollock. The paint can has been preserved by the Pollock-Krasner House and Study Center, Long Island, New York. This painting also preserves several strands of human hair found embedded in the paint layer.



Fig 15. Jackson Pollock: as in figure 14, detail showing a strand of hair partially buried in paint.

As some artists were very particular in their choice of paint and medium, such a choice can be interpreted as fingerprint



Fig 16. Jackson Pollock: Untitled, mixed media, detail, Private collection, USA. This is another example of a Pollock drip painting identified with matching fingerprints. The image shows the process of removing the partially embedded hair from the painted surface. The hair is supported on the sticky side of a small label for protection during the removal.



Fig 17. Jackson Pollock's studio floor, detail, Pollock-Krasner House and Study Center, Long Island, New York. The detail photo shows a partially buried hair in the black paint deposit. The specimen was removed for later DNA analysis.

mitochondrial DNA analysis is being used. At first, we will not know if these hair samples are definitely Jackson Pollock's but if a match is found, taken together with the fingerprints, they add to the accumulation of evidence. As a further step, a surviving relative could be found and asked to provide a DNA sample and that might lead to a positive identification.

Another area that is a crucial field of research in authentication is pigment analysis. Many new techniques are available to help identify paint

substances and media but what is often of great interest is the tell-tale presence of some additive, contamination or manufacturing pattern. As some artists were very particular in their choice of paint and medium, such a choice can be interpreted as fingerprint. Currently, I am working with Dr.



Fig 18. Jackson Pollock: Untitled 1948, oil on canvas, 66 x 47 5/8 inches. Private collection, USA. The painting preserves a fingerprint matching one on a paint can used by Pollock. The reference fingerprint was found on a paint can preserved by the Pollock-Krasner House and Study Center, Long Island, New York.

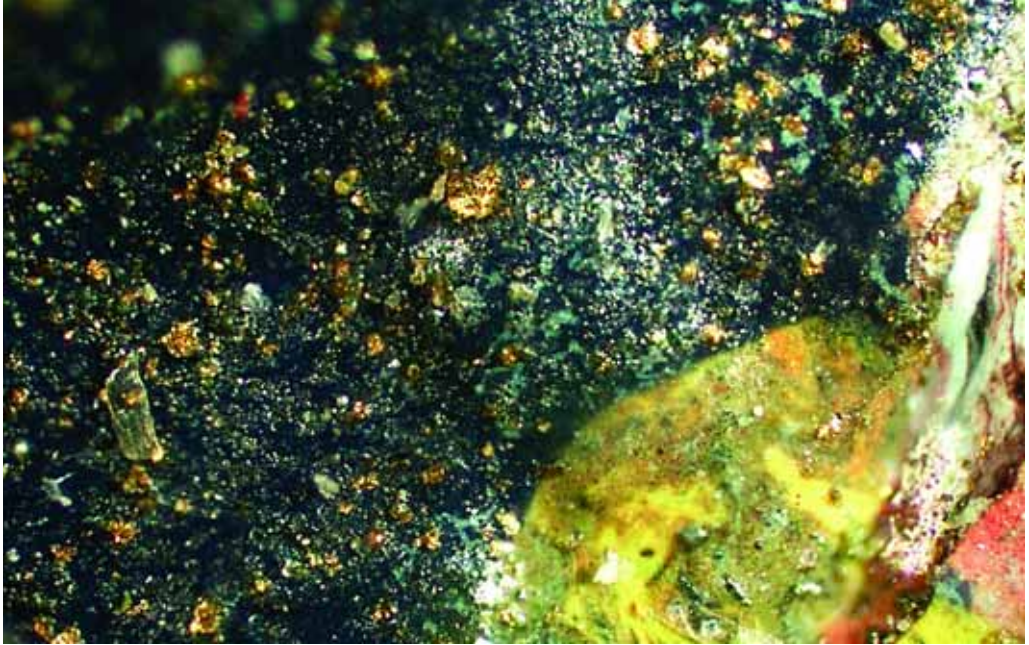


Fig 19. Jackson Pollock: as in figure 18, detail, photomicrograph, 100X showing small flakes of gold adhering to the surface.

Nicholas Eastaugh of the Pigmentum Project, in collecting and analysing data on Pollock's paint materials to establish a 'baseline' for what physically and chemically could be considered a Pollock. Though Pollock used commercially available and common materials it appears he has manipulated them to work the way he wanted them to and the possibility exists that such manipulation may be diagnostic and possibly even fingerprint. The central analytical instrumentation of the project is of course the microscope. Another example of microscopic analysis involves searching for contaminants that may be characteristic of an environment. In the case of the much-publicised Jackson Pollock found by Teri Horton¹², I identified microscopic particles of gold paint (probably from an atomizer) on her painting (Figures 18, 19 and 20).

In my microscopic investigations of some samples from the Pollock studio floor I also found microscopic particles of gold paint with the same characteristics. This is not direct proof by itself but a part of the puzzle nevertheless, adding to the

accumulation of evidence. This brings me to stress the need to evaluate all evidence and always within its own context when pursuing an authentication. I cannot conceive of an 'authentication' being complete when basic questions have not yet been asked. My emphasis is to allow the painting to speak for itself and not impose bias on it. For an authentication to be clear, there must be specific and supportable explanations as to why a work is connected to a particular artist. My view is that if the painting is correct then all or at least most of its characteristics also have to be correct when

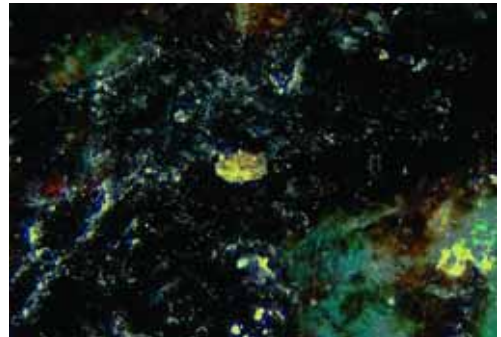


Fig 20. Jackson Pollock's studio floor, detail, Pollock-Krasner House and Study Center, Long Island, New York. The detail photo shows a portion of a match stick found partially embedded in paint on the floor also preserving particles of gold. Magnification 100X.

Provenance is important – but not all important.

viewed against the body of work left behind by the artist in question. That of course includes determination of age and materials used.

If forensic evidence is present such as fingerprints, then every effort is made to document and to compare. If no comparison exists, then a search is made amongst the suspected artist's undisputed works. If there is no such evidence or a search does not provide comparisons, then we turn to investigating the full physical and chemical make-up of the painting to serve as *fingerprint*. A host of techniques is available in that arsenal, many of which are readily available in modern museum conservation labs or in some private consulting labs. Among the most important techniques are the various methods of imaging from x-ray to ultraviolet, to visible light, to infrared. These can provide some of the most basic clues that can then be followed through microscopy – a field of incredible diversity of techniques involving elemental and molecular analyses which permit the detection of substances to part per million levels and provide information about the organic constituents of paint etc.

The Traditional Approach

There is of course the 'provenance' element that needs an audit if it is to be any more than a narrative. This has been and still is the mainstay of authentication in much of the academic and the commercial domains of the art world. Its inadequacy, when relied upon as the sole resource, is exemplified by many spectacular subterfuges¹³

demonstrating how mischief is successfully perpetrated when the potential for windfall exists. It proves that provenance is important – but clearly not all important. The reality is that so many major masterpieces hanging in museums have little provenance, partially verified provenance, or even have huge gaps in them. A good example is the group of Leonardo works on paper in the Royal Collection, whose history is sketchy at best yet who would say they should be marginalized on that basis alone.

Forensic Authentication

Hence, this is why I developed what I call forensic authentication, which to me means: ask all questions reasonable about every aspect of the work of art, lay out a line of attack that is appropriate to the context and follow through to the end with every means possible. Certainly, we may not be able to answer every question but when I look back and consider where these paintings would be today without this journey, I am certain the merits are apparent. And, were it not for microscopy a host of questions would not have arisen and consequent answers would never have been obtainable. Forensic authentication methodology by no means seeks to replace traditional connoisseurship; rather it aims to bring it into the realm of the scientific method so that all evidence is weighed in the course of objective due process.



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In 1984, art conservator Peter Paul Biro was first to take advantage of human contact marks on a painting for identification, when he was successful in authenticating a J.M.W. Turner canvas having matched fingerprints left on it by the artist. The case, the first of its kind, brought him worldwide acclaim.

Since then, Paul has specialised in solving some of the most challenging authentication cases, while building the first ever database of artist's fingerprints. His methods have been requested by the FBI and various universities. He has performed forensic examinations of paintings in museums and collections around the world. Paul has published in journals including *Mankind Quarterly* and *Antiquity*.

Under preparation is a first ever manual on forensic examination of works art.

He is presently completing his cataloging of J.M.W. Turner's fingerprints in the Turner Bequest, Tate Britain, London. Paul has given talks at Harvard University, the University of Toronto, and more recently for The American Appraisers Association in New York, and the Royal Microscopical Society. He has given interviews for major newspapers; including *The Guardian*, *The Observer*, *L.A. Times*, *The Age* (Australia), *Globe and Mail*, (Canada). He has appeared on prime time television, discussing his work on the BBC, CNN, CBC, and NBC. Paul's discoveries are the focus of a soon to be released feature length documentary produced by New Line Cinema and Harry Moses (long time Producer of CBS 60 Minutes) entitled 'Finding Jackson Pollock'. Most recently, Paul has joined forces with the Pigmentum Project, Oxford University, bringing about the convergence of scientific and forensic methodologies in authentication, while unifying currently disjointed disciplines.

¹ N00560, Martin Butlin & Evelyn Joll, *The Paintings of J. M. W. Turner*, Yale University Press, New Haven and London, 1984, ISBN 0-300-03276-5, Plates, page 287.

² Identification by fingerprint was first adopted in England in 1905. It received general acceptance worldwide in 1908 and has been used ever since in both civil and criminal proceedings.

³ Dr. Hill reported his findings in *Turner Society News*, vol. 66, in March 1994.

⁴ *Journal of the Fingerprint Society of Great Britain*, 1994.

⁵ The Pigmentum Project, www.pigmentum.org.

⁶ For more information see: <http://www.birofineartrestoration.com/turner.htm>.

⁷ Dr. Joyce H. Townsend, *Turner's Painting Techniques* Tate Publishing (2004). ISBN 1854375784.

⁸ Phillips International Auctioneers and Valuers, *Early British and Victorian Paintings*, December 1995, lot 46.

⁹ A listing of some of these articles are available at: www.birofineartrestoration.com/in_the_news.htm.

¹⁰ Further information may be found at: www.pigmentum.org/lazurite/

¹¹ Fingerprints used in this context may be found on works by Raphael among others. I documented such occurrences at the National Gallery, London, in 1997-98 on two Raphael paintings in their collection, personal discussions and correspondence with Dr. Nicholas Penny. The NGL later made mention of his fingerprints in 2004 in the *National Gallery, Technical Bulletin*, Volume 25, 2004, page 11.

¹² The full study may be found at: www.birofineartrestoration.com/Pollock/Pollock.htm.

¹³ A good example is the case of John Myatt and John Drewe. Among the many publications of his exploits, a brief and concise account is available at www.museum-security.org/myatt-drewe.htm