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The Interaction of Scientific and Art Historical Investigations into Works of Art



The laboratory (www.artanalysis.eu) of **Laurette Thomas, Ilenia Cassan & Associates** specialises in the analysis of works of art, collaborating with researchers, curators, art historians, experts, and restorers. They are members of InCoRM, International Congress of Museums (ICOM), *Chambre Européenne des Experts d'Art* (CEEAA), *Associazione dei Storici dell'Arte Italiana* (AHA), and Icon Network. The laboratory takes part regularly in conferences, workshops, and international tutorials to maintain standard analysis protocols at top international levels.



Every art historian's dream is to find a document – drawing, photograph, text, etc. – which identifies a work with an artist, its date, and its place of execution in an unequivocal manner. Unfortunately, this event is as rare as suddenly finding a gold nugget in one's pocket.

So the art historian is forced to become a detective, looking for clues that will shed light onto a work or a group of works. As an artist lived in a particular place, at a particular time, was surrounded by other creators such as writers and composers, may have been interested in mythology or science from which creative ideas were drawn, the art historian must retrace all these steps that lead to the work and to its *creative content*. It is often more like wandering in a labyrinth searching for corridors that lead somewhere, and this means to the ideas and creative practice of which the work is made, and to the place of the work in a cultural and time setting.

The scientific expert has a clearer path but not necessarily an easier job.

The scientific path is marked out by the *material* aspects of the object being examined. In the case of paintings, these material aspects are the paint surface and undersurfaces, the pigments, varnishes, etc., the brushwork, the canvas or other material support, whether and how it may have been treated, the stretcher and the nails or glues holding it together, whether it is keyed or not. Identification

of all these factors is what the scientist wants to know for they give information about time and place of execution and reveal aspects of an artist's style (as in the brushwork). Discovering a 20th century pigment in what looks like a 17th century painting, as happened in the forgeries of Vermeer, is part of the detective work of the scientist. (See, N. Eastaugh, "Authenticity and the Scientific Method", *Journal of InCoRM*, Vol. 1, No. 1.) Scientific findings are providing more and more information about the work of an artist or a group of artists and are becoming increasingly important to the art historian.

Thus art historians and scientists have the same aims: through the analysis of the work of art to discover how an artist created using the materials of pigments and brushwork (etc.) in order to transform creative ideas revealed in the style. The corollary is that inconsistencies are also picked up, helping art historian and scientist to detect forgeries or, perhaps, simply student work.

What Scientists Do, What Art Historians Do

Scientific experts – who are mainly chemists – investigate the *material* of the work of art. Art historians – who are historians specialised in art – investigate the

painterly and pictorial ideas in the work of art – the *style* – in order to identify a work with an artist in a specific time and place.

Scientific Tools and Methods

Scientific methods for analysing works of art have progressed by leaps and bounds over the last ten years alone. While it is true that some of these techniques have been in use since the 19th century, such as the X-ray, the technology



I. Cassan using an XRF (left). Denis Pitzalis (Scientific Researcher at the Cyprus Institute / Centre de Recherche et Restauration des Musées de France) using a video microscope (centre). Laurette Thomas taking a sample (right).

may have improved especially in relation to the invention and application of more recent instruments, such as Raman spectroscopy, or due simply to the ever-more sophistication of digital technologies. It is an on-going process.

This process, and progress, is due to the development of what is known as “non-destructive techniques”. These techniques are digital, computer based methods for in-depth analysis of pigments, layers, ground, brushwork, supports such as canvas or paper, stretcher, glues, labels and stamps, and so on. What was invisible to the eye is becoming increasingly visible, and its nature known, due to these techniques.

In this becoming visible and knowable, scientists are providing invaluable information to art historians.

Refined information about pigments and other materials found in paint layers is helping to place works within a general time frame. Especially important here is that more accurate dating of artists’ works can be based on patterns found in the use of certain pigments. The same may apply to brushwork and the laying in of paint as well.

Equally, anomalies and inconsistencies in works of

art can be detected using these non-destructive techniques. Ageing of binders found in pigments, called polymerisation, of paint layers, and so on can be detected with some of these techniques. Falsified ageing also becomes strikingly visible. (See E. Jägers, “Scientists Under Fire?”, *Journal of InCoRM*, Vol. 1, No. 1.)

These new non-destructive techniques, then, serve both the art historian in order to better understand an artist’s work, and the art world by detecting works that should not be attributed to a given painter.

Some Non-Destructive Techniques

■ **Raking Light Photography** captures the *general* characteristics and condition of a painting. The light is placed at a tangent to the surface so that it reveals the way the paint is applied, such as brushwork and textures, as well as the condition of the canvas itself such as tension, deformations, or damage.

■ **Macro-Photography** captures the *specific* characteristics and condition of a painting. This includes details of paint application, the laying in of the paint, brushwork, impasto, and so on. It allows for high-resolution magnification of areas selected for investigation using optical zoom and then digital zoom, revealing the painterly techniques that are individual to an artist.

■ **Infrared Reflectography (IR)** reveals what may exist underneath a paint surface including underdrawing, signatures and inscriptions, under painting, sequences of grounds, and so on. Infrared Reflectography also reveals the presence and nature of certain pigments due to their mineral or other content. In addition, restoration of surfaces shows up clearly.

■ **Ultraviolet Photography (UV)** reveals the presence and ageing of varnishes and overpaintings on the surface of a work, as well as being able to evaluate the state of conservation of a work.

■ **Radiography (X-Ray)** penetrates through the paint surfaces to reveal the structure of the various paint layers, and of restorations; it also reacts to the nature of chemical elements that are present. First used for the analysis of painting in 1896 following its discovery and use in medicine, Radiography has improved with digital technology.

■ **X-Ray Fluorescence (XRF)** is a hand-held instrument

which may also be fixed to a tripod. When the small aperture is placed directly over a given area of the paint surface, the atomic weight of the pigment is measured, thereby identifying it. It is thus another means for pigment identification without taking samples, and it reveals pigments used in restoration or those which are anachronistic, i.e., incompatible with what is meant to be the place and date of the painting.

■ **Raman Spectroscope** is an instrument used to detect pigments by reading from their reflected light. This decreases the need for the “destructive technique” of taking pigment samples from works of art, although this is practised where necessary.

■ **Spectrocolorimeter** measures colour by analysing the wavelength reflected off the paint layer. It detects physical nuances in the state of a colour making it possible, for example, to see a colour before and after restoration which the naked eye cannot detect. Use of the spectrocolorimeter is complementary to the chemical analysis of pigments.

Analysis

All these non-destructive techniques provide methods of analyses that are specific to the instrument, while the information derived may overlap with other findings. They are complementary, and may also add to the resulting information in a number of ways.

The scientific Expert combines correct application, thoroughness, and exactness of the methods that have been used to obtain reliable results. Thus can they pronounce on the pigments, binders, and other materials found in the work, following which they can assert that a work has a certain age. The scientific Expert does not attribute works to given artists as this is the task of *history*. At most, scientists may say that the pigments found in a work were used at a certain period and are compatible with those that have been found in other known works by a given artist. In addition, brushwork, underdrawings, manner of laying in the grounds, and so on may be said to be typical, or not, of the known work of a certain artist.

Art Historical Investigation into Style

The foundation of all art history lies in the identification of a work of art with a given artist. Apart from documents, the *artistic* means of accomplishing this is in discovering what is known as the *style* of an artist’s work. Style is made up of the

painterly content – the materials and how they are used – and the pictorial content – the images and their meaning. *

The painterly and the pictorial information may then be set in a context of changes and developments of an artist’s work leading to a history of his or her style. Style is the way we read, experience, and understand a work of art.

Kazimir Malevich moved from Cubism to Suprematism, so there is the analysis of his Cubist style, then of his shift from Cubism to his Suprematist style, followed by the analysis of his Suprematism. This process seeks to understand the causes and characteristics of painterly and pictorial ideas in each of the styles and as they change, their history.

As Malevich belonged to a group of artists who also practiced Cubism, there is the analysis of the Cubism that is particular to each of these painters’ works. These particular Cubist styles may then be assimilated into a more general analysis of what could be called, Russian Cubism.

Thus art historians look first at the *art*, then at its *history* in order to understand how an artist is expressing ideas (in the pictorial content) and the means used to convey them (in the painterly content).

It is true that the history of art – which really began in the 19th century – has had many approaches. It has been curious about the subject matter found in paintings (e.g., iconography or representations of historical events), the role of art in given social, political, economic contexts, the collecting of biographical information about artists, groups or styles – to name the more classical approaches. Even the history of the history of art has been the subject of several scholarly studies.

These approaches contribute important and necessary information but they always rely on basic assumptions about what art actually is, even when their purpose is to establish a context for these very works of art. What art “is”, in itself, is where art history begins, then, and this means to understand why a work of art looks like it does and what the ideas are that generated this “look”, or appearance, and are conveyed by it.

It is on the basis of style, then, that all approaches to art and its history are built and is where the true history of the art object, *as art*, is to be found. Thus understanding style is the first task of art history, and its method is the analysis of the nature of the painterly content and of the pictorial content and of how they interact.

■ The **pictorial content** of a work of art consists in what is seen, the pictures and their subject matter, together with all the symbolic, philosophic, geometric content. In a Renaissance painting the pictorial content may be a Madonna and Child, in a French 17th century painting it may be a

scene from Greek or Roman mythology, while in Dutch 17th century painting it may be a still life or a portrait, and in 19th century French and English painting it may be a landscape. In 20th century painting, pictorial content may be all manner of representation, from Surrealism to hyperrealism, or it may be planes of colours, from Piet Mondrian to Mark Rothko. In abstract painting, the pictorial content unites with the painterly content, the painterly content becoming the pictorial content.

■ The **painterly content** consists in the materials of painting and how they are used to create the pictures we see, the pictorial content.

With the materials of painting – pigments, textures, charcoal, etc. – the artist reveals forms and shapes (of human figures, clouds, or planes of colour). There are lines, or outlines, or there are swathes of pure colour. The colours originate with the pigments (and sometimes with other materials) which, in turn, can be applied in any number of ways. The surfaces may be smooth or rough, even grainy, the pigment applied in thin or thick layers, the brushwork being broad or pointed, short or long, heavy or light.

This painterly content is always an expressive means for the painting and so reveals the expressive content in both the painterly and the pictorial contents. The painterly is a bridge to the pictorial. Hence the painterly content not only serves to create the pictorial content but may also provide its expressive qualities. From the painterly content arises the nature of the pictorial content. In a German Renaissance Madonna and Child, the brushstrokes disappear in order to give crisp edges, unified surfaces, and rich detail to materials or fabrics (such as shot silk or textured brocades), the effect being almost sculptural. In a 17th century Italian painting of the Passion of Christ, the brushstrokes may be fiery impastos to enhance the emotional content of the painting. Entirely different is Russian non-objective and Suprematist painting where the painterly content of colours, shapes, and their relationships in space are themselves the pictorial content. Here the subject matter is the pure experience of colour and light and the sensation of space.

Contributions of Science to Art History, of Art History to Science

Now we see so clearly how the discoveries of the scientist can contribute to the work of the art historian.

For example, in the analysis of Leonardo da Vinci's, *Virgin of the Rocks* (1506) in the National Gallery, London, it was found that the artist used earth pigments – the ochres

and umbers – to paint the rocks, and plant pigments to paint the leaves on the trees. This complementarity between the substance of the pigment and the substance of what is depicted is an artist's means of bringing reality into a work of art. It is also the expressive means used to distinguish between qualities of things such as the weight of rocks and the delicate transparencies of leaves. Here, what is seen in the picture is in harmony with what it represents, the painterly content contributing to the pictorial content in a very real and concrete manner.

In Russian Avant-Garde painting where the painterly content is used to convey experiences of light and colour, the artists were using pigments that correspond to optical, spectral colours. In this way they were joining what is seen in the painting to how we see in the world, they were joining the painterly with the pictorial.

In order to gain a true understanding of the painterly content, then, the art historian needs to know the pigments used by an artist and what relationships there are among them. Also significant here is that such information is helping to date paintings by establishing chronologies of changes in an artist's palette.

Likewise, the information provided by how the pigments were applied, whether they are structural or are meant to catch the light, as well as issues of paint layers, may reveal the thought within the painting. Overall, the findings of scientists are greatly expanding our understanding of content in the finished work.

Thus the art historian must rely on what the scientist can provide. Without it, only part of the painting can be known, and this only inadequately, since the pictorial content depends on the painterly content not only to make it visible but also to give it aspects of meaning.

So apart from providing the reassurance to the art historian that a painting is at least sixty years old, the necessary time for the unified ageing of a painting, the scientist is providing the most fundamental elements with which to understand the work *as art*. Only with these elements can the art historian truly begin to assimilate the full extent of painterly components that make up an artist's style, and this leads to a much more thorough history of art. Art historians are being able to fill out the body of an artist's work based on trustworthy information which, in turn, gives confidence and authority to the work of the art historian.

The ever-newer information coming from the scientific Experts is a great boon to establishing a really reliable art history as the history of artistic creativity and the history of artists' styles. The work of the scientist is thus also contributing to a wider range of means for the attribution of

works and, most significantly, to the art historian's ability to distinguish between what is truly of an artist, and what may be but a superficial resemblance.

What scientists are gaining from this collaboration with art historians is precisely a better art history within which to place their findings. Knowing that the subject matter, the pictorial content, of Malevich's Suprematism is light helps to explain the recurring use of certain pigments that are part of its painterly content. The corollary is that the discovery of another, contradictory, kind of pigment alerts the scientist and leads to further investigation. This same awareness that the pictorial content of Malevich's Suprematist painting is light will allow the scientist to understand why the artist used crushed glass or other materials to make light reflect off of surfaces. What could have been thought of as an anomaly now becomes coherent. It adds new and unsuspected information about content in the painting for the art historian.

This new interdisciplinary approach between scientists and art historians is in its early stages, and the full impact of this collaboration is yet to come. In the meantime, though, with what the scientist is providing we can now enter the artist's studio, as it were, and witness the creative process itself. And that, after all, is where art begins.

* The terms "painterly" and "pictorial" are those used by the Russian Avant-Garde artists to distinguish between *what* is seen, the "pictorial", and *how* it was created, the "painterly". Malevich called his Suprematist paintings of 1915, "Pictorial (*zhivopisnie*) Masses", while Popova titled her paintings of 1916-1918, "Painterly (*zhivopisnaia*) Architectonics". It is significant that it was the Russian Avant-Garde artists who provided the terms on the basis of which not only a theory of their own innovative art can be built, but one that applies to all painting in all times.

LINK: See *The Online Journal of Nondestructive Testing & Ultrasonics* (NDT.Net): NDT.net Database Search Pitzalis, Cassan, Thomas, Gianoncelli for, "Non-destructive Analyses for Modern Paintings: The Russian Avant-Garde Case", a paper delivered at UNESCO's 9th International Conference on Non-Destructive Technologies, Jerusalem, Israel, 25-30 May 2008.