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AUTHENTICATION OF A PAINTING BY RENE MAGRITTE

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Abstract

Two main aspects were studied in the paper. The first consisted in establishing the authenticity of a painting made in the manner of the painter René François Ghislain Magritte (1898-1967), by determining the nature of the pictorial materials and their state of conservation, highlighting some archaeometic characteristics. The second aspect refers to the validation of the assessment carried out in 2003 by the art historian Amelia Pavel (1915-2003), which is considered by art critics to be superficial in few authentications. The painting "The Hope of the Son's Return" was made by Rene Magritte, in the period between 1960-1962, as Amelia PAVEL also reveals. This corresponds archeometrically and chemometrically, by determining the age of the pictorial materials and the support, as having been executed in 1962. The aesthetico-artistic expertise combined with through multispectral techniques (IR, UV, and VIS Reflectography) and microscopic (Optical Microscopy, Stereomicroscopy, SEM-EDX), highlight the certain attributes of authenticity, the painting being by René Magritte. As for the previous expert's inscription on the back of the painting, graphoscopic and archaeometric analysis revealed that it belongs to Amelia Pavel.

Keywords *Authentication; Oil Painting; Rene Magritte; Multispectral analysis / Relectography IR, UV, VIS; Optical microscopy; Stereomicroscopy; SEM-EDX*

Introduction

When considering illegal activities with works of art, old documents or various archaeological artefacts, three aspects are followed: *forgery* - through which a total or complete fake is made; *counterfeiting* or partial forgery - through which only certain characteristics are changed (addition or modification of inscriptions; removal or reformation of the structure and morphology of protective materials, pelliculogens, pictorial materials and supports; modification of the registers of iconographic systems or sequences, on reduced or extended surfaces), *theft/illegal embezzlement and trading* [1-3].

In general, the fake wears the defining features of a particular style, which reproduces the faithful characteristics of an "authentic original", very easily succeeding in convincing buyers, art dealers or collectors.

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The forgery refers not only to the work as such or to the signature, dating, etc., but also to other characteristics or illegal modifications, such as erasures, devarnishing, revarnishing, structural and chromatic reintegration, other additions and insertions that occurred over time.

The falsification and counterfeiting of works of art is motivated by personal, sentimental, religious, truthful, burdensome, as well as practical and scientific motivations [3].

In general, the purpose of these types of illicit activities can also take different forms, starting with the sentimental-personal and ending with the pecuniary. When we consider the activities of reproducing an authentic work, with the aim of trafficking and selling it as an original and obtaining a profit of any kind, then we are talking about a fake and not a scientific copy, which has other destinations.

In the complex activity of authenticating works of art, nowadays, the art historian or critic, the so-called traditional expert, is powerless without a collaboration with technical-scientific experts from related fields (chemistry, physics, biology, geology, archaeology, anthropology, etc.

By investigating some archaeometric characteristics or evaluating the chemometric ones, with archaeometric value, the dating is carried out. By aesthetic-artistic analysis, it is possible to determine the author, school, workshop, etc. Using instrumental methods, the nature of the materials and their state of preservation are determined, respectively the archaeometric characteristics are identified and their interpretation is made.

The paper presents the establishment of the authenticity of a painting made in the manner of the painter René François Ghislain Magritte (1898-1967), by correlation with the nature of the pictorial materials and their state of conservation, with the highlighting of some archaeometic characteristics. The study continues with the validation of the assessments carried out by the art historian Amelia PAVEL (1915-2003) in 2003. The painting "The Hope of the Son's Return" was made by Rene Magritte, in the period 1960-1962, as Amelia PAVEL also reveals. It corresponds archeometrically (chromatic deviation - ΔE^*, degree of whiteness - %, porosity, diffusion between layers/diffusion between pigments and fouling structures, respectively the thickness of the fouled structure) and chemometrically (the ratio between C/S, Zn/C, Si/Al) as having been executed in 1962. The aesthetic-artistic expertise and that through multispectral techniques (Reflectography IR, UV and Vis) and microscopic (Optical Microscopy, Stereomicroscopy, SEM-EDX), highlights the certain attributes of the authentication. As for the inscription of the previous expertise, on the back of the painting, through the graphoscopic analysis it was revealed that it belongs to Amelia Pavel.

Experimental part

Presentation of the painting

The study included an oil painting on pressed cardboard by the Belgian Rene Magritte, which was purchased on the free market of antiques by a collector from Bucharest, who requested an expertise to authenticate and validate the dating and attribution inscription on the back, signed by art historian Amelia Pavel from Bucharest.

Therefore, in addition to establishing the authenticity of the painting, the owner also requested verification of the attribution of the inscription on the back, signed by Amelia Pavel on August 18, 2003, by which the work, entitled by our collective "The hope of the son's return", was considered to be the work of the painter Rene Magritte.

The painting comes from a private collection and has been taken into the custody of our laboratory for scientific authentication using multi-analytical techniques at the owner's request. The main objective of the expertise is to establish the authenticity of the painting (Fig. 1) and verify by graphoscopy the inscription signed by Amelia Pavel on August 18, 2003 on the back, by which this work was considered to be the work of Rene Magritte, with unknown title.

Fig. 1. The painting "The hope of the son's return ", attributed to the painter René François Ghislain Magritte (1898-1967): a. Recto; b. Verso

Through the authentication attributes highlighted at first glance, the work represents a surrealist composition in the manner of the painter René François Ghislain Magritte (b. November 21, 1898, Lessines, Hainaut, Belgium — d. August 15, 1967, Brussels) on pressed cardboard, in colours of oil, executed with a fine brush in thin paste. The author is a prominent representative of European surrealism in painting, who distinguished himself in art after several failures, coming back in force after the Second World War, following his peregrinations of artistic training in England and France.

Selection of comparison systems. Conservation status

Rene Magritte's works frequently display a series of ordinary objects in an unusual context, giving new meanings to ordinary things. Magritte's use of ordinary objects in unfamiliar spaces is related to his desire to create poetic images. He described the act of devising a pictorial iconographic system as "the art of placing colours next to each other so that their real appearance is obliterated, and familiar objects - the sky, people, furniture, solid structures, etc., are united into a single poetically disciplined image". The poetry of these images has no symbolic meaning, old or new, but rather a "visible image that hides nothing but evokes mystery, and indeed, "when you see one of my images, simply ask yourself: what does it mean?" the artist often emphasized.

The same visible image, evoking mystery, can be found in the present painting, in which the realistic/photographically rendered "child" (Fig. 2a) meditates standing with his hands in his trouser pockets, not positioned in space and time. He stands outside an old, poor interior, with an enamelled cast-iron sink, an old wooden bench and a half-open door, exuding a dying atmosphere. Someone (seems female) sketched very lightly in thin pencil, is waiting for him in the last moments (Fig. 2b). She is gone to the other world, being centrally framed in the second plane located outside the room, on the right of the painting, facing the "son".

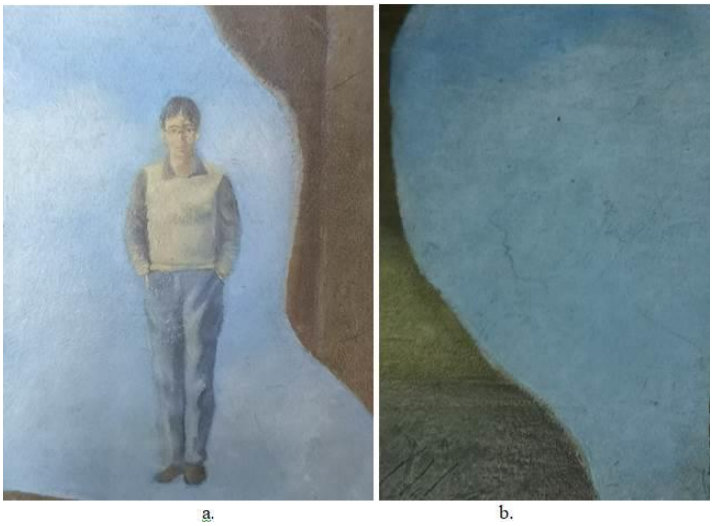
The painting has a fir frame ornamentally profiled along the length of the wands and painted with black varnish over plaster preparation. The painting and the frame are rectangular.

The dimensions of the painting are 380.0×420.0×3.25mm (the dimensions of the cardboard support). The author's signature, "Magritt", with the final letter "e" missing, is in the lower left corner (Fig. 3), in iron red colour, having a discontinuous path resulting from writing, but also from a possible sampling of colour by the strapo extraction technique with scotch tape, carried out after 2000.

From the graphoscopic analysis of the two specimen signatures (on the painting and in the literature), it is clear that the signature is original, with the difference that on the painting the signature bears the letter "M" and not "m" (Figures 3 and 4). We must mention that many of the

artist's paintings were either not signed or the signature is on the back of the painting. He often signed on the right side, in legible areas.

The support is made of pressed cardboard, is 3.25mm thick, and has a patina corresponding to a display period of approx. 60 years. On the reverse, in the centre, is an inscription aggressively erased by scraping and covered by rubbing with a blue-green colour over a semi-transparent yellow one (Fig. 5), which raised suspicions from the beginning.



a. b.

Fig. 2. The image of the two characters of the composition:
a. The estranged Son (realistic painting);
b. The mother who is waiting for him (sketched very briefly, only the outline of the face and shoulders)

Fig. 3. Author's signature

Fig. 4. Author's signature [4]

Fig. 5. The erased writing on the back of the painting. By signature is an authentication by Amelia Pavel, dated August 18, 2003

Initially, this inscription was not legible in any of the three reflectographic radiations, only very weakly in ultraviolet (as will be seen below). After a light washing operation with cotton swabs dipped in distilled water, it was possible to partially highlight the inscription: "Painting by R Magritte…, dimensions 0.38x0.42m...dated 1960-1962." signed: "Amelia Pavel" and date of authentication "... August 18, 2003" (Fig. 6).

Fig. 6. The inscription on the back of the painting, after light erasure with cotton swabs dipped in distilled water and after drying, which clearly shows that the painting was originally authenticated by Amelia Pavel in 2003

As mentioned, Amelia Pavel (b. November 7, 1915, Bucharest – d. December 21, 2003, Bucharest), is recognized as a critic and art historian, who made many authentications upon request [5-7]. The anamnesis of the painting (data on its provenance and the route taken by the painting) is unknown. The owner did not provide any other information, except that the painting was purchased in 2005 and is currently kept in the family, being displayed in the living room. Because of this, it was not possible to determine the motive for the scraping and fluorescent coating of the inscription.

Sampling and processing of the samples

In order to determine the nature of the component materials (painting layers/varnish, polychromy and preparation, support and ornamental frames) and their state of conservation, as well as to identify some archaeometric characteristics, a series of samples were taken, especially for the pictorial materials: varnish, colour and preparation, indexed: MPi (i = number of the respective sample). In the determinations, the microsamples were used as such or summarily processed by splitting or grinding.

The pictorial materials, being applied in a very thin layer with a fine brush made of squirrel or cat hair, were taken with the scalpel from marginal areas, located under the frame. Three representative colour samples were selected. The state of preservation of the pictorial layer required careful sampling, as they were brittle and very thin.

Methods

Along with visual analysis with magnifying instruments (hand magnifiers) and stereo magnifier (STEREO MX4, 10-220X), a number of instrumental techniques of multispectral analysis and high-resolution microscopy were used, such as:

a. UV, Vis and IR Reflectograph using a Document detector type device, with USB port, HS525A series, with 30X magnification power, with UVA (365nm), UVC (254nm), having infrared (IR) domains, Blue-White light (470nm), laser (980nm). USB powered microscope 1.3MP (2.0MP interpolated), with manual focus from 10mm to 500mm, frame rate: max 30f/s under 600lx brightness, 8 white LEDs with adjustable illumination and magnification from 20X to 200X, AVI video format and a portable UV lighting device, with led: G5, UV 4W.

b. SEM-EDX. The analysis used a scanning electron microscope, SEM model VEGA II LSH, produced by TESCAN Czech Republic, coupled with an EDX detector type QUANTAX QX2, produced by BRUKER/ROENTEC Germany. The microscope, fully controlled by

computer, has an electron gun with a tungsten filament, which can achieve a resolution of 3nm at 30kV, having a magnification power between 30X and 1,000,000X in "resolution" operating mode, the acceleration voltage between 200 V at 30 kV, scanning speed between 200 ns and 10 ms per pixel. The working pressure is less than $1x10^{-2}$ Pa. The image obtained can consist of secondary electrons (SE) or backscattered electrons (BSE). The Quantax QX2 is an EDX detector used for qualitative and quantitative microanalysis. The EDX detector is of the 3rd generation, X-flash type, which does not need liquid nitrogen cooling and is approx. 10 times faster than conventional Si (Li) detectors. The technique, along with the visualization of the microphotogram, allows the rendering of the image with the mapping (arrangement) of atoms on the investigated surface. Based on the X-ray spectrum, it allows the determination of the elemental composition (in gravimetric or molar percentages) of a microstructure or a selected area and the evaluation of the variation of the composition along a vector arranged in the analysed area or section.

c. Optical Microscopy. A Zeiss Imager a1M type microscope was used in the optical microscopy analyses, which has an AXIOCAM camera and specialized software attached. Samples were analyzed at 50-200X magnification in dark or bright field.

d. Optical stereomicroscopy. Optical stereomicroscopy analyzes used a STEREO MX4 type microscope, manufactured in St. Petersburg, to which a camera was attached.

Results and discussion

Aesthetic-artistic analysis

The painting was made on a cardboard support pressed with a preparation based on animal glue and chalk dust, in a thin film. The technique is in oil colours, applied with a fine brush of squirrel or cat hair in a thin layer. The iconographic system of the composition is part of the group of works by the painter René François Ghislain Magritte, generically entitled "The Human Condition", made after 1957. Thus, the composition centrally presents a poor interior of an old, abandoned house (a wide hallway with a pillar to the left of the entrance, bricked up), with an old, enamelled cast iron sink without a tap, and a simple, wide, wooden bench. In the background, a three panelled door, the last one at the top having a small four-panned window with cross-shaped lattices. The door is ajar to the inside. The colour of the walls allows, by using burnt oil on the background of sepia and burnt shadow, to reproduce old age, poverty and the neglect of the passage of time. The interior is morbid, with alternating greys and faint blues towards the floor (cold colours) and dirty whites towards the ceiling that dilute the sepia and burnt shadows (slightly warmer colours). On either side of the hallway are two fractal-like sections in the form of an "endless sequence", with images from the outside of a faintly milky blue sky dotted with almost transparent clouds. In the left plane, on the background of a sky sprinkled with thin, stratified clouds, is the "boy", gone to study (wearing glasses), rendered almost photographically (Fig. 1a), meditating while standing with his hands in his trouser pockets, not being positioned in space and time. In the plane on the right, also suspended centrally, against the background of the sky with thin, continuously distributed clouds, a mature woman's face (Fig. 2b), almost illegible, looking at the "son", is sketched in thin pencil. The rendering of the volumes and shadows of the "son" clothing was done through gradients: for the pants - light colours diluted with white, on a darker blue-ceusian background (Fig. 7a), and for the sweater and shirt - greys on a sepia and white background (Fig. 7b).

Part of the central areas were analysed in white, UV and IR light, in order to highlight damage to the physical condition of the painting layer, degradation of the chemical nature of the polychrome materials and interventions of repainting, restoration or forgery (Figures 8 and 9).

Fig. 7. The clothing of the "son": a. pants; b. the sweater and the shirt

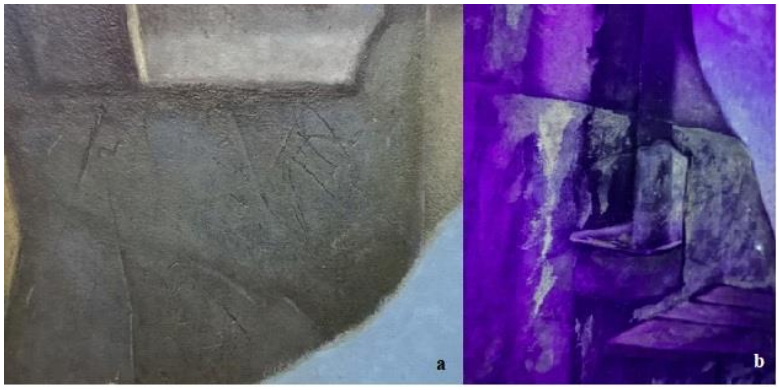


Fig. 8. White light and UV analysis of two central areas of the painting
to highlight some later interventions:
a. The presence of damage from handling and use of the support before painting
b. Lack of repainting, restoration or glazing interventions

Fig. 9. White light analysis of wash drawings and varnish (protective varnish)

In figure 8a, in reflected white light (D50), damage to the support by etching, chiselling or pressing with a sharp point is visible, before the creation of the painting, which proves that the support was initially used for other activities workshop (writing, cutting or embossing) and then the preparation was applied and painted. Like any painter, often under the impulse of inspiration, the artist did not pay due attention to the support.

Using reflectography in UV light (figure 8b), respectively white light (figure 9), the layered application and elaboration of polychromy, the presence of wash drawings and shadows, as well as the presence of retouched or integrated areas, which appear darker and in relief, are highlighted. It is a painting full of symbols. All the constituent elements of the composition present novel juxtapositions of normal objects, from everyday life, in a context that gives them new meanings. This technique of juxtaposition, later known as "magical realism" is the essence of Magritte's creation. Apart from the real static or dynamic ambient elements, his works are marked by an often-macabre spirit, the artist creating surreal versions of a genuine painting.

Magritte's technique, according to the literature [8-17], is precise. The details are rendered with an almost photographic accuracy, that one wonders if the painting is not, in fact, a photo collage modified in Photoshop. The painter's signature on the left is the ultimate proof that we have an original painting by Magrette, which makes us look for interpretations.

In Magritte's eyes, reality has a subversive nature, like Einstein's theory, since the concept of "relativity" seems to dominate this reality, be it physical or artistic.

Signature analysis

Special attention was paid to the investigation of the author's signature area. Initially, it was analysed by reflectography in UV, Vis and IR, in which a path of the non-uniform signature was highlighted, which from a graphoscopic point of view corresponds to the author's specific characters for the period 1957-1967 (the period that also includes the one established by Amelia Pavel, 1960-1962).

Figure 10 shows a detail of the signature analysed under stereo binocular magnification in white light. Figure 11 shows some details of the signature under UV light, in which it can be seen that in the area of its delimitation, writing color sampling interventions were carried out by strapo extraction, after the creation of the work, more precisely after 2000.

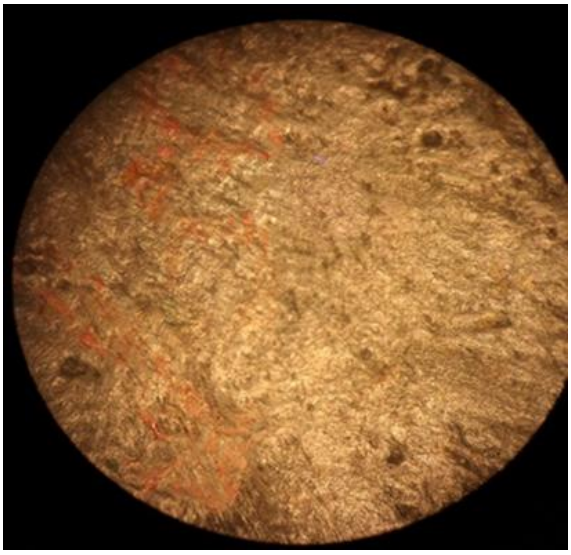


Fig. 10. Binocular stereo magnifier signature photo, which highlights the discontinuity

Figure 12 show a detailed analysis, using the Document detector type device with USB port, of some areas with different signature characters in Vis and blue-white light reflected dynamically from three points, showing the discontinuity of the writing in the signature area.

Fig. 11. Signature area analysed under UV

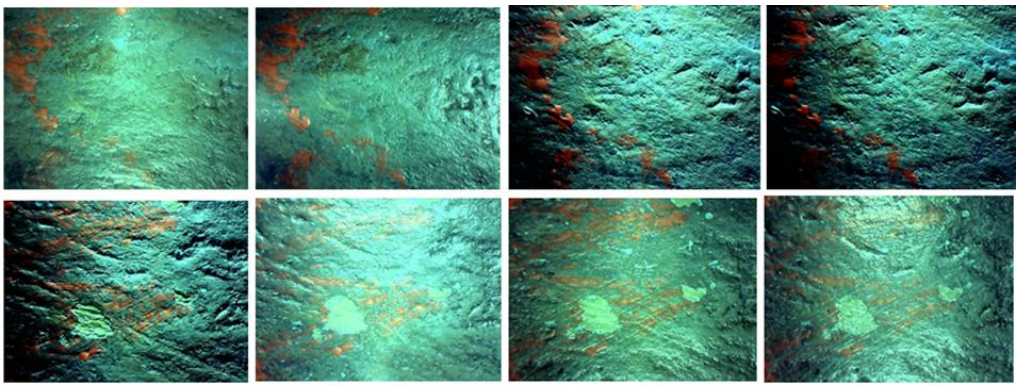


Fig. 12. Signature character areas in blue-white light dynamically reflected from three-points, highlighting the microtopography of the polychrome surfaces and gaps made by "strapo" extraction with scotch tape

Next, in order to eliminate the suspicion of forgery interventions, using the same device, a detail in the signature area was analysed in two reflectographed lights (IR and blue-white) (Fig. 13).

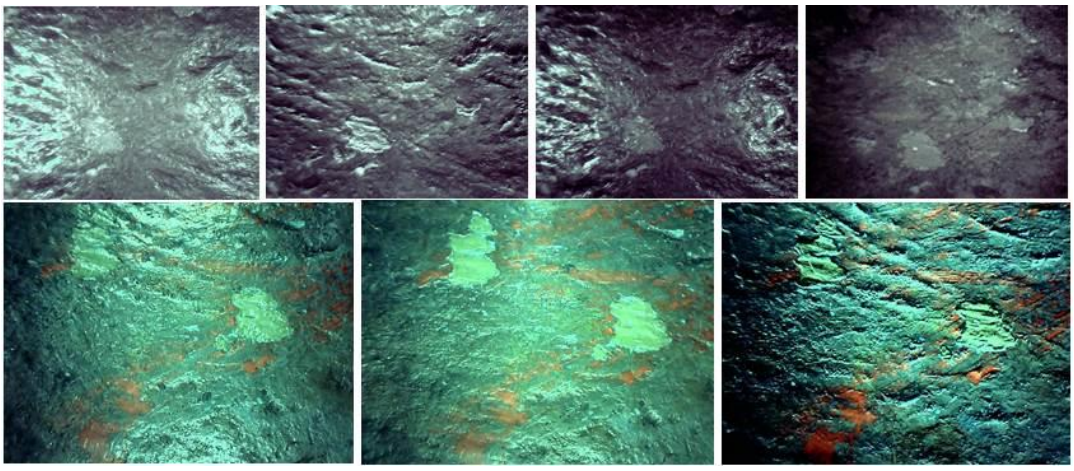


Fig. 13. Analysis in the two reflected lights, IR and blue-white, of some areas with characters of the signature and areas with gaps made by "strapo" extraction with self-adhesive tape, for investigation of handwriting and to eliminate the suspicion of forgery

By analysing the images in figures 14 and 15, no tampering interventions were highlighted [18-25].

Figure 14 shows in the three reflected lights (blue-white, UV and IR), the area of Amelia Pavel's authentication inscription on the back. This inscription is only legible in white light (D50) after washing.

Fig. 14. Analysis in the three reflected lights (blue-white, UV and IR) of Amelia Pavel's inscription

Graphoscopic analysis of Amelia Pavel's signature in the authentication inscription on the back of the painting, photofixed in white light, corresponds to the period signed by the critic.

Moreover, this signature was compared with other specimens of the expert's signature found on various paintings of the same period, for example with a signature on Nicolae Grigorescu's "*Apple Flowers*", recently examinated, and there are elements of similarity with the authentication inscription of this painting (Fig. 15).

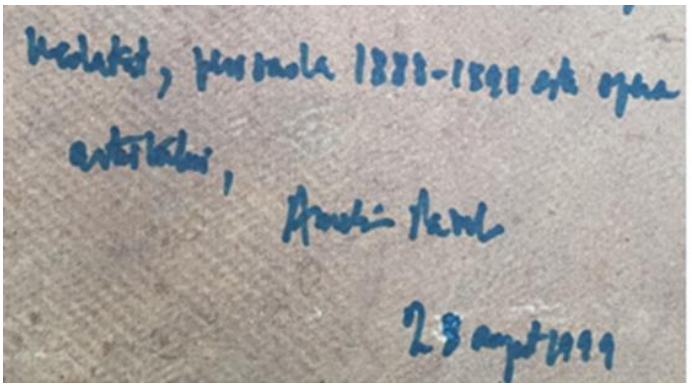


Fig. 15. Writting with Amelia Pavel's signature, used for comparative analysis

Conservation status analysis

The state of conservation of the painting is good, with some unevenly dispersed small damages. There are many points of fine gaps, caused by the removal of pictorial material from various areas of the painting with a scalpel, as well as pictorial material from the signature area by "strapo" extraction with scotch tape. The most obvious aggressive intervention is the removal of Amelia Pavel's authentication inscription from the back. This operation was carried out by dissolution in an aqueous and alcoholic system, followed by scraping and application of a fluorescent colour. This intervention raised very big questions: when and who performed the deletion (the owner or the expert), the motive of the intervention (the cause and/or purpose of the deletion) and others. As for the reason for the intervention, it is possible that the critic did not agree with the owner or the buyer about the cost of the expertise, the latter refusing to pay the requested amount. There is a small likelihood that this writing was deleted by the owner without a clear cause or purpose.

The age patina of the painting, which is partially visible, with an uneven extension, corresponds to a period of storage in the frame, without glass protection, of approx. 60 years.

The most eloquent effect of alteration during the display period is that of the frame, which has a poor state of conservation, having profiled edges with the paint layer missing longitudinally on extensive areas. This aspect proves that the painting has been improperly preserved and handled (Fig. 16).

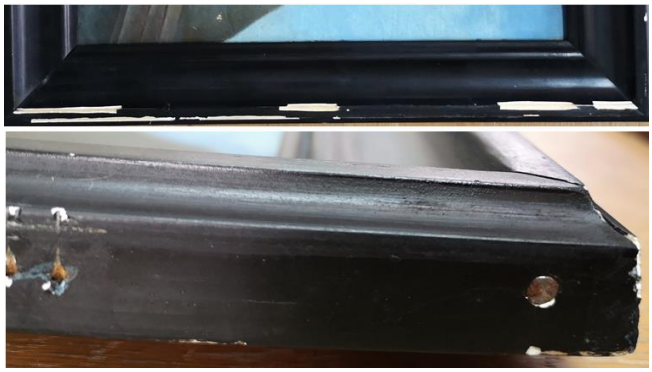


Fig. 16. Damages of the frame (detached cracks) and consolidation interventions

The pictorial surface was varnished with a very thin film of colourless, slightly yellowish varnish. The painting shows no lack of pictorial material or support. There are no visible age cracks or gaps in the painting (lack of pictorial material), except in the signature area and three central areas, the first induced by sampling using the strapo technique, and the others by microcutting with the scalpel, both made prior to our investigations (Fig. 17).

Fig. 17. Sampling area with the scalpel (next to damage to the support before painting)

Figure 18a - d shows images of some areas that were heavily elaborated during the creation of the work, to highlight the brushstroke and other archaeometric features (the face of the boy, the boy's sweater, the blue sky in the left plane and the window bars).

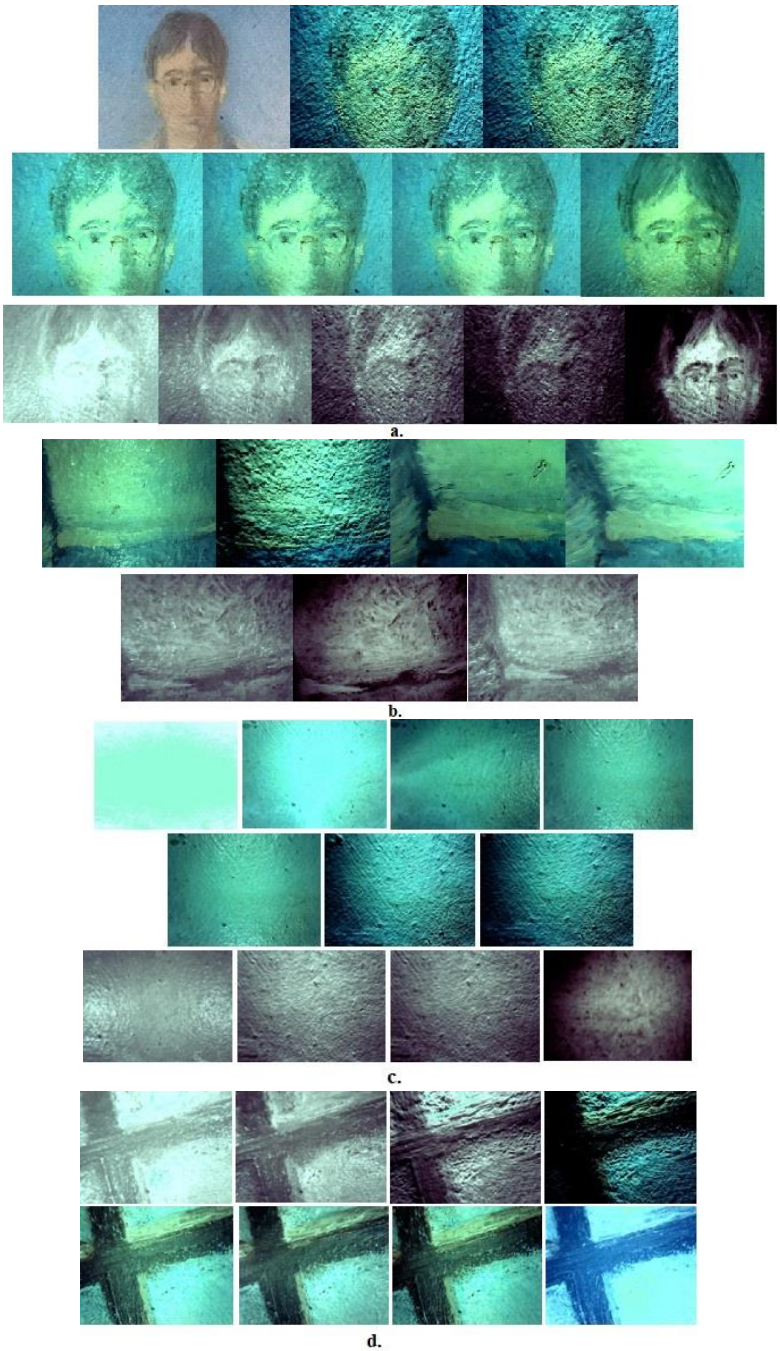


Fig. 18. Images of elegantly crafted details:
a. Head of the Son; b. the son's sweater; c. the blue sky in the left plan;
d. the latticework of the door window, which highlights the complexity of the brushstroke in the elaboration in successive pictorial layers, analysed in dynamic reflectographic lights: in the visible, in blue-white, UV and IR light

They have been analyzed in static and dynamic reflected lights, such as: in visible light, in blue-white light, UV and IR, which revealed no repainting, chromatic reintegration (restoration) or forgery interventions. Moreover, they allowed to highlight the complexity of the elaboration of the four details of the pictorial elements, the author applying each time a different brushstroke and direction.

Clear differences between varnish and painting materials can be seen in UV/Vis reflectography. No falsification interventions (structural and chromatic reintegration of the pictorial layer) were observed. Stereomicroscopy shows no visible cracks of age and no interventions subsequent to the creation of the painting.

The area of the author's signature is visible directly and by Vis, UV and IR reflectography, not being re-varnished. It has lacunae from the removal of writing colour for analyses, previously made, the results of which are unknown. The signature corresponds graphoscopically.

The frame and support do not show xylophagic attack. The link, the nails fixing the support to the frame and frame appear to be original (Fig. 19).

Fig. 19. The link and nails for fixing the painting

Analysis of pictorial materials and their state of conservation

Among the pictorial materials used by the author, we mention:

- for the varnish or the pelliculogen for mechanical and climatic protection, but also with an aesthetic role, boiled linseed oil was used;
- as pigments were identified: zinc white, earth colours, ultramarine type (blue, red) or other coloured earths (green, brown, etc.), burnt shadow, ivory black, chrome green, zinc and titanium white, Prussian blue, iron red, etc.
- boiled linseed oil was used as a binder.

Through the analysis of some components of the painting materials using SEM-EDX (Fig. 20), the manner and degree of color elaboration during the creation of the work, the polychrome combination systems and their stratigraphic arrangement, then the arrangement of the color and varnish fouling areas (climatic, mechanical and aesthetic protection varnish) were highlighted. Aslo, the depth of the presence of archaeometric characteristics and of the chemometric ones with archaeometric value (the degree of carbonation), the morphology of the surfaces (texture and microstratigraphy), the shape and arrangement of the pigment granules, etc., were highlighted. The three analysed colours showed good chromatic stability, as such or in summative systems (mixture of colours and binder). All the archaeometric and chemometric characteristics fit the period of execution around 1962.

Scanning electron microscopy coupled with X-ray spectrometry (SEM-EDX) allowed surface detailing, with clear highlighting of the main archaeometric characteristics and the chemometric ones, with archaeometric value. These allowed a more precise determination of the period of execution as well as establishing the authenticity of the painting as belonging to Rene Magritte.

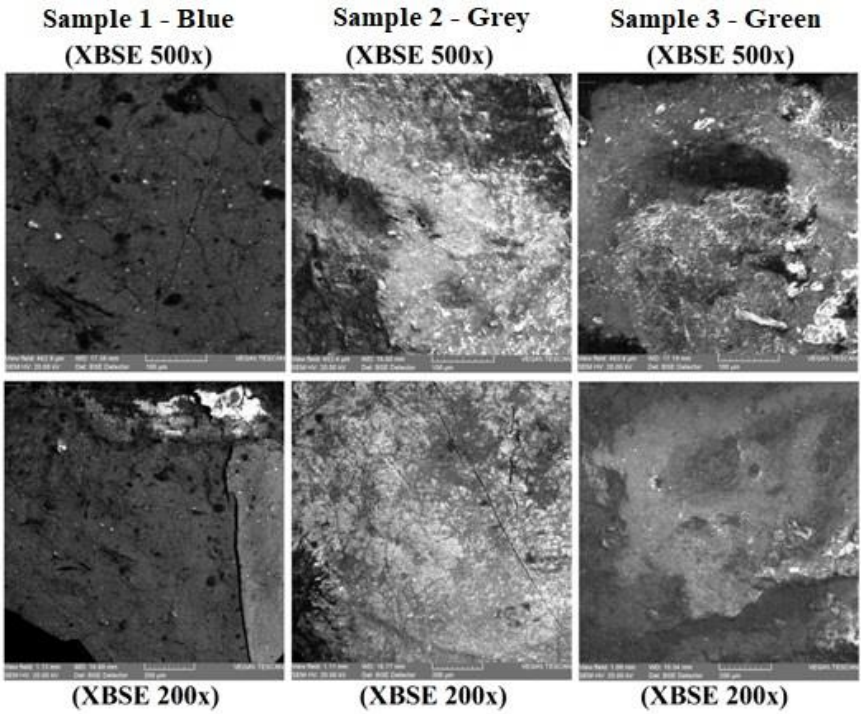


Fig. 20. SEM micrographs (XBSE 500X and 200X) of the three colours analysed

Thus, with the help of the scanning electron microscope (SEM), coupled with the X-ray diffractometer (EDX), the following aspects were very clearly highlighted:

- the manner and degree of elaboration of the colours when creating the work by the painter;
- polychrome combination systems and their stratigraphic arrangement.
- arrangement of varnish and dirt fouling areas on colour;
- the depth of the presence of archaeometric characteristics, and chemometric ones with archaeometric value (the degree of their penetration into the volume phase of the analysed materials);
- surface morphology, highlighting iridescence, texture and microtopography;
- the shape and arrangement of pigment granules.

The three colours analysed, along with the varnish, showed good chromatic and microstructural stability.

The archaeometric characteristics (porosity gradient regarding the penetration from the surface into the volume phase of the white color and the penetration of the oxidatively fouled surface structure in depth) and the chemometric ones (elemental stoichiometry ratios: C/S, Zn/C, Si/Al) places the painting in the period of execution around 1962.

Table 1 show the data obtained by SEM-EDX for the three representative colours analsed.

The data in Table 2 show a good correlation between the two archaeometric characteristics highlighted in the blue and green samples (the gradient of porosity regarding the penetration from the surface into the volume phase of the color and the penetration of the

oxidatively fouled superficial structure at the depth of 150μm) and the chemometric ones (from columns 2 and 3 of Table 2).

Table 1. The elemental composition (weight percentages, %) of the three analysed colours

	Elemental composition (%)														
Sample	**Si**	**Al**	**Fe**	**Ca**	**Mg**	**K**	**Na**	**P**	**Ti**	**Zn**	**Co**	**Mn**	**S**	**Cl**	**C**
Blue	0,91	4,95	1,77	0,73	-	0,68	0,83	0,10	23,81	3,28	2,27	0,21	0,74	-	14,74
Grey	1,87	3,67	3,48	1,04	0,43	0,50	1,12	0,25	7,87	3,30	1,97	1,485	0,85	-	21,99
Green	2,58	3,63	3,40	1,08	0,48	0,77	1,07	-	6,37	2,29	-	0,80	1,36	0,28	22,28

Table 2. The chemometric characteristics (C.C.) of the three areas analyzed

Sample	**Chemometric characteristics**		
Colour	**C/S**	**Zn/C**	**Si/Al**
Blue	19.949	0.222	0.184
Sepia-grey	25.717	0.150	0.510
Green	16.348	0.103	0.711

* Valid chemometric characteristics; **partially valid chemometric characteristics;
***valid chemometric characteristics

The two archaeometric characteristics correspond to an interval of about 60 years (the rate being about 1 - 2μm/year, considering constant preservation conditions).

The first chemometric characteristic related to the increase in porosity as a result of binder embrittlement and CO2 penetration in the presence of hygroscopic moisture (carbonation process), given by the C/S, Zn/C and Si/Al ratios, fits, in terms of rate of evolution, within 60 years. C/S value decreases 4.5 times compared to the reference (blue and green samples). For Zn/C and Si/Al ratios, the values decrease about 2 times, respectively increase 5 times compared to the same reference (blue sample).

Conclusions

The painting "The hope of the son's return" was made by Rene Magritte, in the period 1960-1962, as the art historian Amelia PAVEL assessed in 2003. Based on the archeometric characteristics identified during the analysis of the nature and conservation state of the pictorial materials and the support, it was executed in 1962.

The aesthetic-artistic expertise corroborated with the analysis by multispectral techniques (IR, UV and Vis Reflectography) and microscopy (Stereomicroscopy, Optical Microscopy and SEM-EDX) highlight the certain attributes of authentication, the painting being by Rene Magritte.

As for the inscription of the previous expertise, located on the back of the painting, the graphoscopic analysis revealed that it belongs to Amelia Pavel. Since there was no anamnesis data (history and peregrinations/transfers of the painting) [26] it was not possible to establish the motive of the erasing action by dissolution in hydroalcoholic solution, scraping and covering the inscription with a fluorescent colour.

The conclusions which are based on the data obtained from the expertise are presented as follows:

a. ***Establishing the conservation state***

The pictorial surface was varnished, when the work was created, with a colorless, slightly yellowish varnish, after a period of maturation of wash drawings and shadows from thicker films of boiled linseed oil.

The painting shows insignificant gaps of pictorial material. It has only very small gaps resulting from a sampling prior to the current expertise, but whose analysis results are not known to the owner. No age cracks are visible. The hanging ring (link) and the nails that fix the support in the frame appear to be original.

There are small areas where there is evidence of destruction and alterations of age, prior to the creation of the work, and there are no forgery interventions.

b. ***Establishing the nature of pictorial materials, support elements and framing elements***

Among the pictorial materials used by Rene Magritte, we mention:

- for varnish or pelliculogen for mechanical and climatic protection, but also with an aesthetic role, the author used boiled linseed oil;

- zinc white, earth colours from the ultramarine group (blue) or other coloured earths (green, brown, etc.), burnt shadow, ivory black, chrome green, zinc and titanium white, Prussian blue, iron red, etc. were used as color pigments;

- boiled linseed oil was used as a binder for the colors, and bone glue for the preparation.

c. ***Establishing archaeometric characteristics***

For the pictorial materials, three other archaeometric (evolutionary) characteristics have been identified, besides the chromatic deviation - ΔE^* and the degree of whiteness - %:

- the porosity gradient regarding the penetration from the surface into the volume phase of the three colors and the penetration of the oxidatively fouled surface structure at depth;

- diffusion between application layers / diffusion between pigments and fouling structures;

- the thickness of the fouled structure.

d. ***Evaluation of some chemometric characteristics with archaeometric value***

Among the chemometric characteristics with archaeometric value, the following elemental stoichiometry ratios were evaluated: C/S, Zn/C and Si/Al.

e. ***Establishing the authenticity of the painting and verifying the attribution of the inscription on the reverse***

The authentication inscription is signed by Amelia Pavel on August 18, 2003, whereby the work, later titled in our laboratory, "The hope of the son's return", is considered to be the work of Rene Magritte. It was not possible to identify the author and the motive for the deletion of the inscription.

It has been established by static and dynamic reflectography in four light sources (visible-white light D50, blue-white, UV and IR) that the work belongs to the painter Rene Magritte and the signature is original.

Based on the bibliographic references and the graphoscopic study of the handwriting, the attribution of the authentication expertise carried out on August 18, 2003, belongs to the critic and art historian Amelia Pavel.

Based on the archaeometric and chemometric characteristics with archaeometric value, the painting is about 60 years old.

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