CONSIDERATIONS REGARDING CONTEMPORARY MIXED MEDIA PAINTINGS: THE STUDY AND RESTORATION TREATMENT OF ROMUL NUȚIU'S *DYNAMICS*

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Abstract: This paper presents the scientific investigations and restoration treatment of Dynamic I (1969) by Romul Nuțiu, one of the most representative artists of abstract expressionism in Romania. The artwork, part of the *Dynamic Universe* series, was created using the so called aquatic experience, a technique developed by Nuțiu which employed the use of large reservoirs filed with an immiscible mixture of water and industrial paints. The paintings were the result of the paint transfer onto the canvas, which was left floating on the water's surface. *Dynamic I*, the first within this innovative series, is a monochrome black and white alternation, composed of two separate stretched canvases, overlapped. With several degradations affecting the paint layers as well as the canvas support, a restoration treatment had to be developed in accordance with the specific nature of the artwork.

A combined spectroscopic approach was carried in order to obtain a comprehensive view of the materials used as well as on regard the characteristic forms of degradations that were affecting the paint layers. Fourier transform infrared spectroscopy (FTIR) allowed identification of the binding media, pointing towards a siccative oil, along with several oxidative ageing products of the oil triglyceride esters. The presence of a polyvinyl acetate resin was also identified, possibly ascribed to the preparatory layer.

Regarding the pigments, XRF analysis highlighted the presence of zinc white – for the white paint areas, and the use of a typographic ink with a lead-based pigment, within the black areas respectively. The yellowing effect of the paint surface was correlated with zinc soaps formation, metal carboxylates being clearly recognized by FTIR spectroscopy in all analyzed samples. The findings of the technical investigations allowed the development of a compatible treatment solution, specifically formulated to avoid swelling effects, pigment extraction or any undesirable changes of the original optical properties of the paint surface.

Keywords: contemporary art, Romul Nuțiu, conservation science, spectroscopy, material identification, metal carboxylates, zinc white, yellowing

1. INTRODUCTION

The Artist (1932 - 2012)

Romul Nuțiu was one of the most constant artists dedicated to abstract expressionism from the Romanian art scene. Although he had not left the country to work abroad during his lifetime, his international career has tremendously risen since 2008, when he started a fruitful

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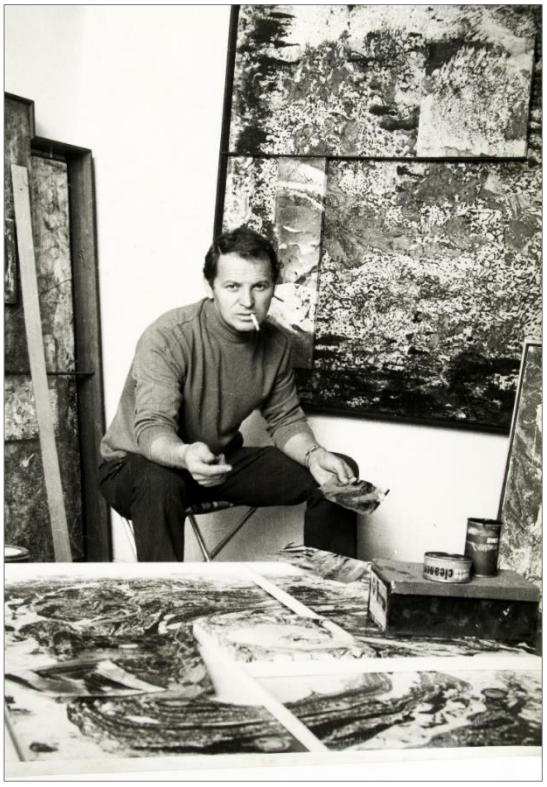
collaboration with Dr. Joana Grevers, art dealer and historian based in Munich, Germany.

In his creation, the author conveys the idea of *élan vital*, initiated by the French philosopher Henri Bergson. This *philosophem* defines an omnipresent spiritual force which produces the development and can be perceived only intuitively and not rationally; appearing in all the creation processes - be they artistic or scientific - and also in nature's development.



Guided by spontaneous intuition and driven by his semantic complexity, the artist moves beyond the canvas, creating objects and installations which are more like paintings transposed in space. Thus the creative act becomes an event [1]. Through his tendency of abstraction and experimentation, initiated since the early 1960s, the first modular paintings on canvas appeared. By overlapping several different canvases, the artist sought to achieve a three-dimensional, utopian effect. During the 1970s, he began the theme of *Dynamic Universe* which implies the use of large vessels filled with water and industrial paints. Rejection between oily colors and water has created the "risky" suspension effects; usually his canvases were immersed in these basins.

Figure 1. *Romul Nuțiu in his home studio, 1968*
Courtesy of Mrs. Simona Nuțiu Gradoux

Dynamic Universe: Dynamics I

The artwork entitled *Dynamics I* (*Fig. 2*) represents the debut of this cycle and is part of the contemporary art collection of the Museum of Art Timișoara. Developed in a mixed technique, a combination of oily medium and water, the painting is composed of two separate stretched canvases that have been overlapped.

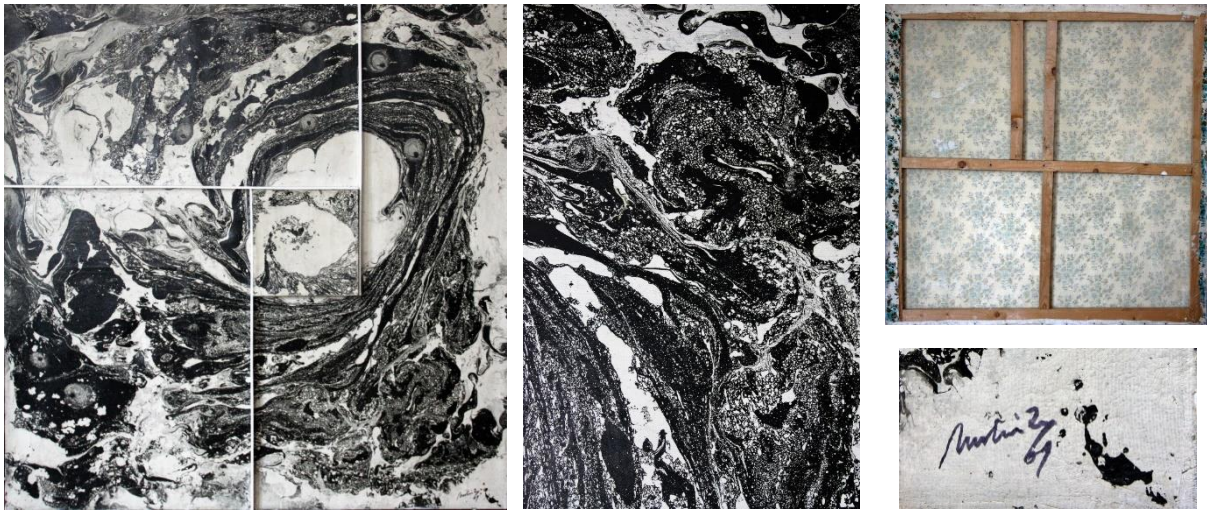


Figure 2. *Romul Nuțiu's Dynamics I (1969). Mixed media on canvas, 130 × 130 cm. Museum of Art Timișoara; from left to right: artwork before treatment; detail of painting technique; reverse side of the painting; detail showing artist's signature*

Three wooden baguettes are supporting the smaller canvas in place as attached to the larger one. The dynamics of the artwork is also reflected by the matte/gloss monochrome alternation between white and black. The artist's signature is found in the right lower corner alongside 1969.

By consulting the collection's conservator and curator more information could be obtained. The artwork has been subjected for almost ten years to fluctuations in temperature, humidity and artificial light while part of an internal exposition. During the rest of the time it was stored in normal microclimate conditions. No records of previous restoration exist.

In terms of the conservation state, the canvas support was deformed and locally perforated as a result of handling accidents and microclimate variations. It had lost its original tension, especially at two corners, as inferred from the wavy appearance (large canvas). Reverse of the canvas shows interesting details on regard the textile support - an organic material visually similar to industrial cotton with a repetitive floral pattern. The color layer exhibited adherent and non-adherent deposits, a yellowish/oxidized aspect, scratches, crazing and local incipient detachments. Inspection in UV light showed a specific dull yellow fluorescence for zinc oxide, while pH level of the surface was determined as being slightly acidic (6.2) and conductivity equivalent to approximately 880 μS/cm.

Taking into account the above mentioned conservation concerns, the painting was considered for restoration. Moreover, the artwork is intended to be itinerated for two different museums in New York, USA - the Pollock-Krasner House and Study Center, and Steinber Museum of Art in Brookeville respectively, as part of an international exposition called 'Abstract Expressionism behind the Iron Curtain'.

A chemical investigation was taken into consideration in order to be able to develop the best restoration approach. The main goals of the scientific investigations aimed identification of the paintings materials as well as insights into the artist painting technique and working methods

2. MATERIALS AND METHODS

2.1 Samples

Several micro paint fragments were sampled non-invasively from the reverse of the canvas. Sampling points are shown in *Fig. 3* along with a series of microscopic details of some the analyzed paint fragments.

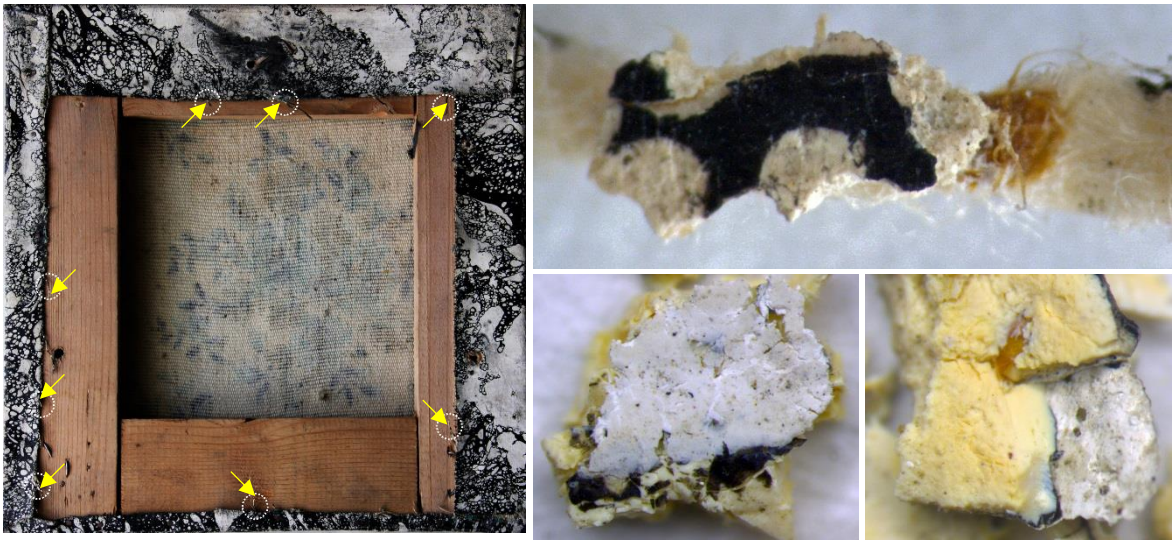


Figure 3. *Reverse of the small canvas showing sampling areas and some microscopic details of the analyzed fragments*

2.2 Fourier transform infrared spectroscopy (FTIR)

Molecular analysis was performed via FTIR spectroscopy. Infrared spectra were recorded in Attenuated Total Reflectance (ATR) mode with a PerkinElmer Spectrum Two FTIR spectrometer equipped with a diamond ATR crystal. Spectra were registered in the mid-infrared region (4000-370 cm^{-1}) at a spectral resolution of 4 cm^{-1}, by averaging 16 scans. Data processing was done in Essential FTIR.

2.3 X-Ray Fluorescence

XRF measurements were carried using TRACER III, a portable energy-dispersive XRF spectrometer by Bruker Elemental, equipped with a Rh X-ray target. Data collection was achieved with the following setup of the working regime: 40 kV tube power, 11 μA current intensity, 60 s accumulation time in air atmosphere. No filtering was applied.

3. RESULTS

Binding media

FTIR spectra registered on investigated paint fragments shows complex absorption patterns with broad absorptions bands within the fingerprint region. These large absorptions are due to the presence of various functional groups with similar spectral ranges that cause signal interferences. Complex material systems, artist's paint layers can be viewed as a mix of organic and inorganic compounds coming from the original painting materials: binding media, pigments, mineral fillers. In addition, several alteration products can be developed over time that further contribute to this chemical heterogeneity [2].

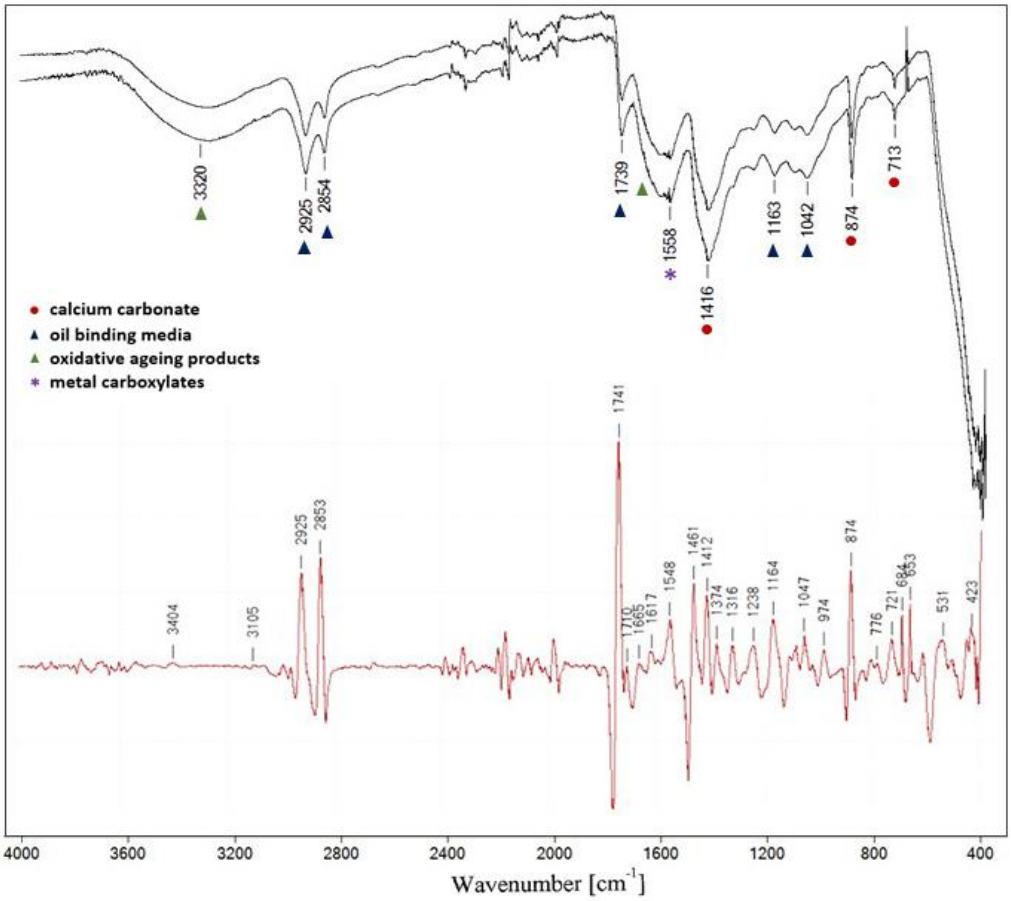


Figure 4a. *FTIR spectra and second derivative registered on the white paint samples. Diagnostic spectral features are highlighted*

Diagnostic peaks ascribed to calcium carbonate could be highlighted within the white paint samples via the sharp peaks at 874 and 713 cm^{-1} (C-O bending), the broad absorption band at 1410 cm^{-1} (C-O stretches), and the small peak at 1794 cm^{-1}. The high concentration of this mineral, as inferred from the band intensities, can be correlated to the use of modern paints materials where calcium carbonate is frequently added as mineral filler [3].

On regard the binder, detailed analysis of the FTIR data highlights characteristic infrared bands that can be ascribed to a drying oil paint medium: well-resolved peaks within the C-H stretching region at 2925 and 2854 cm^{-1}; carbonyl peak (C=O) at approximatively 1740 cm^{-1} and a series of C-H bending, C-O and C-C stretching, and C-H rocking respectively within the fingerprint region with peaks at 1460, 1412, 1374, 1238, 1164 and 1090 cm^{-1} [3]. In the identification of these last peaks the apparent spectral resolution of the spectra was increased by using the second derivative [4].

Involving complex processes, the ageing of drying oils has been well investigated and described in several studies [4-6]. Based on relatively apolar mixtures of triglycerides with different fatty acids profiles, the drying processes of these oils involves cross-linking of triglycerides to high molecular weight substances [6]. Due to the chemical environment in paintings, these substances are not stable end products but rather unstable products that undergo further reactions: hydrolysis of the ester bonds, new oxidation products, oxidative cleavage of the fatty acid hydrocarbons chains, etc.

Characteristic ageing products could be identified such as hydroxyls/hydroperoxides (peak at 3400 cm^{-1}), ketones, esters and acid carbonyls (bands at 1778, 1710, 1316 cm^{-1}) as a results of the oxidative polymerization of the fatty materials [5]. Other bands such as the peaks at 1617 and 1548 cm^{-1} can be ascribed to carboxylate ion formation caused by reaction of the pigment with the oil medium [7]. The lower intensity of the carbonyl peak as compared with the C-H vibration at 2925 cm^{-1} can be correlated with the relatively low amount of intact ester bands [4].

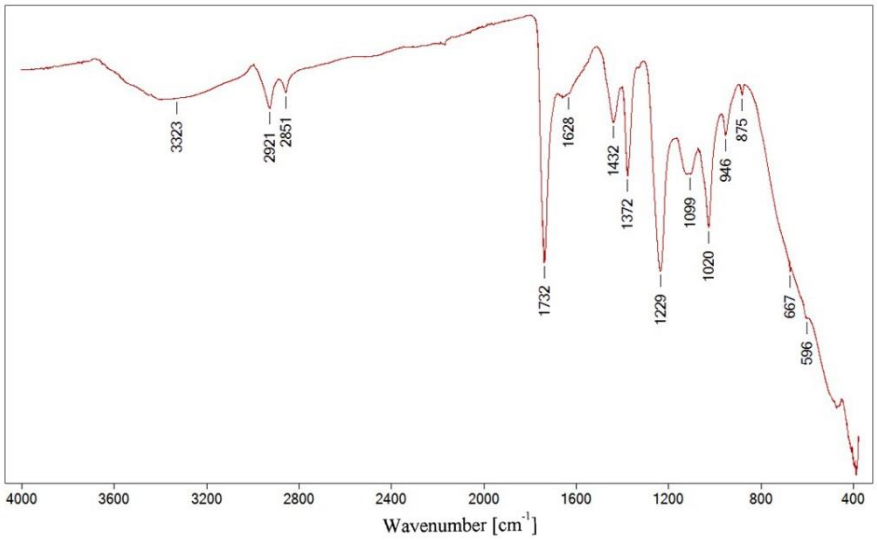


Figure 4b. *FTIR spectra showing characteristic absorption pattern for PVA resin in one of the analyzed paint fragments.*

In one of the analyzed samples, characteristic bands such as those given by the presence of a synthetic (polimeric) resin could be identified. The peaks within the fingerprint region allowed an exact identification, the rounded peak centered at approx. 1230 cm^{-1} being the most diagnostic in the FTIR spectra of polyvinyl acetate resins (PVA). Taken into account the distinct peaks at 1432 cm^{-1} and 1372 cm^{-1} respectively, along the broad area of absorption between 1120 and 1000 cm^{-1}, a possible PVA homopolymer can be inferred [3].

No other representative absorptions – such as those given by the presence of a varnish layer, could be identified

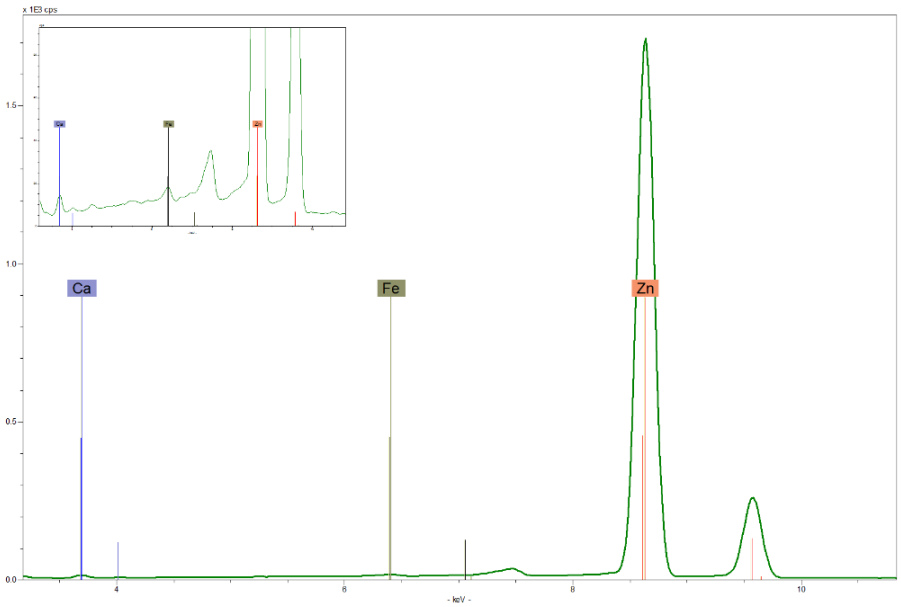


Figure 4c. *Detail of XRF spectra showing the high emission lines ascribed to zinc in the case of the white paint samples; calcium and iron come as minor components.*

Pigment analysis

In terms of the pigmenting material FTIR data doesn't shows any diagnostic peaks but rather a trend, a fall of the spectra towards lower wavenumbers that may suggest the presence of metal-atoms. Although no characteristic absorptions could be ascribed via infrared spectroscopy (band due to metal atoms appear bellow 400 cm^{-1}, within the far infrared region), XRF analysis points towards zinc white, as inferred via the zinc high intensity emission lines registered within the same analyzed area.

As shown in previous studies [4, 8], zinc white has a specific reactivity in oil based paints. Intensively studied since the first half of the 20th century, zinc oxide tends to react with the fatty acids of siccative oils and influences the ageing processes in various way as it stimulates the formation of alcohol groups and the hydrolysis of glycerol esters. Also it forms metal carboxylates with the carboxylic acid present. Zinc carboxylates were identified in all analyzed white area samples (1600-1500 cm^{-1} region), the registered variation in bandwidth being correlated with the presence of carboxylates with various molecular weight [8].

On regard the black areas, XRF analysis highlighted the presence of lead and sulfur, along with traces of aluminum and manganese that may point towards the use of a typographic ink, a practice that may be found in modern and contemporary artworks [9]. FTIR data did not highlight any characteristic peaks for these samples, registered spectra being dominated by the binder IR absorptions. In contrast with the white analyzed areas, FTIR spectra registered on the black paint samples show a much greater intensity of the C-H stretching vibrations within the 2900-2800 cm^{-1} absorption region and overall, much broader absorptions within the fingerprint area that may suggest the existence of higher concentrations of oxidation products [4]. The second derivative profile highlighted the existence of two distinct absorption peaks at approx. 1657 cm^{-1} and 1599 cm^{-1} that may be ascribed to amine structures. These finding are in agreement with the typographic ink inferred from the XRF analysis, as free amides can be added in inks containing phosphotungstic or lead pigments in order to improve their working properties [10].

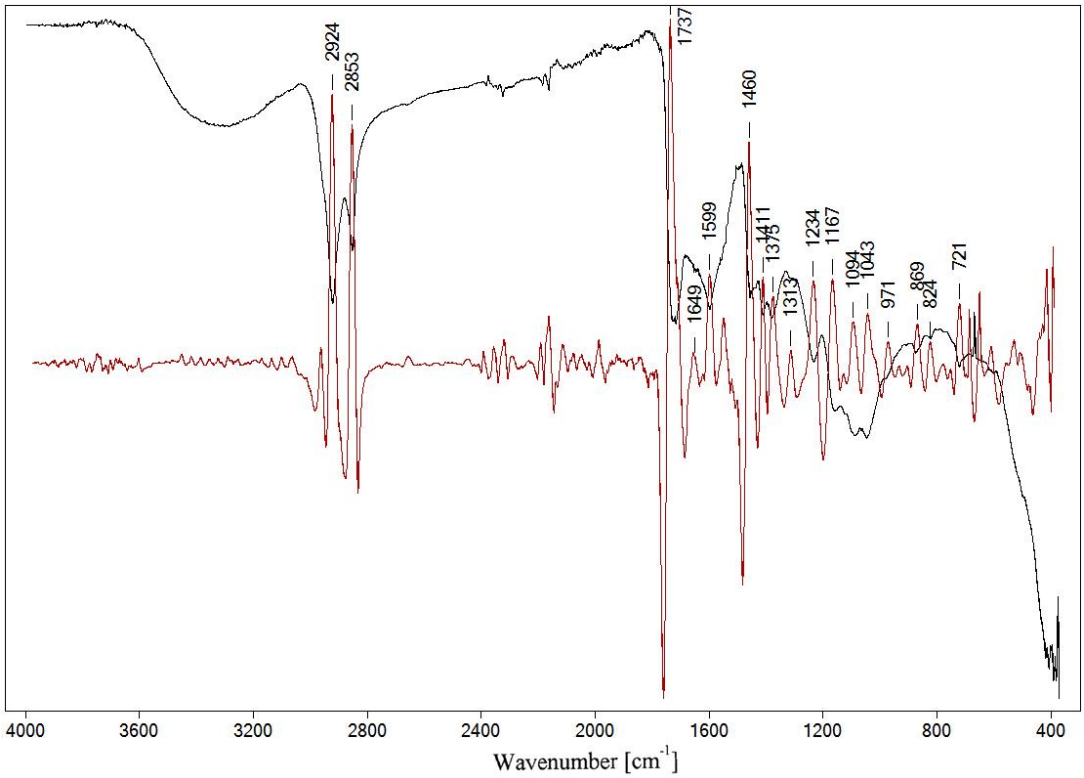


Figure 5a. *FTIR spectra and second derivative registered for the black paint sample. The arrows indicate specific spectral features associated with the presence of free amines. The broad absorption region (1600-1500 cm^{-1}) can nevertheless be correlated with high concentrations of metal carboxylate as well.*

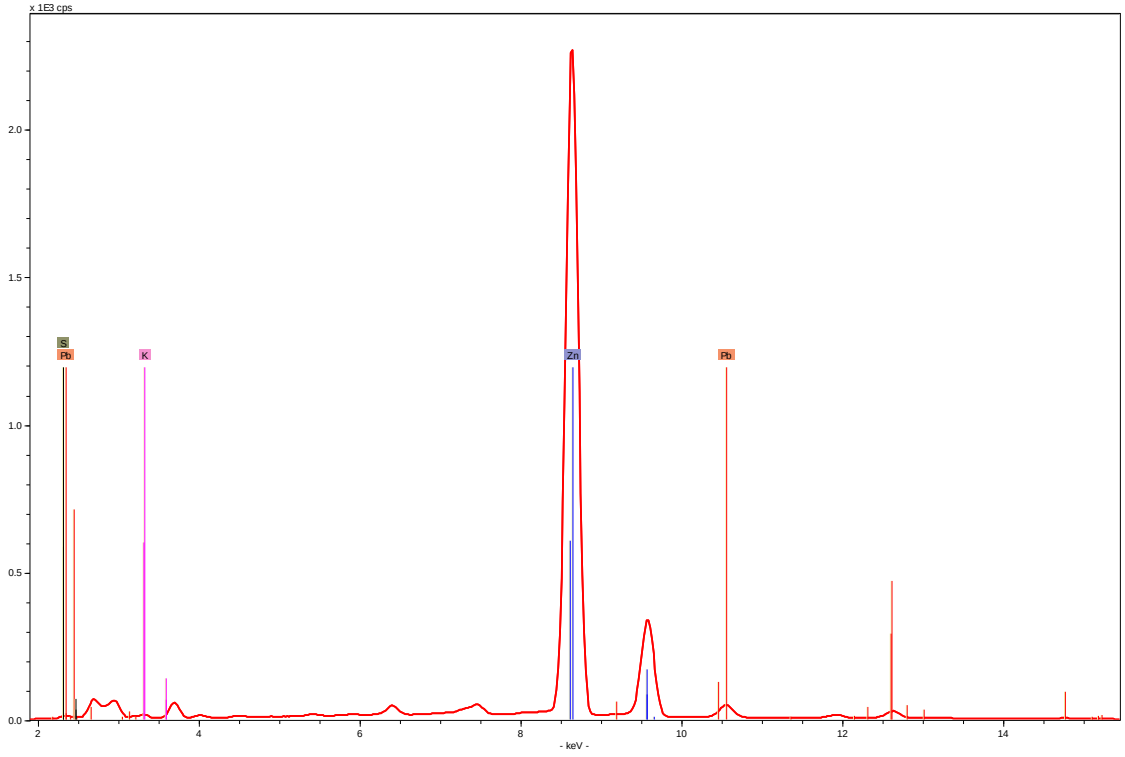


Figure 5b. *Expanded view of the XRF spectra highlighting the presence of lead, sulfur and potassium, along high concentrations of zinc.*

4. DISCUSSION

Restoration treatment

Based on the results of the scientific investigations an adequate restoration treatment was formulated. Three primary goals were established for the cleaning of this painting: to remove surface dirt and dust, to minimize swelling effects or pigment extraction, and to avoid undesirable changes in original optical reflection (sheen). During practical testing the painted surface showed no hydrophobia, thus implying the selection of an aqueous solution [11-12]. In contrast, the verso was water sensitive due to its lack of preparation. It was pursued the flattening and reinforcement of both canvases by solvent impregnation. Controlled heat and pressure was maintained until solvent evaporation.

From the 1940s onwards there has been an emergence of a wide variety of synthetic binding media for the dispersion of pigments. These types of synthetic polymer including acrylic, PVA, alkyd, nitro-cellulose, polyurethane, epoxy and silicone resins, behave differently in response to environmental conditions and aging. Therefore the choice of binder has important ramifications for conservators and conservation treatments [13].

The first restoration stage has implied superficial cleaning of dirt deposits on the painted surface, including the verso. In the first phase dry removal was carried out using soft synthetic sponges. The favorable condition of the binders allowed this intervention without any risk of abrasion. In the second phase, various premixed solutions were tested to determine the optimum chemical equilibrium, all having the same pH value and conductivity. The optimal cleaning solution (gelled) was buffered to a pH equivalent to 6 and a conductivity of 500 µS/cm. Cleaning of the assembly proceeded gradually (*Fig. 6*), applying the solution by brush (chess board pattern) and neutralizing with lightly dampened cotton swabs until surface uniformity. The white pigment displayed sensitivity in some areas, already eroded, and has been carefully observed during treatment. Later, possible presence of cotton debris was checked for in ultraviolet fluorescence. Dirt deposits were more consistent on the small canvas area than the larger one.

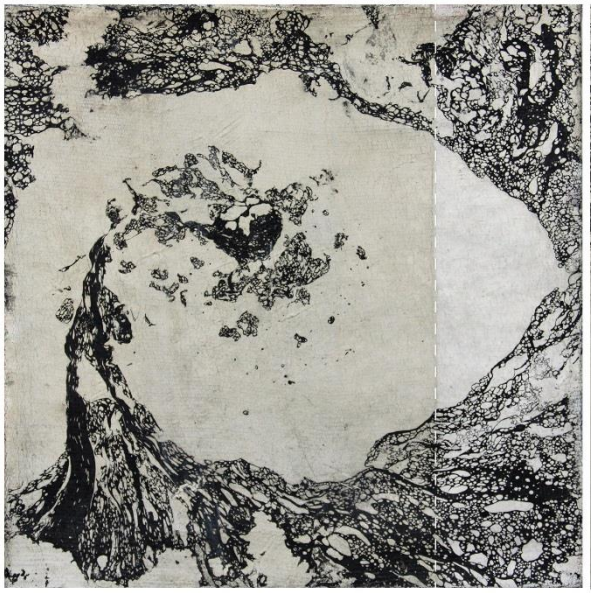


Figure 6. *Details during the superficial cleaning of the painting*

Consolidation was the second stage of treatment applied after complete evaporation of the cleaning solution. The stretchers (fir wood) were in a precarious condition, joined at the corners with metallic nails, with no inclination and/or feathers. Both canvases have been removed from

their stretcher in order to replace them with suitable auxiliary supports. Exceptionally, the larger canvas had its left side glued to the stretcher, apparently with a synthetic adhesive. This inappropriate consolidation process applied by the artist was often used during the 20th century [14]. The local perforations were mended or supplemented with additional threads by using polyamide and hot needle. BEVA 371 (30% concentration in naphtha) was impregnated by the reverse and kept under pressure and heat (not greater than 60˚C) until drying. Simultaneously the fragile edge was strip lined. Therefore both supports have been flattened, including the early-stage color detachments. Sequentially they were correctly retensioned on the new stretchers (*Fig. 7*) and mounted together with the ensemble (baguettes, frame).

Figure 7. *Details showing restoration of the damaged area caused by a glue lining*

Prior to the chromatic integration, the artwork was isolated intermittently. Retouching was implemented with reversible pigments in an aqueous medium. The final varnishing was applied by spraying Regalrez 1094 resin (9% concentration in isooctane). This is a low molecular weight aliphatic resin, very stable to darkening over time and ultraviolet radiation [13].

Considerations

The unconventional choice of industrial cotton by the artist has been a particular case in the restoration process. The elasticity of the fiber was treated through general consolidation and retensioning on the auxiliary support. Also, the mixed technique applied to the support arose a few questions regarding contemporary innovations. It is worth mentioning that during the process, when the assembly was dismantled, a discolored/yellowish hue was noticed (see *Fig. 8*) that coincided with the area covered by the small canvas.

This area did not disappear after surface cleaning most probably as a result of the chromatic alteration suffered by the pigment. The phenomenon can be mainly related to the reactivity of zinc white in oil based paints and higher rate in soap formation processes [8]. Nevertheless, the catalytic effect of other components has to be taken into account, moreover as lead based pigments were also identified within the artwork.

According to previous studies [15], lead carbonate tends to chromatically convert to yellow/orange in the presence of an acidic environment. In addition, the hue can turn to brown/black, especially in contact with sulfur producing lead sulfide. Taking into account the results of the spectroscopic investigations all elements favorable for this reaction were found present.

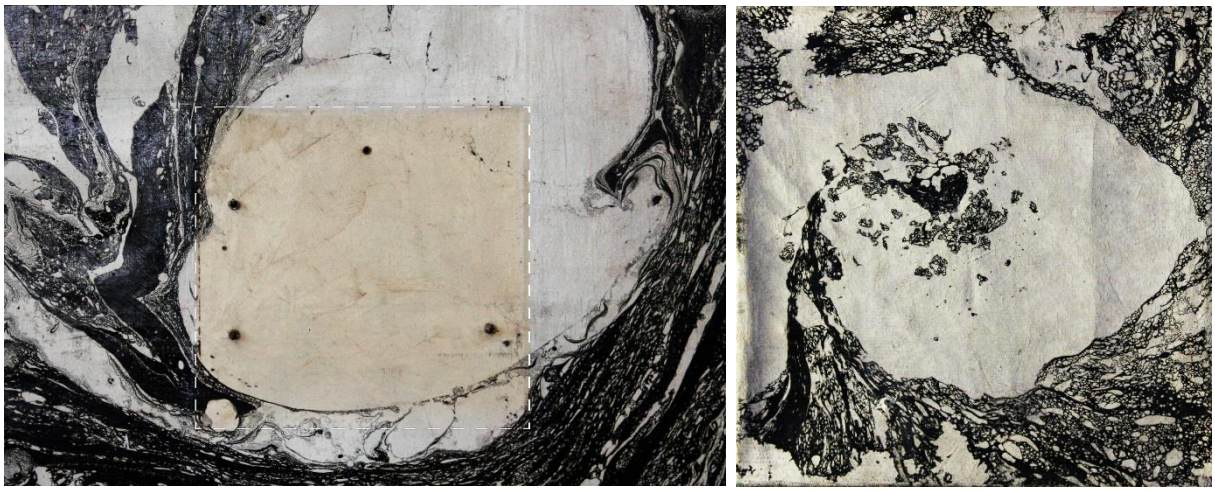


Figure 8. *Detail of discoloration area revealed after removing the small canvas (showed in the left image)*

Figure 9. *Final assembly of the artwork after applied treatment and interventions*

Regarding modern pigments, it is necessary to determine in what manner does the light exposure affect (or not) the discoloration of pigments, alongside other atmospheric or structural

catalyzers. Although there is limited data regarding the type and quantity of light exposure, for this case study, it is certain that the discolored area was maintained in absence or reduced quantity of radiation. Other factors such as interactions with atmospheric pollutants are considered relatively uniform. It remains a subject of future research: to establish a clear distinction between the deterioration effects of light radiation and the absence of light (darkness) on contemporary paintings, whether varnished or unvarnished.

4. CONCLUSIONS

The technical study of Romul Nuțiu's painting Dynamic I offered interesting insights on regard the artist choice of materials and working methods, crucial aspects for the layout of an adequate restoration treatment. Although simple in terms of the color palette, analysis of the artwork proved not always to be straightforward, analytical difficulties being due to the execution technique. High concentration of white zinc and other mineral filers such as calcium carbonate were identified via the elemental analysis, while FTIR data highlighted the use of an oil binding media as well as of a polyvinyl acetate resin, this last one possible ascribed to the preparatory layer. Characteristic ageing products for oil-based paints were identified, along a series of metal carboxylates - results of the chemical reactions formed between the binder molecules and the present pigments. The yellowing of the paint surface could be related to the reactivity of the zinc white pigment, although the lead based pigments identified within the black areas - probably due to the use of typographic ink, could also be related to the overall chromatic alteration of the paint layers.

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