Study of technology and preservation state of an 18th century triptych by the use of physicochemical diagnosis methods as prerequisite for its conservation

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Introduction

This case study presents the study and conservation of an 18th century triptych from Astros Kynourias - Peloponnese belonging to A. Tsoumas family and includes a brief aesthetical and historical analysis, the presentation of the applied physicochemical methods results, its pathology record and the presentation of the conservation works that were carried out.

Emphasis is given on the contribution of physicochemical methods and analytical techniques in the study of construction technology, technique and preservation state of an artwork, which is a prerequisite for a holistic conservation approach.

Aesthetical and historical study of the triptych

The central iconographical theme of the triptych - whose right wing and top fretwork are missing – is “Virgin the Unfading Rose” and is framed by gilded fretwork, which on the upper part is composed by two levels (Fig. 1).

The central composition is surrounded by three zones, where various saints are depicted, while the left triptych wing forms on the upper part a quart circle and is separated in three horizontal zones with depictions of ”the Ascent of prophet Elias”, the Saints Charalampos, Nikolaos

Figure 1 Triptych “Virgin the Unfading Rose”, late 18th century. Tsoumas' family, Astros Kynourias. Egg tempera on wood. Dimensions: 52,8 cm X 55,9 cm X 3,3cm (opened).

and Spyridon and Saint George murdering the dragon.

Dating evidences of the artwork constitute the frame fretwork, as well as the central composition. Concerning the gilded frame, the general aspect of its upper part reminds iconostasis elements of 17th and mainly 18th century, when generally the artists' intention to attribute iconostasis elements on the triptychs fretwork becomes explicit and the golden fretwork ornaments are fabricated on blue or red background (Papyros Publishing House, 1991α). Elements for the more explicit chronological dating of the artwork are its high relief, as well as the type of fretwork ornaments and patterns, that refer directly to the second half of the 18th century (Fig. 2).

Figure 4 Tsoumas' family triptych, Astros Kynourias. Detail from the central composition of the triptych with the "Unfading Rose".

Concerning the central composition of "Virgin the Unfading Rose" (Fig. 3), the iconographical type has its origin in the italian and more specifically the Florence painters of the 14th and 15th century (Kren and Marx, n.d.) (Berenson, 1963)- that's the reason we observe an infiltration of western iconographical elements in the byzantine type (eg. the elaborate maforion, the crowns with the "fleur de Lyses", the suavity of the faces) - but his deeper roots are found in the devotional life of Orthodox Church and more specifically in the Akathistos Hymnos (Pallas, 1971). The first dated examples of the iconographical type come from the end of the 17th - beginning of 18th century (Pallas, 1971) and we can distinguish mainly three subtypes. The first one, includes the depictions of Virgin Mary in large bust supporting Christ standing on a lectern, it is found in the early examples of the "Unfading Rose" and reappears in the late 18th century (Pallas, 1971, Musée Carnavalet, 1993). The second one concern the depictions of Virgin Mary in bust supporting Christ standing and the cluster emerges through one or two big roses (Chatzidakis *et al*, 1968, Karakatsani, 1980). The third one includes variations of the other two subtypes that are found during the entire 18th century (Kalokyris, 1972), and enthroned depictions of Virgin Mary that dominate during the 19th century, as it arises out of engravings with the "Unfading Rose" (Papastratou, 1986).

Figure 3 "Virgin the Unfading Rose & Iesai Root", Antonios Sigalas, 1786, Athens Byzantine Museum. Detail from the central composition. (Achimastou-Potamianou, 1998)

The central composition of Astros triptych has remarkable resemblance with the one of Antonios Sigalas icon (Fig. 4) of the Athens Byzantine Museum dated in 1786 (Achimastou-Potamianou, 1998) and belongs to the first subtype of the "Unfading Rose", that reappears in the late 18th century, when the lectern where Christ is standing resembles and refers to the Altar.

Another dating evidence is the depiction of Saint Charalampos in the central zone of left wing, who becomes particularly popular as a protector against the plague during the 18th century, when a lot of relatively unknown saints also enter the iconography and are depicted in prominent place in icons and triptychs (Gouma-Peterson, 1994).

Study of the artworks technology and preservation state by the use of physicochemical diagnosis methods

The examination and the technical analysis of the triptych that was carried out included:

- Photographic documentation of the triptych under visible light and its specific areas of interest.
- X-ray radiography.
- Optical microscopy of painting layer cross sections and stereo macroscopic observation of the painting surface.
- Infrared B&W reflection photography.
- Color Infrared Photography.
- Gas chromatography of the old varnish.

X-radiography (Roentgen)

For taking the radiograph, we used an Agfa cp-bu 30 X 40 cm film in cassette with reinforcing plates of medium sensitivity and without the use of antidifusional diaphragm (Klitsa, 2001). The focal distance between artwork and lamp was 1 m., while the characteristics of X-ray beam were 10 mAs and 55 KV.

The radiograph of the triptych (Fig. 5)- connected to the degree of X-ray absorbed by the object, depending on the nature, the volume, the density and the atomic number of the matter's chemical elements (Alexopoulou – Agoranou, 1993) – gave valuable information concerning the internal structure, the preservation state and the nature of its construction materials.

Figure 5 Tsoumas' family triptych, Astros Kynourias. X-radiographs of the triptych's two wings.

Concerning the wooden support, the metallic joints – areas of high absorption – by which the second frame level is attached to the upper part of the main support, are four quite thick nails fixed obliquely.

Also, remains of two symmetrically fixed metallic joints are located on the upper part of the frame and constitute evidences of the former presence of a "crown fretwork" attached on the upper section of the central wing.

The nails by which the left fretwork piece is attached on the second level of the frame are particularly thick and long, while the left triptych wing – like the lost right wing - is joined to the central one by quite long Y shaped pieces of thick wire implanted deeply in the support.

In the same time, the exit holes and the tunnels caused by the activity of wood destroying insects, are visible as low absorption areas and are extended along all the left wing.

The fretwork's details are clearly revealed, due to gesso accumulation in the relief cavities, making however complicated the general image and indistinguishable the extent of the insects attack, since only some tunnels are visible on a small detached fragment of the frame. Above Saint Anne's depiction and on the one of Saint John, the round areas with absorption higher than the rest of the support are evidences of wood knots presence, due to the wood's higher density, while the cracks of the support appear as very low absorption areas.

Concerning the ground layer, it appears to be quite finely smoothed, since no traces of the tool by which it was applied on the wood are observed. Small dots of high absorption, noticed sporadically, are indicative of the ground layer's penetration in the wood which is common in ground layers containing lead white. Likewise, we can distinguish defects of the support that existed before the artworks creation, like on the round crack above Saint Anne's head and the round area below Virgin Mary's right hand, that indicate gap filling or intrusion of ground layer in the wood. On the other hand the areas where the ground layer is lost have quite low absorption.

The sketchy outline of the painting is visible under the form of thin and sharp white lines (Milanou, 1987). The high X-ray absorption of these lines indicates the presence of lead white in the ground layer and wherever they appear to have more contrast its indicative of the absence or low proportions of lead pigment in the overlying paint layers (Currie, 1995). The sketchy outline could have been done either by incision on the ground layer and reapplication of second thinner layer of preparation or by incision of ground layer and subsequent application of a thin lead white layer (Fleischer, J. and Bjerre, 1995). However in the latest case the radiograph would have a very low contrast (Currie, 1995) which is not observed in the present case.

On the central wing, the sketching lines follow the main outline of Virgin's maforion, they are quite visible on the volumen held by the angels and underline some inner outlines and details on the draperies and the horses. On the left wing, there is a higher consistency in the outlining of the figures and the supplementary pictorial elements. Moreover, there is a higher detail on the sketching of inner outlines, mainly on the figure of Saint Georges, the depiction of the building and the horses on Prophet Elias' chariot. Besides, the presence of a white dot on the heads of all figures and in the center of halos is an indication that a mark was put on for the use of compasses.

Concerning the paint layer and the painters' style, the areas that gave typical information are the draperies, the landscapes and the animal figures, where the brush strokes are clearer and where generally the icon painters are more freely expressed. We indeed notice a free movement of the brush and the brush strokes are generally parallel the one to the other and intermingle, while in some other areas - like on the building behind Saint Georges and on the dragons' wings - they are applied in many directions. In the same time and on the most part of the artwork there are no distinct limits between the shades of a color, a confirmation that the artist did not follow the strict byzantine technique of applying successive paint layers for the shadings, which can be explained to a large extent by the western influences under which the iconographical type of the "Unfading Rose" evolved.

Finally, regarding the contribution of the method to the pigments' identification, this cannot be used of its own, since the pigments' X-ray absorption is affected by the variations of paint layer thickness, the pigments mixture and the ground layer absorption (Alexopoulou - Agoranou., 1993). However, taking into account the shades of each color in visible light and the general classification of pigments according to their chemical composition and thus their x-ray absorption, along with the results of IR photographic methods we were able to draw some conclusions that are presented in a separate section.

Optical Microscopy

For painting layer cross-sections observation, five sampling spots were selected, so as to include the biggest possible chromatic variety but with the restriction to be from already deteriorated areas and not from individual compositions of small dimensions.

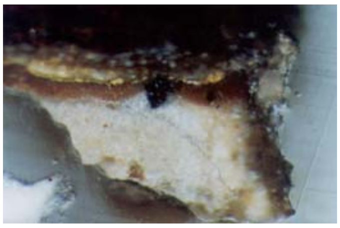

Figure 6 Sample 1, from the upper right part of the fretwork frame.

The samples were mounted in synthetic polyesteric resin and observed by the use of optical metallographic microscope with objective plan-chromatic lens Planchromat Pol 20X/0,40, under reflected light, giving information on the number, the sequence and texture of various painting layers as well as some indications on the mixture/pureness of pigments used (Alexopoulou – Agoranou, 1992).

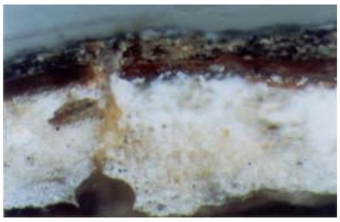

Figure 7 Sample 2, from the upper right part of the fretwork frame.

The ground layer, that is taken in Samples 1, 2 and 3 (Fig. 6-8), is of 255-320 μm thickness and it's white to whitish. It is characterized by the presence of some colored particles – possibly impurities or pigment residues – and its binding medium is animal glue, as deduced by the presence of gelatinous areas of varying size.

Concerning the overlaying wine-red layer, observed in the Samples 1,2 and 3 (Fig. 6-8)- where the ground layer exists - it is bole layer, which appears to be present in all the extent of painting layer as it is visible in most of the paint layer losses. Its thickness varies from 15μm to 40μm and it is characterized by the occasional presence of big black and small yellowish particles. Also, in the microphotographs is visible the use of gold leaf (Fig. 6, 7) and gold stroke (Fig. 9) by the artist.

Figure 8 Sample 3, from the lower left part of left wing's painted frame.

Figure 9 Sampl3 4, from the green drapery of St. Athanasios on the central wing.

Table 1 Microscopic characteristics of painting layer cross sections.

Sample/ Layer	Thickness	Admixtures	Characteristic texture	Remarks
1				
Dark	55 - 60 μm	indeterminable	crystalline	Varnish layer with dirt
Gold	7,5 - 15 μm	-	metallic	Gold leaf
Wine-red	30 - 40 μm	few yellowish & big black particles		Bole layer
White-whitish	255-320μm	dark gelatinous areas		Ground layer
2				
Dark	30 - 80 μm	indeterminable	crystalline	Varnish layer with dirt
Gold	1,5 - 5 μm (in places missing)	-	metallic	
Wine-red	25 - 40 μm	few big black particles		
White-whitish	255-320μm	yellowish gelatinous areas – few green & black particles		Ground layer
3				
Black	2,5 - 10 μm	-	sleek	Soiling or Burnt varnish
Dark red	2,5 - 7,5 μm	-		Paint layer
Orange	5 - 35 μm	few red particles		Paint layer Probably Vermillion
Wine -red	15 - 20 μm	few yellowish & big black particles		Bole layer
White-whitish	255-320μm	big yellowish gelatinous areas – few green particles		Ground layer
4				
Gold	1,5 - 2,5 μm	-	metallic	Gold stroke
Bluish green	at least 130 - 185 μm	medium sized white particles		

With regard to the paint layers, there is limited mixture of pigments, though we cannot generalize the observation since the number of samples is quite small. Moreover a pigments microscopical identification was not attempted, since as stated by McCrone (1982), the authors believe that it would be safer to draw conclusions by the use of powdered samples and microchemical tests. However the microscopic characteristics of all the painting layers are given in Table 1. Finally, the extent of varnish degradation and the integration of dust and soot in it are obvious especially in Sample 1 and 2 (Fig. 6 & 7).

Infrared B&W Reflection Photography

For infrared B&W reflection photography - where the infra red radiation reflected by the artwork's construction materials is

Figure 10 Tsoumas' family triptych, Astros Kynourias. IR reflection photograph of the central wing.

exclusively recorded – we used a black & white 35 mm Kodak High Speed Infrared film, with natural lighting, a Wratten 87C filter, AF MICRO NIKKOR 60 mm micro lens, f: 16 aperture diaphragm, and 1/15 seconds exposure time for both wings (Kontogeorgis, 1999).

The penetrative capacity of the IR radiation and the fact that many materials reflect or allow its penetration through their mass in a different way than the visible light (Alexopoulou – Agoranou, 1993), gave the possibility to study the paint layers laying under the artworks surface and to shape a more explicit view of the painting layer's preservation state, since invisible – due to dirt accumulation – wears were revealed. Likewise we were able to track down indistinguishable painting details, since in areas where the varnish was burnt, like on the left wing's edges (Fig. 11), the composition became clearly visible. Also, details painted on the gold leaf, like the crowns and the clothing ornaments, where there was dense dirt accumulation, were revealed in detail (Fig 10). Thus the photos were of important use during the painting surface cleaning.

Figure 11 Tsoumas' family triptych, Astros Kynourias. IR reflection photograph of the left wing.

Color Infrared Photography & Pigments Approximate Identification

For the color infrared photography - where, apart from the infra red radiation, a part of the visible radiation reflected by the artwork's construction materials is recorded - we used color reversible 35 mm Kodak Ektachrome Professional Infrared Film/ EIR 200 ASA, natural lighting, AF MICRO NIKKOR 60 mm micro lens, f: 8 aperture diaphragm and 1/500 exposure time for the triptych's central wing and 1/320 for the left wing (Kontogeorgis, 1999).

With regard to the contribution of the method to pigments identification, it is noted that, as in IR B&W reflection photography, the behavior of a color can be affected by the mixture of pigments and the layers' thickness, while especially in color IR photography the colors are influenced by the concentration of the pigment in the medium and the accumulation of dirt (Alexopoulou – Agoranou, 1993). However, having in most cases the false colors of pigments in IR-visible as starting point (Fig. 12 & 13) and with the parallel observation of the colors' behavior in the infrared and their absorptions in X-rays, it was possible to carry out an approximate identification of several pigments used by the artist (Table 1).

White: By IR photos it's not possible to conclude about the pigment

Figure 12 Tsoumas' family triptych, Astros Kynourias. IR reflection photograph of the central wing. False color infrared photo of the left wing.

Figure 13 Tsoumas' family triptych, Astros Kynourias. IR reflection photograph of the central wing. False color infrared photo of the left wing.

used, since all white pigments have absorption to IR of about 0% and their false-color is also white. However, the high absorption in X-rays is indicative of a lead or zinc pigment, possibly lead white ($2PbCO_3.Pb(OH)_2$), silver white ($(Ag,Pb)CO_3$) or zinc white (ZnO).

Red: According to the yellow false-color, possible pigments used are cinnabar (HgS) and cadmium red both of them having a very low IR absorption as in the present case (Alexopoulou-Agoranou, 1993), however the very high absorption to X-Rays exhibited, which is typical to mercury pigments, corroborates to the use of cinnabar (Gettens *et all*, 1972). Moreover, the red used for the depiction of St. Paraskevi's mantle is visibly a different pigment. This has a yellow/ brown false color, which is exhibited by two common pigments: red lead (Pb_3O_4) and Venetian red/hematite (Fe_2O_3) (Alexopoulou-Agoranou, 1993). However, neither its absorption to IR is not so low or its absorption to X-rays so high as to indicate lead (Fitzhugh, 1986). So we must assume that it's probably a ferrous pigment, hematite which is common in icon painting (Alexopoulou-Agoranou, 1993).

Blue: Two common pigments that exhibit a deep blue false color in the infrared-visible are azurite ($Cu_3(OH)_2CO_3$) and artificial ultramarine ($Na_{8-10}Al_6Si_6O_{24}S_{2-4}$) - the natural ultramarine having a red false-color (Hoeniger, 1991, Alexopoulou-Agoranou, 1993). However, the very high infrared absorption of the pigment shows rather that it's the case of azurite (Muller, 1978), while artificial ultramarine has a rather low IR absorption. This fact also is in accordance with the approximate dating of the artwork in the late 18th century – artificial Ultramarine was first fabricated in 1828 in France (Plesters, 1966, Chrisoulakis, 1993) – and is corroborated by the medium to high X-ray absorption exhibited (Gettens and Fitzhugh, 1966), since azurite is often found mixed with lead white (Alexopoulou-Agoranou,1993).

Table 2 Pigments approximate identification by X-radiography and IR photographic methods.

Color	X-ray absorption rate	IR absorption rate	False-color	Probable Pigment
White	V. High	≅ 0%	unaltered	Lead white, Silver white or Zinc white
Red	V. High	≅ 0-25%	ochre yellow	Cinnabar
Red (St. Paraskevi)	Med-High	≅ 25 -50%	Yellow/brown	Hematite (Venice red)
Blue	Med. / High	≅ 100%	deep blue	Azurite
Green (draperies)	Med./Low - In places High	≅ 100%	blue/black - black	conclusion impossible
Green (ground)	High	≅ 25%	red magenta	Cobalt green
Earth colors (flesh priming)	Med.	≅ 75%	grey green	Presence of Raw Sienna and/or Yellow Ochre
Black	Low	≅ 100%	unaltered	Carbon black

Green: The characteristic red false-color exhibited by the green background of the figures depicted in bust – including the central composition – is typical of cobalt pigments (Alexopoulou-Agoranou, 1993). Thus we can assume that the pigment used is cobalt green (CoO.nZnO), which is in accordance with its rather low IR absorption and its high absorption in X-rays (Alexopoulou-Agoranou, 1993). This finding, also allows a more precise dating of the artwork, since cobalt green was discovered in 1780. Concerning the green on draperies, the image is rather confusing, since they have a black and in places a blue/black false-color, its IR absorption is very high, while its X-ray absorption varies from medium/low to high, possibly due to layer thickness variations or pigments mixture.

Black: Infrared photography is not helpful for the identification of black pigments. Though the low X-ray absorption exhibited by the pigment, indicates the use of carbon black.

Earth colors: A conclusion about earth pigments would be risky, since these are always used in mixture in icon painting, especially in the depiction of flesh. Nevertheless the characteristic greenish hue of flesh priming in the IR-visible and the rather high IR absorption are indicative of the presence of raw sienna and/or yellow ochre (Alexopoulou – Agoranou, 1993).

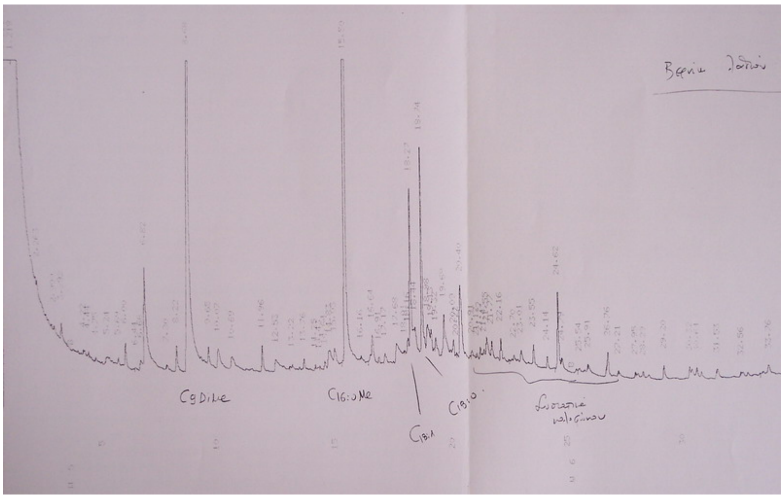

Figure 14 Tsoumas' family triptych, Astros Kynourias. Gas Chromatograph of the old varnish. Sample was taken from the area below St. Elias figure, on the left wing.

Gas Chromatography

Gas chromatography was used for the analysis of varnish composition, which was necessary given that this layer would be removed during conservation and thus it was essential to preserve this evidence of the artworks construction technology. The varnish sample, after appropriate treatment (Ioakimoglou,1992), was placed in Perkin Elmer 8700 chromatograph with trichoid column RH5, 15m X 0,32 I.D. X 0,10u/m, while the temperature programming was between 80 C^o and 320 C^o, with 6/ min bent of anode.

After comparison of the chromatograph (Fig. 14) with a model one of methylesters mixture, we detected the characteristic peaks of two saturated fatty acids' methylesters, the palmitic (15.50 min) and steatic

(18.74 min) and in lower concentration the mono-unsaturated elaic acid's methylester, all of them found generally in old coats of oil or egg tempera.

Another peak observed on the chromatograph at 8.68 min is of the azelaic dimethylester, which is formed in oil coats during their oxidative polymerization, its concentration being at least equal to the palmitic's concentration. In the triptych's varnish their ratio is $A/P \cong 0,9$, indicating that we have the case of oil varnish. Moreover the high ratio of palmitic to steatic methylester concentration ($P/S \cong 4,5$) - being the characterization clue of an oil - indicates the use of poppyseed oil (Ioakimoglou, 1993).

As ascertained after comparison with a model chromatograph of egg yolk, mastic and colophony, the peaks that appear after 21 min, indicate the presence of colophony. Moreover, the two peaks that appear at 24.62 and 26.76 min, suggest the presence of aphydravietic acid and - in low concentration – 7-oxoaphydravietic acid, both of them detected mainly in old resin samples and being indicative of the varnish resin's oxidation (Ioakimoglou, 1993).

Figure 15 Detail from the upper left part of the fretwork frame, where the piece was partially detached.

Artwork's pathology record

Wooden support

In the central triptych wing the support is curved due to its humidity content fluctuations (Schniewind, 1989, Dessy, 1996 Smulski 1998). The movements of the support strained the frame's second level, thus causing its cracking and fragmentation in four segments, one of which was completely detached, while another one is lost. At the same time, in the lowest part of the frame and the upper part of the support there are cracks, some of them quite long and extended up to the painting surface (Fig. 17 & 19), while some others on the back side are caused by the contraction/expansion of wood knots (Schniewind, 1989).

Figure 16 Detail from the upper left part of left wing's left section. The activity of wood destroying insects has cause losses of wood.

Figure 17 Detail from the lower part of central wing's fretwork frame, where the curving of wooden support has caused extensive cracks.

The transverse crack in the upper left part of the frame and the partial detachment of the left fretwork piece (Fig. 15) is caused by the expansion of the rusted nails in combination with their bad placement. However the more remarkable damage, due to the oxidation and mechanical strain of metallic joints, is the loss of the right wing and the "crown fretwork" of the triptych.

With regard to the biological degradation, as detected on the radiograph, the effects of wood destroying insects' activity are located mainly on the left wing, where the tunnels of 1-20 cm length are extended lengthwise – locally also on the wood surface (Fig. 16)– and they mostly do not branch. As we deduced also by the exit holes of round form and diameter 1,5 - 3,0 mm but also by the relatively coarse-grained excrements frass the attack was caused by a beetle of the Anobiidae family (Jackman, 2000), superfamily Bostrychoidea, series Bostrychiformia, suborder Polyfaga (Bejsak - Colloredo - Mansfeld, 2006).

The activity was inactive, as it resulted from the dark color of aged timber that the frass and the wood in the exit holes had, as well as from the fact that newer accumulation of frass was not observed (Lyon, n.d.).

At the same time we detected the action of coloring fungus on the support of the central wing, where the wood was locally discolored on the surface without, however, presenting fragility or other structural degradation.

Painting and varnish layer

As we deduced by the gas chromatograph, the varnish was oxidized, resulting in its discoloration and loss of transparency, the effect being intensified by dust and soot integration. Also on the upper and lower edge of the left wing, where the varnish was burnt, part of the compositions was indistinguishable (Fig. 19 & 20).

Figure 20 Detail from the central wing of the triptychs. The distortion of the paint layer is intense on S. Anna's draperies

Figure 19 Tsoumas' family triptych, Astros Kynourias. The initial preservation state of the triptych.

Figure 18 Detail from the upper left part of central wing's painting surface. The craquele' pattern and the discoloration of varnish are intense as well as the crack of the wooden support.

A dense craquele´ pattern is present on almost all the painting surface (Fig. 19), accompanied by minor or major losses of paint layer and locally of ground layer also.

At the same time on the draperies of many Saints there is a complete loss of the surface paint layers, while on the areas where orange-red pigment has been used, the painting layer was intensely distorted (Fig. 18) with an effervescent appearance and presented detachment of the ground layer and exfoliations or losses of the paint layer.

Conservation and restoration works

Wooden support

Figure 21 Detail of the central wing's lower section were we implanted wooden joints to prevent the extension of cracks.

Considering the extents of the tunnels and the wood decay around the metallic joints observed on the artwork' s radiograph, the wood of the left wing as well as of the fretwork frame was consolidated with Paraloid B72 acrylic resin solution (Down *et al,* 1996, Horie, 2000) in acetone and the process was repeated with solutions of gradually higher concentration.

Following, the detached fragment from the fretwork frame's second level, this was attached on the frame with wood adhesive, while the left fretwork piece was likewise consolidated on the frame without removing the metallic joints, since as we concluded by the radiograph an attempt to remove such big nails would cause serious damage.

On the upper and lower sections of the central wing and in the most prominent cracks of the support, we transversely implanted wooden joints of about 0,5 cm diameter (Fig. 21 & 22), while on the ending points of the cracks we drilled holes of 1 mm diameter and about 2 mm depth in order to prevent their further expansion. Similar holes where drilled on the wood knots in order to weaken the strains.

With regard to the statics of the frame's second level, we inlaid and attached thin balsa wood pieces in the gap (Fig. 22), in order to restore its cohesion with the main wooden support, while the wood losses on

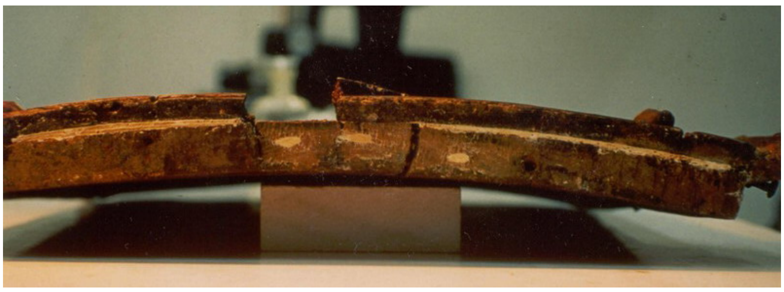

Figure 22 Detail of the central wing's upper section were we implanted wooden joints transversely to the cracks and inlaid balsa wood pieces in the gap between the wooden support and the frames second level.

the upper section of the central wing and the left section of the left wing were gap filled with wood pulp.

Finally, a light chemical cleaning was carried out in order to remove soiling of dust and soot from the wood's surface, while the surface fungus discoloration was partially removed by mechanical means and the wood joints, the balsa pieces and the wood pulp were coated with cassia solution.

Figure 23 The central wing of the triptych during the cleaning of the painting surface and the removal of old varnish.

Painting layer

Initially, the ground layer and the paint layer were consolidated with Primal AC 33 acrylic resin emulsion (Horie, 2000). In the case of the fretwork frame the solution was used in higher concentration because of the thickness of its ground layer – this being evident also on the radiograph – and the restrictions of the relief to exercise prolonged pressure.

The painting surface cleaning of the dust and soot soiling and the removal of the old varnish were carried out both by mechanical means and by solvents mixtures chosen after spot tests and according to the peculiarity of each area (Fig. 23 & 24). In every case the stereomicroscope was used for the observation of pictorial details and of the cleaning progress, while the infrared photos of the triptych where used for guidance during the whole procedure.

Figure 24 The left wing of the triptych during the cleaning of the painting surface and the removal of old varnish.

The aesthetical restoration of the painting surface was carried out with water colors and imitative retouching only on spot paint losses, while on the areas where the orange paint layer was exfoliated a light lazure was applied and the painting surface was coated with a light varnish layer.

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