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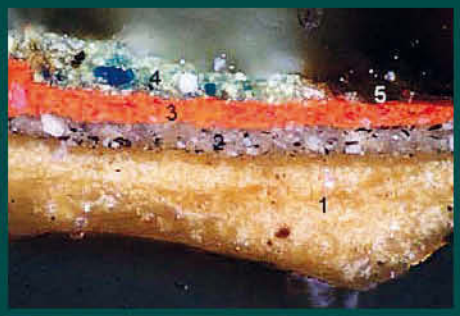
ESRARC 2014

6th European Symposium on Religious Art, Restoration & Conservation

Proceedings book



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Front cover (clockwise from top left)

Cross section from a sample taken from Virgin Surrounded by Flower. Green leaf over a red flower petal, showing the use of double ground. *Credits: Enrique Parra, Larco química laboratory.*

Restoration of a Mural Paintings

Passion Clock from Langestrand church, Vestfold county.

Detail of the radiography where it is possible to observe the golden inscription underneath the Virgin chromatic layer. *Radiography performed by José Figueiredo laboratory.*

The Holy Saviour triptych inside the chapel in the Tivoli Cathedral.

Vault of Good Shepherd, Catacombs of Priscilla, Rome

The Cavalcade of the Holy Cross, Church "Feast of the Cross" of Pătrăuț, Suceava, Romania

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ICVBC

Opificio delle Pietre Dure

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Introductory Lectures

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RESTORING RELIGIOUS ART - FROM THEORY AND ETHICS TO PRACTICE

Giorgio Bonsanti

Since we are dealing in this occasion with religious art, let me try and define this concept, "religious" art, more for myself than for my public in the first place. Actually, what do we have in mind when we use this expression? Because we can just choose as an answer its most immediate and obvious meaning, taking into account in this case the subject or content of an artwork, so that we could speak of religious art, if a painting or a sculpture portrays characters (if you allow me this term) or events taken from the Ancient or the New Testament, and from the subsequent history of the Christian Church; or of any other faith or religion, for that matter. No doubt, this definition does not tell us much about how real and sincere is the religious feeling of this artwork; undoubtedly many pious Madonnas and Saints were painted or carved by artists whom we know from sources to have been total unbelievers. It must be kept in mind that an open declaration of atheism for many centuries would have been very unpopular within a society, even leading those responsible towards an exemplary fate. It is only since the second half of the XVIII century that people, and that at the start only in very selected cultural environments, were allowed to declare themselves devoid of the faith in God. Unfortunately the possible consequences of a declaration of atheism are still dramatic in many parts of the world, you are not allowed to do that. Anyway, also considering the concept of art as it was popular for many centuries until comparatively recent times, that is, not of an intellectual activity (even before than practical) calling for the noblest prerogatives of manhood, responding to an inner urgency to express thoughts and sentiments, but of a very plain, common manual job, whose finality was to provide images necessary for professing religions and responding to the prescriptions of worship, then yes, we can define as "religious" the greatest part of western art from the late antiquity to the XIX century. There were even artists, such as Fra' Angelico, who devoted themselves totally to religious art, by whom we do not have one single painting of a different subject. Fra' Angelico, according to Vasari, could not paint a religious image without shedding tears of compunction. On the other hand, Michelangelo used to criticise Flemish painting because too openly intended to move believers to piety; but he specified that piety resided not in the painting itself, but in the believer's hearts and minds.

Otherwise, we can sort to a different way of considering "religious" an artwork, that is, whenever, independently from its specific subject, we recognise a kind of religious attitude from the artist towards its subject. In that case, we use the term "religious" in a theistic way; not literally, but meaning instead that the author of that artwork is a deeply responsible person, who intends through his art to address all mankind, that everything he accomplishes comes with a sincere feeling of love and sharing for his fellow humans, that he starts a dialogue with their souls going deep to the very roots of human existence. This means finding a sort of "religion" in humanity as such; if we exploit this second meaning, we could interpret as "religious" also a still life [like Caravaggio's at the Ambrosiana in Milan] or a landscape painting [by Claude Lorrain, for instance], or any artwork showing a human being as a frail and defenceless creature, confronted with disturbing situations due to his condition as a human being, subject as such to illness, sorrow, despair [see Rembrandt's Bathsheba at the Louvre], ultimately to death. In other words, we can recognise a profound religious content also in artworks created by the most atheist among artists, in case this artist is seeking to find answers to the most basic questions concerning the human life. He has no belief in God, but feels sympathy for his fellow humans.

Let us also consider, as a side issue, that we can generally agree that, for many artworks once of religious identity and origin, the prevailing function is rather nowadays cultural, in that these artworks are housed in Museums, where they are admired for their artistic and historical value. This does not rule out the possibility that some bystanders still look at these artefacts rather according to their religious role of the origin. I have seen visitors in Museums crossing themselves in front of an icon; and this duplicity of meaning, religious and artistic, is particularly evident in the large number of artworks still preserved in a religious context, serving both worship and artistic appraisal.

Now, the basic question I want to address in this occasion is whether the status of "religious", whatever definition we choose, recognised to an artwork, calls for a particular attitude whenever we are planning to do restoration on it. This question is not unheard of, and not unprecedented in my own personal experience. I recall a conference in Florence at the Library at the Uffizi in 2008, devoted to liturgical patrimony from the viewpoint of art, worship and museums, where the matter was also of conservation; and, still more specifically, at a

recent occasion in Sarzana in September 2013, a conference on the conservation of ecclesiastical heritage. I myself have developed some observations in a recent contribution to a volume in honour of a former colleague from the Soprintendenza in Pisa, Clara Baracchini. It goes without saying that considering the conservation of religious art I am not referring here to bureaucratic definitions of this term, which one finds in the codes of laws, following peculiar situations deriving from a national tradition or historical events; as it happens in the case of Italy, where the Vatican, although by all respects a foreign State, is all the same enclosed within the Italian national boundaries, a fact which has left some consequences on Italian history. Actually a special regimen for religious art in Italy was introduced in the Pacts subscribed in 1929 between the Fascist government and the Vatican (known as "Patti Lateranensi"), renewed in 1984, declaring that "concerning the cultural patrimony belonging to organisations or institutions of the Catholic Church or to other religious confessions, the Ministry of Cultural Heritage…will take care, as regards the exigencies of worship, in agreement with the respective authorities". In fact, this means that according to Italian laws, cultural properties of the Church cannot be sold, displaced of manipulated without a specific permission granted by the Soprintendenze, the State authority responsible for the custody and protection of the cultural patrimony. This can lead to cases in which this "agreement with the respective authorities" as recommended by the Patti Lateranensi is not to be reached easily. While major artworks belonging to the religious patrimony are conceived by common consent as of outstanding artistic value, which requires for them a sort of accurate "handling with care", liturgical objects of lesser importance are still now commonly used daily in the exercise of worship. Now, while there is in conservation a general understanding that an appropriate use of an object of artistic and/or historical value is not in itself an obstacle for its preservation, which is particularly apparent in the case of architecture, where a "use" of some sort provides a security for a better care (of course we can discuss what "appropriate" means in a specific occurrence), with liturgical objects any prolonged handling turns out to be undoubtedly detrimental from the point of view of conservation [I'm now showing a monstrance from Palermo, which would be unwise to handle for daily worship]. Let us just imagine the still surely not uncommon (at least in the Latin world) case of a wooden Crucifix which the parishioners periodically propose to carry in a procession, so that what conservation forbids, religion requires. This calls for a ruling from the Soprintendenza frequently unpopular for the local community. And in our experience are cases when the deep religious value attributed by a local community to an artwork which they saw mostly as an object of worship, made it difficult for the Soprintendenza to displace it temporarily for conservation, because the population objected strongly to their altarpiece leaving its place in the local church.

Reverting now to what I have defined as the basic question, how does the religious quality of an artefact affect the type of conservation to which it is to be submitted, let us recall that the painting of a Madonna with Child possesses a cluster of immaterial values: historical, artistic, and, in our case, religious; but these values are made apparent, visible and tangible by means of what we define as "materials": wood boards or canvas, a priming made out of gypsum and glue, colours made out of pigments mixed in a binding media. According to the major Italian theorist of conservation in the XX century, Cesare Brandi, as he wrote in his *Theory of Conservation* (appeared in its first edition in 1963), "one only restores the matter of an artwork", its physical substance. What Brandi meant, is that a restoration is addressed to the physical substance of an artwork; the restorer must not attempt to intrude into its spiritual world by somehow competing with the artist who created it, as this would happen for instance by resorting to integrations (in case of losses or lacunas in the original) worked out according to subjective suppositions about the original state and shape of the object. A restorer must address his/her action towards the materials so to say objectively, restoring supports and painted films independently from all possible sources of external influence; the first among them being their author, how famous were he in art history. In the same way, a physician concentrates on healing his patient no matter how powerful or wealthy he is (at least this is what should happen). An alternative way of conceiving restoration foresees a more personalised approach, more dependent on the specificities of all kinds encountered while performing the various steps of conservation, and open to taking into account a series of external parameters. As a first reaction, most of us would choose the first model, that of an impersonal relationship between the restorer and the object to be treated, as more rigorous and fit to the codes of ethics in restoration. But I believe this matter to be more complex than it would appear at a first glance; and a preliminary observation to express at this regard, is that every restoration leaves its mark on the object, no matter how this might seem undesirable. No intervention can be considered integrally irrelevant; after all, if we resort to restoration it is because we want to do something at the advantage of an artwork,

and doing something means that we influence the matter and the material history of an artefact. This is the main reason why we try and follow those ethical and theoretical principles which were established in the course of time, such as that of minimum intervention. Now, many could accept that in the bulk itself of the artwork were performed actions aimed at consolidation, since this seems the operation more directly responsible for prolonging the future life of an artefact; but would protest vehemently against other operations not considered strictly necessary for conservation, first of all, the cleaning of a polychrome surface. The fact is, as professionals in conservation are very well aware, that cleaning is not a sort of luxury carried out in order to please the individual taste of decadent aesthetes, but the foremost and preliminary condition to access an artefact, without which all subsequent operations couldn't be pursued and accomplished. But we cannot renounce acknowledging that cleaning (surely in itself a highly delicate operation), whenever an artwork's surface carries expressive values, meets the basic need of permitting their coming to light. Cleaning does not modify the inner identity of an image, but enables this image to transmit its values and meanings. Restoration as a principle does not intervene on the image itself, but on the accidental and occasional modifications underwent by this image in the course of time. Considering all this, one should as a consequence not be surprised if different restorers reach slightly different final results on similar objects. As in music, we have one and the same text, but executions change. This demands of course, as I already said, all the imaginable sense of respect and responsibility, but the final visual aspect of an artwork should mirror the various options taken during restoration while dealing with the components accumulated on this artefact in the course of time, not with its inalterable nucleus. Restoration is by definition a critical act, in that it consists in a series of progressive choices. No wonder then if we consider admissible not coincidental outcomes; what is fundamental is that the whole project is clearly constructed on the basis of scientific analysis, and equally clearly made understandable to all those bearing an interest, the "stakeholders", and the general public.

On the other hand, standing by the concept of "personalised restoration" doesn't mean that we see conservation as the domain of uncertainty and randomness. Its procedures and methods are representative of science, in that conservation is based on the typical process pertaining to science, of analysis, diagnosis, prognosis, therapy, assessment. In order to build a project for the restoration of a specific artwork, one must have in mind the results to be reached, and consider a series of different parameters, some of which are related to a series of variables: historical, geographical, social, anthropological, and still more. Other coordinates have to do with practical, material questions. All of them must be very thoroughly examined at the stadium of making up the project. For the practical questions: I shall refer to one and only example. When the huge painting by Caravaggio, the Beheading of Saint John the Baptist, was restored at the Opificio in the last decade of the XX century, after time consuming discussions and investigations, it was decided to reline the canvas, an operation we nowadays strive to do without, if only possible; this choice was made considering the incidence of marine environment and climate, and that it wouldn't be possible for practical reasons to keep the painting under uninterrupted surveillance. Furthermore, a series of practical precautions and devices were taken in order to ensure at best its isolation. On another level, it is a fact that some publics are more prepared than others to see artworks in their real conditions and to accept having a painting show its age and possible damages. That the final destination can direct the ultimate choices is particularly true in the case of artefacts still nowadays destined to worship. Recently an altarpiece by the Quattrocento Florentine painter Neri di Bicci has been successfully recuperated after being delivered from infamous repaints, on the ground, as the restorer wrote, that "our certainty was the duty of returning to the parish and the small community a painting which would be readable and available for worship". We take note that an "availability for worship" has been in this case the principle prevailing above all others, and we cannot reject this principle on the basis of an abstract theoretical conviction. It must be stressed, besides, that the Italian tradition can afford extensive pictorial restoration, on the ground that the principle of recognisability is observed, avoiding any deception for an unprepared public. This can be typically achieved by differentiating the pictorial treatment of the surface, which can be done in different ways, because applications can vary on the condition that the basic principle is followed. Thus, dealing with religious art and artefacts created for worship, does present specificities from the point angle of restoration, on a practical basis but not without some ground also theoretically. We, the restorers, shall cope with them, as we do, on the basis of our ethical principles and practical experience.

THE GILDING TECHNIQUES IN THE ANCIENT SACRED ART

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The importance of special expressive materials, such as gold and silver, in the ancient sacred art

Gold and silver were widely used by the artists in the past to enrich their holy pictorial representations, thanks to the their special optical properties, brightness and exclusive colour. Many and different way of using gold and silver were invented in the various historical periods. They have been used according to the kind of object to be decorated, the expressive result to be achieved, the historical period, the specific context, the intention of the artist.

Starting from the centuries of the Middle Ages an extreme care was adopted by the artists in the preparation of the wooden panels before applying on them the paint layers and the metal leaves. This very accurate way of proceeding was a common practice in the work of artists and craftsmen in the ancient times. It was aimed at achieving a high expressive result in connection with the prevailing kind of their subjects: the sacred figurations. The materials to be used for the representation of so "precious" subjects, as the holy figures, should be equally precious, in the sense of sought-after and accurately selected. In this viewpoint the gilding techniques represented a really attractive solution.

In the next pages some of the more common gilding techniques are illustrated.

The metal leaves in the panel painting

"Gold and silver backgrounds"

The realization of the so-called "golden background" became a standard practice especially in the 14th century. The holy figures were painted on brilliant precious gold backgrounds.

The metal leaves had a square or slightly rectangular shape with a few centimetres side (usually around ten). They were prepared by the so-called "gold beaters", craftsmen with a such a high ability to obtain extremely thin metal leaves, of just a few microns, mostly 1 to 5. At these levels of thickness the surface where the leaf had to be applied must be absolutely free of any roughness, which would negatively affect the appearance. In the oldest periods craftsmen were able to achieve this smooth surface directly on the "gesso" preparation, through a very thorough polishing of it. The "gesso" ground was usually realized in two layers, the inner, close to the wooden panel, coarser than the upper, obtained with a very fine granulated gypsum (calcium sulphate). Both, were mixed with animal glue. Later, and much more commonly, the typical "gold background" was obtained by interposing, before the gold leaf, an intermediary layer made of "bolus" added with a small amount of animal glue. Bolus is a very fine powder with variable colour from red to orange to yellowish to brown. Thanks to it there is no need to polish the surface. When dry, it is moistened with a wet brush to reactivate the glue so as to assure a good adhesion of the gold leaf. The orange or red colour of the bole below the thin gold leaf gives a warmer appearance to gold. Let's say that the "bole" enhances the appearance of gold. The appearance of the gilding was usually still improved with final finishing work that enhances its brightness and, if necessary, enriches it with engraved drawings. The "*burnishing*" is nothing more than a careful smoothing of the gold background obtained by means of a special tool made of agate stone, extremely smooth to permit, by pressure, an uniform polishing in all points. The "*engraving*" is a still more precious technique to make decorative geometric-shaped drawings, thanks to a series of special "punches", the gravers, which could be shaped at one end so as to leave marks as dots, crosses, lines, asterisks, stars, etc..

The same techniques used for the "golden backgrounds" were also adopted for the "silver backgrounds", but the latter were less common than the former because of the lesser chemical stability of silver to the atmosphere. The tendency of silver objects to darken with time is well known. This is due to a remarkable affinity of to some sulphur compounds (particularly hydrogen sulphide) with the formation of dark brown products. Actually the most of the "silver backgrounds" are nowadays unrecognizable to our eyes because of their dark brown or greyish appearance. Unfortunately, no restoration technique is known that could give back the original brightness.

The "mecca" varnish

The leaves of silver and other "white" metals, as tin for example, could be enriched with the technique of the "mecca" varnishing. "Mecca" is the ancient name of a kind of a transparent, yellow varnish, which was applied over the silver or tin leaves to give them a more precious appearance. It is unclear, however, whether such a practice was to have less expensive imitations of gold leaf, or alternative

forms of colour expression. The "mecca" varnishes were made of linseed oil and natural resins such as sandarac, copals, etc., added with yellow dyes such as saffron, buckthorn, etc..

"Mordant gilding"

When you have to decorate the painted surface with fine details the bole technique is unsuitable. To fix the gold leaf you need a stronger adhesive, a mordant, which can be laid on the painting with a brush, to plot the drawing. Once the mordant is become sticky, the gold leaf is applied and will remain attached only where the mordant is. It is easy, later, to eliminate, with a hard brush all the parts of the leaf under which no mordant is.
The final effect is precise and impressive.

Other variants of gilding techniques in painting

There are variants of the classical gilding techniques described above that use bole or finely grinded Earths, Ochres, Red Lead or even Vermilion dispersed in oil, like in the "mordant method". These preparatory mixtures are often used as a sort of adhesive putty with which you can create also some relieves so that the gilding stands in evidence, an useful way for instance to realize the holy figures' haloes.
A quite unusual metal decoration technique is that used by Giotto for one of the painted decorated frames in his big Painted Cross in Santa Maria Novella in Florence. Non destructive analyses of this greyish decorated frame, made with X-Ray Fluorescence, put in evidence the presence of Mercury and Tin, a quite unexpected composition. Well, we were in front of a decoration made with a *tin amalgam* formulated by Giotto, a fluid material that could be laid like a colour. This is a totally unknown way of making a metal decoration. Today the decoration looks light grey, dull, but at the time of Giotto certainly had a bright silvery appearance, standing out against a carmine background. It was probably used as an alternative to a silver mordant technique, in theory to realize something more stable to tarnishing than silver. Unfortunately, the oxidation of tin changed also this alternative material into something with a greyish appearance.
Another example of alternative metal decoration technique can be observed in a series of ancient icons dating back roughly from the 6th to the 9th century AD, mainly kept in the ancient Monastery of Saint Catherine in Sinai. It is a technique with a great optical effect. The haloes shine in a dynamic way as a compact disk. We do not know how else to describe this special optical effect.
The effect is physically explainable only thinking about a microgroove structure. The walls of the microgrooves reflect light but they change constantly their orientation towards the observer according to the movement, creating the dynamic effect of light shadow cones. This technique of gilding is unknown in other cultures of the same period and, till now, is also unknown the technical method for obtaining this special effect, but it is definitely a way to make a preciously exquisite representation of the sacred figuration.

"Cochiglia gilding" ("Shell gold") and "Pastiglia gilding" (Gold relief)

Among the gilding techniques it is certainly worth to mention also the so-called "shell gold". In this technique gold is used exactly like any other pigment, as a fine dust mixed with a binder (usually, a diluted arabic gum or egg solution). It is particularly appropriate to realize very thin details, impossible to be obtained with the mordant technique. A significant example of this method of gilding can be observed in the famous painting "Birth of Venus". Botticelli used this technique to enhance the parts in light of the leaves in the vegetation on the background of the painting. It is also frequent, for instance, to enlighten the parts of blond hair hit by light.
Finally, the possibility of creating small and delicate pictorial details allowed by this technique was widely used in the illuminated manuscripts, painted on parchment or paper.
A variant of the "shell-gold" technique is the "gold relief," also based on the use of gold powder, in this case mixed with a little 'chalk and other inert powders, and added with natural binders to form a thick paste able to give some relief to the gilded detail.

Metallic leaves in wall paintings and on marble objects.

The composite leaf "Gilded Tin"

In the wall painting a gilding is difficult to be achieved by simply using the gold leaf technique, because of the roughness of the surface and the thinness of the leaf. The "gilded tin leaf" allows to overcome this problem.
The composite "gilded tin leaf" is made of a tin leaf (thickness about 10-20 microns), above which a mordant film is applied followed by the usual gold leaf (2-3 microns).
Successively, the composite tin-gold-leaf was cut out according to the appropriate shape required in the specific context (a halo, a star, the embroidered border of a garment, etc.), and then transferred to the surface of the fresco. The surface where the leaf had to be transferred was first prepared with an oily mordant, the same used for the panel paintings. After the oil is dried (oil on exposure to air becomes viscous and sticky) the leaf was applied and allowed

to adhere to the surface with a mild compression. The mordant between tin and gold is different from that between tin and the surface of the fresco. Such difference is to be attributed to a small amount of some component added to the oil, probably a natural yellow dye such as Saffron or Spin Cervino. Thank to a higher thickness, the double leaf (gold + tin) has a considerable thickness and for that is no longer influenced by the roughness of the fresco surface. Today, where gold is gone, tin shows a black colour due to the formation of oxidized products. The "gilded tin leaf" is not exclusive of the wall paintings. You can find it also on marble sculptures, bas-reliefs, etc.

The "mordant gildings" (gold and silver)

When it was necessary to make some little gilded details (small decorative elements, threads of hair in light, etc.) it was adopted the same the mordant-gilding technique previously described for the panel paintings

As for the silver, this was occasionally used for the representation of reflective metal elements, such as blades of swords, armours, etc.. Unfortunately, in this case too the metal tends to darken, losing its typical colour and reflective appearance.

"Tablet gold" ("Pastiglia gilding")

The "pastiglia gilding" above described for panel paintings has been used also in mural painting but in a somewhat different way. In mural painting it may be useful to combine the effect of the gold brightness with that of volume, of relief, similarly to the "Pastiglia gilding" in panel paintings. The volume could be obtained with beeswax or mixtures of wax and resin, to model certain decorative elements, as small spheres, tablets etc. Then, the gilding was realized by applying the gold leaf to the wax with the typical linseed oil mordant.

The "mordant gildings" (gold and silver)

When it was necessary to make some little gilded details (small decorative elements, threads of hair in light, etc.) it was adopted the same mordant gilding technique previously described for the panel paintings.

As for silver, this was occasionally used for the representation of reflective metal elements, such as blades of swords, armours, etc.. Unfortunately, also in mural painting the metal tends to darken, losing its typical colour and reflective appearance.

The gilded bronzes

The amalgam gilding

When the gilding is to be realized on a bronze surface, the technique differs somewhat. The metal, especially copper and its alloys, opens new possibilities of gilding, new techniques that in theory (but unfortunately not always in practice) allow a greater resistance.

In the Middle Ages and Renaissance it is common to find bronze sculptures, such as statues, doors of church buildings, funerary monuments, etc. partially or wholly gilded to make most precious their surfaces.

One of the more common technique of gilding, specific for copper and its alloys, is known as "amalgam gilding". Once the sculpture was completed, with a great care in polishing, a gold amalgam was applied on the parts to be gilded.

Many metals, including gold, easily dissolve in mercury, forming a viscous mush, the amalgam. This can be applied with a brush on the bronze surface. At this point a triple amalgam is formed: mercury-gold-copper. It is then necessary to remove mercury, leaving only the gold fixed to the copper (bronze). This operation requires working at a high temperature, over 357°C, the boiling temperature of mercury. Being mercury a highly toxic substance, today this way of operating would be unacceptable. At the end of the operation the gilded surface requires an accurate polishing, to obtain the proper appearance.

The amalgam gilding is stable if stored indoors, as, for example, the case of the funerary monument of the antipope Baldassarre Cossa, artwork of Donatello within the Baptistery of Florence.

Quite different is the situation when the amalgam gilded bronze is placed outdoors, especially in an urban centre affected by air pollution. A significant example of this is that of the three bronze doors of the Baptistery of Florence, mainly the North Door and the East Door, the latter better known as "Paradise Gates", an Italian Renaissance masterpiece.

The problems of the amalgam gildings on bronze objects exposed outdoors is originated by the contact between gold and copper (bronze); the former, gold, a "noble" metal, not subject to oxidation, the latter, copper, much more susceptible to oxidation. It is called a "galvanic couple". When between the two metals a dielectric is formed, this generates a corrosion battery. This makes copper much more susceptible to oxidation. Dielectric is the name given to a conductive solution, for example a salt. Water soluble salts are common in polluted atmospheres. They slowly deposit and accumulate on the surface of objects exposed outdoors, in our case, on the amalgam gilding of an ancient bronze object. A certain moderate porosity of the amalgam gilding facilitates a slow penetration of water solutions of salts inside, in particular between gold and copper (bronze) and this starts to work as a dielectric. Copper initiates to corrode with the formation of copper salts which crystallize between copper and

gold, concentrating in small points. They push the gilding to the outside; a diffuse phenomenon of flaking takes place. Thousands of pustules arising from this process affect seriously the gilding.
The example that we brought, the wonderful "Paradise Gates" by Lorenzo Ghiberti, was deeply affected by this devasting process. A complex and difficult conservation work was carried out in the past decades, basically founded on the use of the water solution of a very selective agent, able to dissolve only the polluting salts without any danger of compromising the gilding. The entire operation was carried out in a special bath that allowed to avoid any manual intervention of restorers on the fragile gilding. The elements of the door that could not be removed for the treatment in a bath, were cleaned with a special laser equipment.

Conclusions

The examples we have illustrated well point out how much has been widespread and varied in the past the use of gold and silver to enrich representations and objects dedicated to sacred art. Undoubtedly the unique colour of gold, its bright glints and its being a "precious metal" evoke a charm now become natural, spontaneous, after hundreds of years of familiarity with its expressive language. Each material has actually its inherent expressiveness and the language of the materials blends, in ourselves, with that of styles and shapes to build the message that the various cultures have been transmitting us for centuries.

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RELIGIOUS INDO-TIBETAN ART: AN INTRODUCTION

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ABSTRACT

This art can be conceived as the percettible remainder of "divinization", the fostering of the process of familiarity with a "archetypal personal divinities" being realized by the attempts to engrave into the formal image a vigorous valency, evoked by a meditating mind in order to prompt it again to another meditating mind. The most important function of this art reveals itself to be that of fostering the process of familiarity of the contemplator's mind through the phases of meditation on a specific *numen*.
The restoration/conservation methodology related to this artistic tradition does not comply with the contemporary "Western" preservation criteria and standards, but it is widely diffused and recurrent in Himalayan temples as well as in other parts of Asia, also regarding the architectural components for, whereas there is evidence of very lively cults, the lack of a philological method is due to a pious attitude towards objects perceived to be sacred.

Keywords: Indian subcontinent, Himalaya, Buddhism, preservation

GENERAL OVERVIEW OF THE TOPIC

Indo-Tibetan sacred art can be mostly conceived as the percettible remainder, the concrete remain, of "divinization"— Greek: *theosis*—, the fostering of the process of familiarity with a "archetypal personal divinities" (Sanskrit: *ishthadevata*) being realized by the attempts to engrave into the formal image a vigorous valency, evoked by a meditating mind in order to prompt it again to another meditating mind for the divinization of both. The most important function of this art reveals itself to be that of fostering the process of familiarity of the mind through the phases of meditation on a specific *numen* that can be expressed in evident anthropomorphic representation as well as through symbolical implements, geometrical specimens or syllables.
The analysis of the link existing between form and mind is not only the first step towards every gnoseological definition of reality as an ontological unity, but rather the possibility of this analysis in itself indicates that when human beings produce 'works of art' they are substantially shaping the subtle matter forming the plane sustaining the universal field of interaction.
Indo-Tibetan sacred art, through whatever physical medium it is expressed, refers back to a main determining reason. The paintings, murals, sculptures, illuminations and many specific elements of the architecture are conceived in order to be utilized as percettible supports for a practice informed—in relation with the body-mind compound—by a non-dual spiritual attitude.
Indo-Tibetan art also constitutes an unique bridge, an essential link between the relative and the ultimate, provoking unpredictable positive transformations in the consciousness that sincerely attempts an approach toward it.
It should be finally kept in mind that the commissioning of these works – by both lay and religions patrons – was and still is aimed also at accumulating 'spiritual merit' (*punya*), meant to be used in overcoming adverse conditions in this life (illness and other existential obstacles) or in future lives (mainly to avoid being reborn into lower realms: infernal beings, hungry ghosts, animals).

The Oriental world and the European based West

The Oriental world is the holder of a culture very different from the European based West, and it is but natural that one would assume—and for many people this assumption appears to be correct—that the patterns worked out within one's own tradition would be if not easier to follow, at least more understandable and meaningful than those worked out by a totally alien tradition and based on premises that are obscure and mysterious to the Western mentality.
The reason behind such an appeal, even in spite of this handicap which sometimes can also be serious, is, in my opinion, the fact that these spiritualities speak directly to the individuals and engage them in a personal quest, while Christianity, though also stressing on the necessity of a personal relationship of the individual soul with his creator, soon tended to subordinate it again to the overcompassing influence

of the "community" (*ekklesia*), which is the visible aspect of the Church. But one should not forget that, after all, even Christianity, at its beginning, was but one among those many spiritualities flooding into Rome—at that time the metropoly of an unified West—from the same direction: *ex oriente lux*. In a certain sense, then, one has to admit that such an attraction is not new to the Western civilization. Nevertheless, the strenght of Western Hellenistic-Roman culture eventually succeded in interweaving Christianity with his own spirit, bending its Oriental characteristics into a well knitted Western mentality. And this, together with its early necessity of uniting its members in a strong community life, with passing of time has brought along a tendency to give to such a community an absolute power, bent to soffocate the individuals and their singularities. Of course, the diversity of the path chosen pushes also the modern Western seekers to regroup themselves into small communities, but the spirit behind such groups is somewhat of a different kind: even if people cluster together around the same master, each individual is engaged in fighting his own personal battle, because, after all, inner transformation and enlightenment are always a personal achievement.

At the present time Himalayan Indo-Tibetan wall paintings – at risk also for the climate change – generally bear evidence of additional retouches as the background has been painted with homogeneous hues in order to cover and conceal the portions spoilt and faded by the course of the centuries, probably obliterating the details and simplifying the decorative drawings but, substantially, without altering the overall composition of the pictures. Of course this restoration methodology does not comply with the contemporary preservation criteria and standards, but it is widely diffused and recurrent for example in Western Himalayan temples, also regarding the architectural components for, whereas there is evidence of very lively cults, the lack of a philological method is due to a pious attitude towards the *dharma* objects. Actually, the relationship to the ancientness of a work of religious art does not play a major role in local traditional cultures, and not necessary the same sculptures or paintings become out of date or old. Sometimes not redoing but refurbishing occurs, also if leaving uneven surfaces.

The Tibetan and Nepalese Sections of the MNAO

These Sections of the MNAO are closely related to the history of the Italian scientific research campaigns in Asia and the life and the work of Giuseppe Tucci (1894-1984). Increasingly widespread and authoritative sources substantiate the opinion that Tucci was and still is the greatest tibetologist. His numerous scientific works, as well as his many works directed to a broader public, have greatly contributed to the dissemination of knowledge about Asian civilizations.

The Himalayan collections in the Museum are primarily composed of paintings on fabric supports (*thangka*), statues made in metal alloys, votive *cretulae* (*tsatsa*), wall paintings, furnishings and ritual objects, as well as jewellery, architectural wooden elements and parts of furniture. The paintings on fabric supports account for one of the world's most important collections of Tibetan art. Among these are a number of works whose painted surfaces were restored in the Museum's laboratory and whose cloth frames, made of precious silk brocades, were treated in a textile laboratory at the Pitti Palace (Florence).

The MNAO houses of a large collection of these Tibetan thangkas, for the most part collected by Giuseppe Tucci during his expeditions in different Tibetan regions. Scientific analyses of these Tibetan paintings were conducted by MNAO in recent years in collaboration with ENEA, ICCROM, INOA and OPD. For those who usually work with Western art it was possible to effectively enter unaccustomed territory, testament to the proficiency and maturity of the team of experts and the synergy among all the partners. In the past decade, a large number of the Tucci thangkas have been investigated mainly using non-destructive analytical technologies (radiography, X-ray fluorescence, infrared reflectography). Non-destructive techniques of analysis were used because of the conditions of the works, but the respect for the integrity of the piece was actually much appreciated by the Tibetans aware of the project – laymen and monks alike – because of their religious beliefs. Thanks to these further scientific studies related to Tibetan paintings we now possess reliable knowledge about their materials and production.

The materials and the data collected in the MNAO, together with the other institutional activities, so precious under the point of view of scientific research and of divulgation of culture as well, make of Rome one of the 'natural' scientific stakeholders for the Central Asian studies, confirming the role of Italy to be that of an important player in the international researches regarding Himalaya, the 'Roof of the World'.

KEYNOTE LECTURES

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MONITORING AND MAINTENANCE: 2 KEY ASPECTS FOR THE CONSERVATION OF MOVEABLE AND IMMOVABLE CULTURAL HERITAGE

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ABSTRACT

European cultural heritage needs to be conserved in all its aspects. To avoid its irreversible loss, appropriate management and maintenance of the environment is necessary. The increasing number of visitors have led to a series of installations (heating, lighting, etc.), causing complicated environmental dynamics which are difficult to manage. The preservation of Cultural Heritage needs a correct management and maintenance of the works of art. A precise methodology needs to be followed in a logic sequence to cover all the necessary aspects. First, an assessment, a monitoring and a correct diagnosis of the environmental conditions are needed using innovative and non-destructive technologies; second, appropriate intervention strategies have to be applied to guide all the intervention steps, also focused on the reduction of energy consumption and CO_2 production in the atmosphere. Third, the most appropriate management and predictive maintenance need to be defined using both common and innovative tools to ensure the best environmental conditions for the conservation and to reduce energy consumption, generation of pollutants and costs.

Keywords: Microclimate, Conservation of works of art, Maintenance of cultural heritage, indoor climate

INTRODUCTION

European cultural heritage is the testimony of the past, enriches our memory and needs to be conserved in all its aspects, with priority to all our moveable and immoveable works of art. Its irreversible loss needs to be avoided, due to inappropriate, poor management and maintenance of the environment.

A preventive operation creating around a work of art the suitable environmental conditions for its conservation reducing restoration needs to a minimum.

Creating environmental conditions suitable for conservation is a very complex matter [1], also because during the last few decades the massive increase of visitors made it necessary to install a series of superstructures (heating/cooling, lighting, ventilation systems for air exchange, etc.). These installations have given rise to an environmental dynamic that is very complex to manage in order to reach good conservation conditions [2]. For this reason the problem of conservation has become much more complex in the last decades.

The many studies carried out up to now have revealed that much can be done to improve conditions, because the new methods and technologies generated during the last decades and in continuous development make it possible to identify problems and causes as soon as they arise. There is a need to create systems and develop methods for the preservation of CH. It is necessary set up long term monitoring to understand the nature of the interventions, the management and future maintenance of cultural heritage.

In the last decades lot of innovative systems and materials have been developed, need to be considered and used to maintain and preserve our cultural identity.

OPERATIONAL METHODS

"To conserve works of art" means to create a suitable environment around it, i.e. constant, not changing over time and in space the environmental conditions needed to maintain specific parameters, first of all temperature (°C) and relative humidity (%), within established values in function of the material to be conserved [3,4]. Also the natural and artificial illumination has to be used in an appropriate way avoiding dangerous and not useful wave lengths in the light spectrum [5]. This means to constantly monitor the environmental conditions for the daily management and to follow a corrective and preventive maintenance approach.

The preservation of Cultural Heritage has specific

targets and methodologies which need to be followed to achieve a logic and constructive view and to reach a correct management and maintenance of the works of art as schematically described.

First, an **assessment, monitoring and correct diagnosis** of the environmental conditions need to be done. This permits to understand the degradation mechanisms of the works of art and to develop strategies to reduce environmental stresses. The use in this monitoring of innovative technologies coming from the most recent national and international projects can strongly contribute to a correct and non-destructive diagnosis.

Second, appropriate **intervention strategies** have to be applied to guide all the steps of the improvement interventions. Moreover, whilst respecting the barriers present in the historical buildings, the use of innovative materials and technologies permits to improve the existing environment also in terms of energy savings and CO_2 reduction.

Third, the most appropriate **management and predictive maintenance** plan needs finally to be defined and followed using both common and new, innovative devices and tools to ensure the best environmental conditions and at the same time reducing the energy consumption [6] and the generation of pollutants. As a consequence cost-effective maintenance is realized, a very important aspect in the lasts periods where the economic crisis is continuously reducing the money devoted to the conservation. Moreover, in this context today the needs of the public and of the objects of cultural value need to be respected in equal parts. Recent development and production of smart devices, energy-saving controls, storage systems and tools, self-healing and storage materials (Fig. 1) [7], etc. go in this direction. These tools/strategies where owners and managers are also involved can provide guidance to achieve the environmental conditions required to minimise the risk of deterioration of collections and to improve visitor's comfort whilst reducing the costs.

Recent European Projects [8-15] were completed and/or are in progress in this direction and important results have become already available to reach these main important targets: conservation, comfort, energy saving, CO_2 reduction and last but not least cost-effective solutions. A lot of work is still needed, but also a lot of the progress already available could be opportunely adapted and used for the conservation of moveable and immovable cultural heritage.

CONCLUSION

The conservation of our cultural value in all its aspects has to be one of the first target to maintain our identity and history. The aim is complex and needs to follow precise methodologies and use common and innovative solutions, results of recent studies, in particular EU projects. The innovative methodologies, materials, tools and devices studied and developed for civil application can be opportunely adapted and used in the field of conservation of Cultural Heritage. This can be associated to most recent demand linked to comfort needs, energy saving, CO_2 and pollutants reduction and costs cut for the maintenance of our works of art.

ACKNOWLEDGEMENTS

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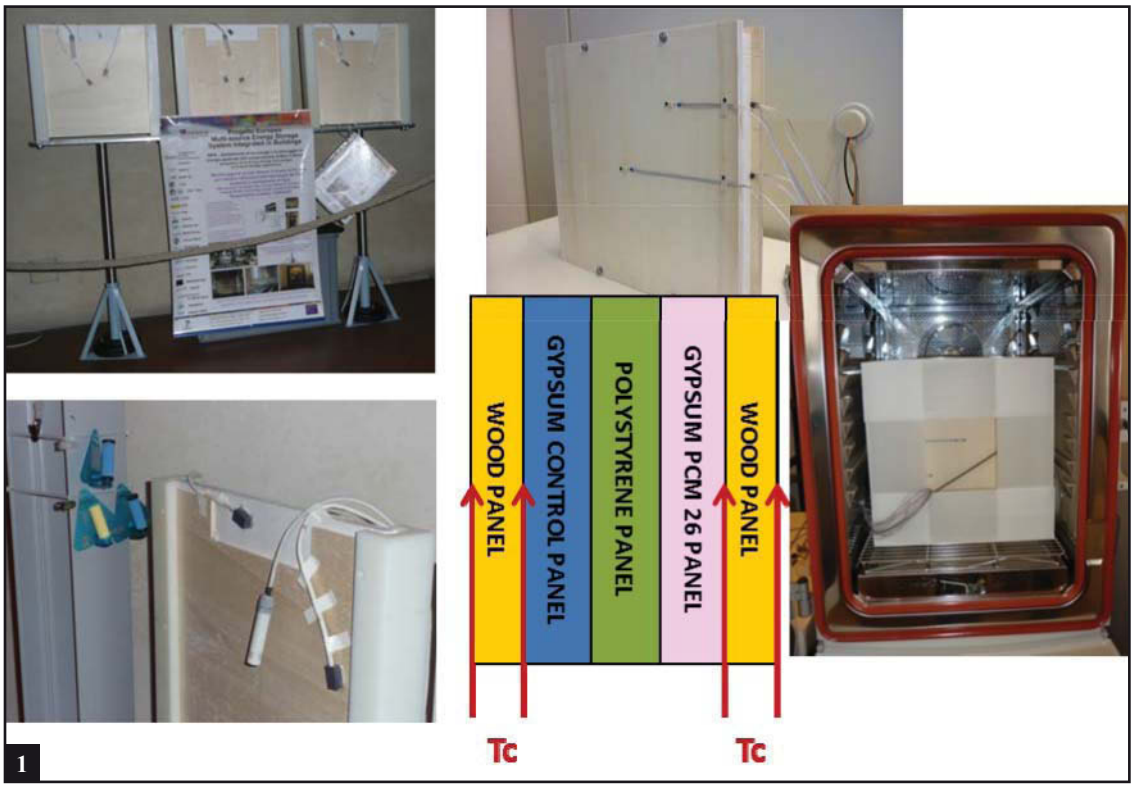

Fig. 1 - Set up of the tests performed in laboratory and on site during MESSIB project to study the possible application of Phase Change Materials (PCMs) to CH field

PRESERVATION AND USE OF THE RELIGIOUS SITES: THE CASE STUDY OF THE ROMAN CATACOMBS

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ABSTRACT

The roman catacombs are the most important early Christian monuments in Rome and they are visited by thousands of pilgrims every year. Their underground nature affects their state of conservation and these specific conditions can not be changed without compromising their integrity. The only viable solution would seem to find a form of sustainable conservation. It is for this reason that in recent years we have undertaken many and diversified experimentation.

Keywords: catacombs, environmental condition, preservation, pilgrimage

INTRODUCTION

The monumental heritage of roman catacombs is composed about sixty funeral complexes carved into the tufa rock; they are very different in size and topographical development [1]. Also the diffusion of mural paintings, about four hundred painted funerary structures, is not homogeneous; they date back to the beginning of the third until the fifth Century with some occasional fresco painting of the sixth-seventh Century, the last testimonials of the use of these underground sites [2]. After this period the roman catacombs were abandoned and remained forgotten in the roman underground until the 1578, when Antonio Bosio began the process of their rediscovery. But in the mid-nineteenth Century, only with the scientific approach of Giovanni Battista de Rossi, we came back to know almost all the early christians cemeteries of Rome. (Fig. 1)

ENHANCEMENT AND PRESERVATION OF HYPOGEAN MONUMENTS

Today, only five catacombs are permanently open to the visitors and just some of the other is it possible to visit on demand. The public of the catacombs is very diversified: some visitors come just for tourist purposes, some other for cultural interests and many others for religious reasons. Each of them has different expectations and needs, but it is extremely difficult to satisfy all the requests [3].

Because of the special environmental conditions, the visit is always with a tour guide and visitors can not stay for a long time in hypogean gallery. Only the groups of pilgrims get the permission to celebrate Mass in some cubicles specially selected. (Fig. 2)

The restrictions imposed to the visitors depend on specific environmental condition of underground sites and they are decided both to the safeguard of human beings and for the preservation of the artworks.

In the hypogean environment the most important deterioration factor is the very high level of humidity. Not only the simple presence of the visitors can cause sensible variations in the microclimatic conditions and can , but also all kind of interventions made to adapt these places to the visits, like lighting installations, systems for air exchange, etc., can cause significant alteration phenomena.

The protection of cultural heritage has as its purpose the preservation of the integrity of a site and its attributes, but a «cultural heritage is a group of resources inherited from the past which people identify, independently of ownership, as a reflection and expression of their constantly evolving values, beliefs, knowledge and traditions. It includes all aspects of the environment resulting from the interaction between people and places through time» [4]. The fruition of historical sites used for religious purposes is specifically or mainly enjoyed by the faithful, and is aimed at the “public access” and above to their effective *Deputatio ad Cultum*.

Therefore the conservation activities must find the right tradeoffs between integrity and fruition, and it is always important judge the impact before commencing any type of intervention.

ANCIENT AND RECENT EXPERIENCES

Since the moment of the catacomb’s discovery the interest of archaeologist have been focused on conservation of the pictorial evidence which is

preserved there. In the past recognition of the fact that the techniques available were not capable of stopping the continuous deterioration at least led to copies and reproductions being made of the paintings by means of simple water colours (Fig. 3). Later there were repeated unsuccessful attempts to remove the paintings. As further technical inventions were developed, reproductions were made photographically; initially these were also touched up with water colour and thus document the appearance of the wall paintings prior to subsequent unskilfully executed surface cleaning.

With the increase in archaeological excavations at the beginning of the last century, genuine emergency restorations were also carried out, but the materials used were inappropriate for an effective conservation of the paintings.

In the past 20 years more responsible conservation actions have been undertaken; they have been aided by an intensive diagnosis of the materials used on the paintings and were preceded by analysis of the techniques used to execute the paintings. About this, a recent very interesting study was carried out about the technology of lime-based mortars and techniques of mural painting used by the ancient fossori to execute the decorated surfaces and a diagnostic campaign was carried out, by means of methods and techniques exclusively non invasive and non destructive for identification of the inorganic pigments used for the paintings and obtain a complete and unambiguous characterization of the colour palette [5 – 6].

Likewise the mechanisms which have led to the various changes and damages were taken into account. For example, bio deterioration has been studied from an european project called "Cyanobacteria attacks rocks": high humidity, stable temperature and artificial light sources allows the growth of phototrophic bacteria like cyanobacteria, green algae, diatoms and lichens. A monochromatic lamp has been experimented like method to reduce biofilm development. The lamp with a blue light resulted the most effective solution, but the impact for the visitors is too strong. [7] More recent is a pilot project, in collaboration with the ICVBC - National Research Council, to study the processes of calcium carbonate crystallisation. Crystal growth, the most common damage in the roman catacombs, affects the readability of the pictorial details, and can alter the former mortar composition and structure. Understand the developing process of this kind of damage could allow to define feasible and sustainable strategies of preventive conservation for plastered and painted surfaces [8].

Finally, the restoration techniques have been refined in order to identify the most suitable methodology for the hypogean underground and the safest products for human health.

In addition to damage caused by natural deterioration caused by environmental conditions, the worst alterations the state of conservation of the paintings are due to unsuitable restorations made in the past. This is why it is done very carefully about the choice of the methodology to be used. In many case methodological choices that have been most successful are those that are closest to the original practices, this is true specially for the materials to use in the restoration work. Often we preferred not to intervene rather than risk making mistakes. This approach recently has been very positive because thanks new technologies we were able to solve old problems remained unsolved in previous restoration works.

The last frontier of conservation activity in the roman catacombs is the laser cleaning methodology. The results of these methodology were unexpectedly good (Fig. 4). The laser technology ensure an absolute control, gradualness of thinning, selectivity and effectiveness of the material removal, without addition of dangerous materials. The impressive results obtained in the St. Tecla catacomb, in the hypogeum of the Aureli and in the cubicle of the bakers in the Domitilla's catacombs are the clearest demonstration. [9]

In this first case-study the restoration works were supported by appropriate scientific expertise to determine the suitable laser parameters and to verify the operational quality. [10 – 11]

CONCLUSIONS

The roman catacombs are the most important early Christian monuments in Rome and they are visited by thousands of pilgrims every year. Their underground nature affects their state of conservation and these specific conditions can not be changed without compromising their integrity. The only viable solution would seem to find a form of sustainable conservation. It is for this reason that in recent years we have undertaken many and diversified experimentation whose results can only be judged in the near future.

ACKNOWLEDGEMENTS

The Pontifical Commission for Sacred Archaeology would like to thank all National and International Institutions, individual scholars and the restorers who have contributed to increasing knowledge about the roman catacombs and their conservation.

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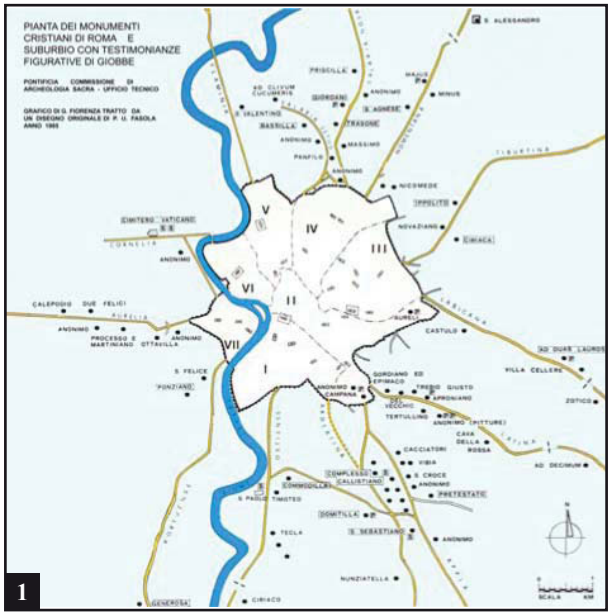

Fig. 1 - The roman catacombs.

Fig. 3 - Anonymous catacombs of "via Anapo".
Water color of A. Chacon (1578).

Fig. 2 - The stairway of the Domitilla catacomb.

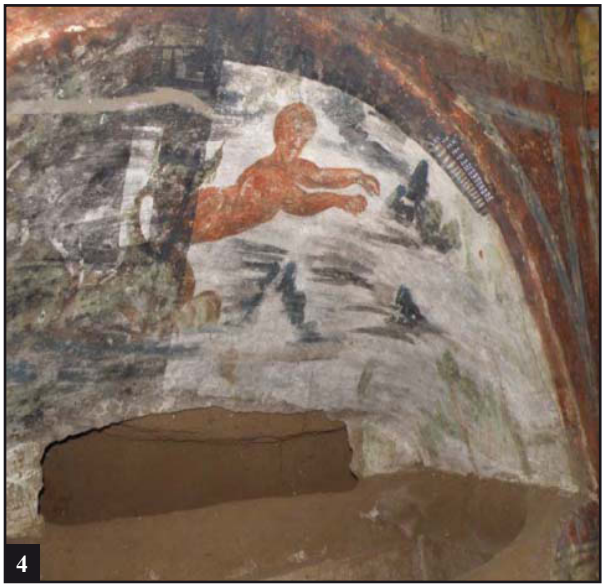

Fig. 4 - Domitilla's catacomb. Test of laser cleaning.

THE SOUTHERN PORCH OF SUCEVIŢA MONASTERY - ARGUMENT FOR THE EUROPEAN CHRISTIAN VISION

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Sucevița Monastery of Moldavia (Romania), enlisted among the UNESCO monuments since 2010, represents a happy union of traditional orthodox and biblical elements, distinguishing itself through the interior and exterior painting of the Resurrection Church.
Inside the church, which is surrounded by a fortified site, we find many biblical and extra-biblical scenes painted in the miniature style of the books, employing the 16th and 17th century decoration style of biblical manuscripts.
We shall insist more on the southern porch of the monastery, which preserves the testimony of a painting of the extra-Orthodox space, with special reference to painting the Apocalypse message, in the symbolic-literal interpretation of the New Testament.
Of the 24 painted scenes of the original interpretation of the Ottheinrich Bible (1425-1530), 16 scenes are analyzed. They are faithful to the biblical text in a holistic manner, compared with the interpretation of Slavic branch of St. Niphon of Constantiana (4th century), who unifies the "Little Apocalypse" in Matthew 24-25 with the Revelation of St. John the Theologian in one iconographic composition.
The intention of the founder and the effort to create something original led to an extensive painting, much more extensive than the one found in the Ottheinrich Bible or other biblical writings adorned with miniatures and engravings, confirming the European dimension of Christianity, in a space in which Latin was spoken, under the influence of the Slavonic language, and motivated by Eastern Christianity.
Painting the message of the book of Revelation has became possible after Dochiariou, Dionysiou and Philotheou monasteries of the Mount Athos used the events of the cosmic end in the iconography of the refectory and the porch of the principal church. The Neo-Byzantine style of the painting was not used in the southern porch of Sucevița monastery. In the painting style of the religious monument in Romania, one can notice an original approach, with Germanic influences.
Multiple scenes that are faithful to the message of the beginning of each chapter of the Revelation constitutes the uniqueness of an interpretation that is close to the contemporary history system of St. John's writing, system avoided by the orthodox interpretation of the Holy Scripture. The scene of the two witnesses (Rev 10) and the scene of the siege of Vienna support this hermeneutics.
Biblical scenes that are better preserved in the vault and on the southern porch pendentives of Sucevița monastery are analyzed while the original elements and pictorial solutions are highlighted.

NON-INVASIVE HYPER-SPECTRAL IMAGING TECHNIQUE: A MULTI-TASK METHODOLOGY FOR THE INVESTIGATION OF ARTWORKS

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ABSTRACT

The application of a non-invasive hyper-spectral imaging (HSI) technique, which operates in the 400-1700 nm range, is presented as a multi-task tool that is particularly effective for the study of artworks and paintings. The HSI prototype scanner developed at IFAC-CNR makes it possible to acquire images with high spatial and spectral resolution. This technique adds several positive aspects to the many analytical, diagnostic, and intervention methodologies accessible in the art conservation field. It can satisfy diverse requirements related to obtaining additional knowledge about the investigated artwork. In fact, non-invasive and portable HSI technique can be applied to the investigation of paintings in many ways. Examples are the identification of pigments and dyes, the evaluation of colour and colour changes, the detection of alteration products, and the areal distribution of different compounds. They also can provide curators and conservators with high-resolution documentation in the visible (Vis) and near infrared (NIR) regions. The NIR images are also useful tools for analyzing the artist's technique by examining the under-drawings. Also, this paper presents both the advantages and the linits of this methodology when applied to the investigation of paintings.

Keywords: hyper-spectral imaging technique, non-invasive spectroscopic investigation of paintings, documentation of paintings.

GENERAL OVERVIEW OF THE TOPIC

Imaging techniques are currently used in the cultural heritage conservation field not only to support documentation, but also to investigate the material composition of artworks, paintings in particular [1-3]. Among them, the recourse to the hyper-spectral imaging (HSI) technique, which was first introduced in the 1980's in the field of remote sensing [4], greatly expanded the potential of imaging methodologies in the study of paintings [5-9].

The hyper-spectral data, usually acquired in the visible and near infrared range (400-1700 nm or 400-2500 nm) simultaneously include both spatial and the spectral information relative to the imaged polychrome surface, producing as output a file-cube (Fig. 1). This means that hyper-spectral imaging merges in a single technique several outcomes from the traditional imaging methodologies used in the conservation field (high-resolution and colour accurate images, infrared reflectography, infrared false colour). In addition, HSI provides, at the same time, a high-resolution spectrum for each pixel of the investigated surface, which makes it possible to classify it as a two-dimension (2D) spectroscopic technique. It is used to identify and map artists' materials, to calculate colour parameters and their changes over time, to reveal under-drawings, and for other types of high-definition elaboration of images. Hyper-spectral imaging is a sophisticated technology, one that makes it possible to simultaneously capture hundreds of reflectographic images of a given scene. These images, acquired on contiguous narrow bands over an extended spectroscopic interval, typically cover both the visible and the near infrared regions.

PRESENT AND FUTURE

The 400-1700 nm HSI prototype scanner developed at IFAC-CNR is based on prism-grating-prism (PGP) line-spectrographs (push-broom systems) connected to high sensitivity Si-CCD (Hamamatsu model ORCA-ERG) and InGaAs (Xenics® model Xeva 1.7-640) cameras, which are mounted on two different measuring heads. The spectrographs selected in building the IFAC-CNR prototype are the models ImSpectorTM V10E and the ImSpectorN17E (Specim Ltd, Finland) covering the 400-900 nm and 900-1700 nm ranges, respectively. Each acquisition head is composed of a telecentric objective (Opto-Engineering Srl, Italy), the spectrograph, and the camera, is fixed with the illumination module, consisting of a broad-band light-source connected to a couple of fibre-optic line-lights terminating with focusing lenses. The fibre-optic illuminators symmetrically project

their beams at 45° angles with respect to the normal direction at the imaged surface, and the acquisition geometry is 2x45°/0° (illumination/observation) in accordance with the Commission International de I'Eclairage (CIE) recommendation on colour measurements [10, 11]. The scanner consists of two orthogonal, high precision motor-driven linear stages, which allow movements along both the vertical and horizontal axes on the plane parallel to the painting surface. This structure is designed to cover an area of about one square metre. The scanning is performed by a sequence of adjacent vertical scans of strips of about 7 cm width slightly overlapped at the edges with acquisition speed of approximately 1 mm/sec.

The spectra extracted from the cubes have a spectral resolution of about 2 nm and 8 nm in the 400-900 nm and 900-1700 nm ranges, respectively. The spatial sampling is about 11 and 9 points per mm, respectively; thus, high resolution images (about 300 and 256 ppi) may be extracted at each wavelength of the investigated range. The high performances in terms of both spectral and spatial resolution are the strengths of this system, which may be used for manifold applications, as will be described by the examples that will be presented.

A customised software platform is used for the recombination of the hyperspectral data, so as to provide data in the extended 400-1700 nm range.

The abilities of the proposed hyperspectral imaging system were tested on paint reconstructions in the laboratory and, subsequently, on artworks created using different artists' techniques and on diverse substrates. Although the electronic spectra of these materials usually show broad and weak absorption bands in the visible region, which may be partially modified by the occurrence of absorption bands due to the presence of other pigments corresponding to different colours in the paint layers, characterisation of the majority of pigments is still possible. In addition, the effect of yellowing of the binder/vehicle or of the varnish does not significantly move their spectral curves unless the pigments are present in the paint layers in very low concentrations. However, its sensitivity range, a critical issue in this scanner prototype, is its limited operative range in the NIR region, which prevents the identification and mapping of some classes of organic and inorganic artists' materials.

About the non-invasivity of the technique, the total exposure to light of a painting during an HSI measurement by means of this scanner is below 2000 luxhr with a UVA fraction of 73 µW/lumen, which is approximately the light dose received during 12 hours of museum exhibition under a steady illumination density of 150 lux.

It is more difficult to define possible damage induced by the local temperature rise, which is not easily measurable with common methods in a non-stationary condition. In any case, the relative rapidity of the scan, the limited extent of the illuminated area (about 25 mm along the scan direction), the fact that the long wavelength IR components are filtered out by the fibres, and the subjective judgement of warmth sensation, probably exclude any damage unless the painted layer is in a precarious mechanical condition.

The proposed technique can be used for:

- Identification of the nature of a pigment/dye;
- Differentiation between pigments of the same colour;
- Differentiation of an original layer/material from another more recent one;
- Assessing the change of pigments colour in time;
- Evaluation of the level of cleaning (before and after the intervention);
- Identification of products of degradation and/or deposition;
- Identification and localisation of various organic components on the surface of a painting;
- Tentative identification of binding media.

In the presentation, an overview of the application of this technique on the previously reported diverse topics will be given with particular emphasis on its obtainable analytical, diagnostic, and intervention results.

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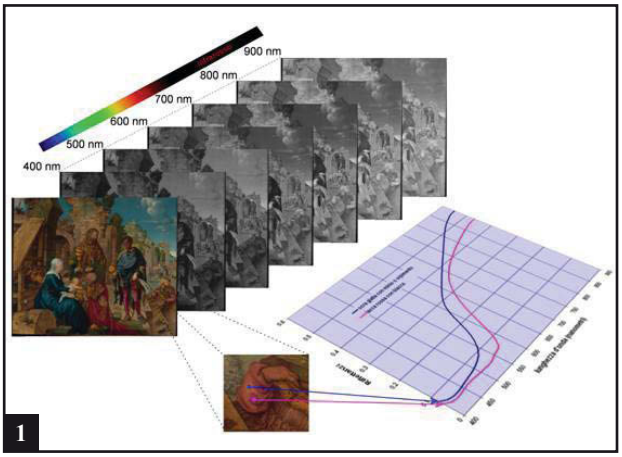

Fig. 1 - HSI data reported as a sequence of narrow-band images or a collection of reflectance spectra.

Fig. 2 - IFAC-CNR HSI prototype scanner during data acquisition.

HISTORIC AND ACTUAL MATERIALS FOR STONE CONSERVATION: AN OVERVIEW

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ABSTRACT

Alteration of stone materials is a natural and unavoidable evolution, due to the complex balance processes that they try to establish with the external environment (lithosphere, hydrosphere, atmosphere, and so on). The rate of the decay depends on intrinsic properties of the stone (mineralogical composition, stone texture and structure, porosity, etc.) but also on extrinsic factors that include climatic conditions, atmospheric composition, localization of the object, use and care given to it, and so on. Atmospheric conditions in urban areas, mainly due to air pollution, greatly promote decay processes of stone materials, expecially for those that are outdoor exposed.
In the course of the years a variety of efforts have been undertaken to preserve and protect stone objects, and in particular consolidant and protective agents have been selected from commercial products developed for the protection of the surface of civil buildings.

Keywords: stone deterioration, conservation, consolidant products, protective products.

HISTORIC MATERIALS FOR STONE CONSERVATION

The deterioration of stone materials is a natural process and it is well know by anyone who works in the field of stone conservation. Furthermore, it is clearly visible by anyone who has looked closely at a historic stone monument or building.
Most of the world's Cultural Heritage is made of stone, so it becomes essential to prevent and limit such loss of our Heritage.
The first step in this direction is a good knowledge of the stones involved. Each litothype indeed undergoes a specific and characteristic type of degrade, due both to its nature and to the external conditions in which is located. In order to prevent and repair to any damage on stone objects, we first have to be able to characterize the stone, then we need to be able to describe the decay with its extent, intensity and rate, and finally we need to understand the causes and mechanisms of decay [1, 2].
Once we have reached all this information, we can have an idea of the behaviour of a particular stone in a particular environment and we can plan the conservation and/or conservation activity to undertake, chosing the right and proper materials and methods.
A conservation project should always start with an accurate investigation with respect to previous conservation and restoration or renovation measures, thereafter the most important conservation interventions comes: cleaning, consolidation and protection [2, 3].
A wide range of techniques is available for cleaning stone, ranging from those that are based on water or different types of products (like chemical or biological compounds), to those that are exclusively instrumental techniques (like laser cleaning).
Differently, consolidation and protection activities are still carried out by means of application of different kinds of products and materials, just like it happened from the antiquity. What has changed in the course of time is the nature of the compounds: in the past only natural compounds (such as milk, egg, waxes, oils, animal and vegetal glues, lime and so on) were used [4].
In detail, linseed oil, wax, animal and vegetal glues, lime and plaster of Paris were used to produce mortars suitable for repairing small defects or applying protective layers. Detached fragments were glued together with bone glue or shellac, often with the support of metallic clamps or pivots. Moreover, mixtures of gypsum and animal glue were used in order to repair marble or limestone objects, while lime and casein were mixed for the production of mortars for filling lacunae.
For the protection of outdoor stone surfaces from the contact with water, bees wax was used on marble and limestones. In addition, it provided a much-appreciated shiny gloss to the covered surface. Bees wax had the advantage of not becoming brittle during time, but it remained sticky so that dust deposition brought to a darkening of the treated surface. Paints were used to protect monument surfaces too, besides decorate them. Finally, lime by itself or mixed with

casein, protein and linseed oil was used in order to produce some kind of water repellency.

THE INTRODUCTION OF SCIENTIFIC RESEARCH IN STONE CONSERVATION

In 19th century, the significant general improvement of chemical research, led to the introduction of scientific investigations into deterioration and conservation of building stone, and products initially synthesized for industrial applications were tested for conservation.

Inorganic compounds like limewater (saturated solution of $Ca(OH)_2$ in water), lime wash (thin layers of very fine lime mortar) and barita water (water dissolved $Ba(OH)_2$) were experimented to consolidate deteriorated stones by new calcium or carium carbonate deposites inside the pores of the substrate according to the reaction:

$$M(OH)_2 + CO_2 \rightarrow MCO_3 + H_2O \quad (M = Ca \text{ or } Ba)$$

This kind of consolidation can be used for carbonatic stones, and it can give a sort of protection to the underlying structure, but it has some disadvantages: the high alkalinity of the solution can mobilize iron compounds and newly formed $CaCO_3$ will be dissolved again in very short time [5].

Tetra ethyl ester of the orthosilicic acid – TEOS is the most widely used chemical compound for consolidating natural stone, in particular granites and sandstones. The consolidant effect is given by the deposition of amorphous silica gel in the pores of the stone. Such transformation occurs via a two steps process: the hydrolysis of the alkoxy groups splitting off ethanol molecules and the condensation of the unstable intermediate silanols –Si-OH to amorphous silica gel. One of the great advantages of these products is that no deleterious by-products are formed and the resulting ethanol evaporates completely. On the other hand, the process is strongly influenced by the necessity of a catalyst and by the humidity and temperature conditions [6].

The alkyl triethoxysilanes have general formula $R\text{-}Si(\text{-}OC_2H_5)_3$, they are similar to TEOS except they have one direct Si-C bond linking an organic C-chain to the central silicon atom: the alkyl group confers hydrophobic properties to this compounds, so alkyl-trialkoxysilanes are used for hydrophobizing porous materials [6].

Fluosilicates are salts of the fluosilicic acid H_2SiF_6 with different cations, like Mg (the most common), Zn, Pb, Al, NH_4 and others. The strengthening effect is based on the formation of amorphous silica gel.

$$2\ Ca(OH)_2 + MgSiF_6 \rightarrow 2\ CaF_2 + MgF_2 + SiO_2\ gel + 2\ H_2O \text{ (in concrete)}$$

$$2\ CaCO_3 + MgSiF_6 \rightarrow 2\ CaF_2 + MgF_2 + SiO_2\ gel + 2\ CO_2 \text{ (in calcitic stones)}$$

However, fluosilicates have no longer a practical application in stone conservation: their aggressiveness in general and the toxicity of the HF (that can be formed in presence of water) in particular, do not make them a user-friendly method.

Epoxy resins are low-molecular-weight linear polymers obtained from monomers or short chain polymers containing epoxy groups at both ends of the chain. The most common epoxy resins are obtained from the reaction between epichlorohydrin and bis-phenol-A, as the main component. A further reaction of such pre-polymer with a cross-linking agent, usually a diamine, gives the epoxy resin.

Epoxy resins are highly resistant to acids, bases and organic solvents, but present serious problems of colour stability: usually these resins become yellow even when stored in the absence of light.

Acrylic polymers are widely used for the formulation of protective products, due to their good adhesion, transparency and film forming properties. Acrylic resins are also used as consolidant and adhesive products, besides protective coatings.

They are thermoplastic materials, obtained from homo- or co-polymerization of esters of acrylic and methacrylic acid. Their molecular weights are in the range 30000-100000 u.m.a.: the characteristics of an acrylic product can be quite different, according on the monomer and the molecular weight. Polymer rigidity and "rubbery grade" change according to the acid moiety (methacrylic are more hard and rigid than acrylic esters) and the length of the ester group: as an example, poly(methyl methacrylate) (PMMA) is hard and fragile, while poly(butyl methacrylate) (PBMA) is an oil at room temperature. Paraloid B-72 (a co-polymer ethyl methacrylate (EMA) / methyl acrylate (MA) 70/30) is a commercial product, which is extensively used since 1970 as a consolidant and protective agent.

One of the most common problems noticed with these polymers is a low penetration of the product inside the stone material. Another limit observed when acrylic resins are used as protective materials, is the loss of the hydrorepellent properties in short times. In order to obtain a long-lasting effect, acrylic polymers are often applied in mixture with silicon

resins, or as an acrylic/fluorinated copolymer [3].
Perfluoropolyethers were introduced in order to improve the properties of polymers used in conservation of stone materials. These polymers were promising protective from different points of view: excellent hydrophobicity, high resistance to UV radiation, inertia towards the substrate and most of the pollutants present in the atmosphere. They are obtained from the photo-polymerization of hexafluoropropene or tetrafluoroethene and they were tested and then suggested as water repellents in the field of stone conservation of monumental buildings. In consideration of their water- and dirt-repellent properties, fluorinated products have been used primarily to develop waterproof coatings [7], but some researches also related their anti-graffiti properties [8]. Perfluoropolyethers are extremely stable, colourless, permeable to oxygen, insoluble in water and most of the organic solvents. Moreover, they are liquid and therefore easily applicable on a solid surface. At last they are non-toxic, have a low superficial tension and a refractive index very close to that one of water. Akeogard PF and Fomblin Y MET were commercial products largely diffused in the past years. Unfortunately, some negative features followed the good preliminary remarks: colour changes and the reduction of protective efficacy in relatively short times when applied on some lithotypes.

THE LAST IMPROVEMENTS IN MATERIALS FOR STONE CONSERVATION

In the last years, thanks to the acquired importance of taking care of both environment and operator health, a lot of efforts have been undertaken to select products that not involve any kind of risk for the operators and for the environment, that are soluble in water or in eco-friendly solvents, and that comes from natural and/or renewable resources. At the same time, new studied products should improve performance and overcome drawbacks.

Inorganic materials

In recent years, the preparation and characterization of inorganic compounds consisting of particles with dimensions in the order of 2–100 nm have attracted great interest due to their significant potential applications. Nanostructures are constituted by clusters of a few thousands of atoms, and show properties that are intermediate between the molecular and the bulk matter state. This is due to the high area/volume ratio of the clusters that strongly affects the physico-chemical behavior of these systems, giving them advantages like low sintering temperature, super-plasticity effects, increase in diffusivity and improved dielectric properties. Morover, nano-structuration confers high hardness and good wear-resistance.
Moderately water soluble calcium hydroxide and water insoluble magnesium hydroxide nanoparticles by homogeneous precipitation were characterized and successfully used as consolidants for wall paintings (frescoes) and stone [9].
Silica based nanocomposites were used as stone consolidant with good results and new formulation and preparations are presently studied and experimented.

Organic materials

Finally, a new class of polymers has been growing its importance as consolidant and protective material for stones because these products may be obtained from a natural, renewable resources. For instance poly(lactic acid) PLA have been synthesized from lactic acid, that is a natural product, easy affordable from many natural sources (corn, sugar beet, or other sugar containing materials), by a fermentation process. PLA is biodegradable in given conditions, it is not harmful for man and environment and it is approved by Federal Drug Administration. It can be obtained by different polymerization processes and its molecular weight depends on the adopted procedure. Different PLAs (having molecular weight among 11800 and 83000 g/mol) were tested on some lithotypes (marble, limestone and sandstone) and showed an interesting photo-stability under (artificial) UV irradiation (Solar Box). Moreover, treated porous materials (limestones) showed high water repellence (Protective Efficacy up to 90%), whilst less porous stones (marble and sandstone) showed a lower hydrorepellency (P.E. up to 50%), due to a smaller amount of product penetrated inside the stone. In order to improve the water repellence of PLA polymers, they were modified inserting a fluorinated moiety (a perfluoropolyether was employed in block co-polymers with PLA). These new polymers showed a good solubility in common solvents and good resistance to UV radiation. They were applied on several stone materials, obtaining good results regarding water repellence (P.E. 75% on sandstone and 90% on marble) and color variations [10].
In order to reduce the fluorine content present in these block co-polymers, other series of fluorinated PLA co-polymers were prepared with undeniable advantages of higher eco-compatibility, higher

solubility in eco-friendly solvents and lower cost. They seem to be very promising as stone consolidant and/or protective products, so further study are in progress on this class of new polymers [11].

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ARTISTIC AND CULTURAL EVALUATION

RELIGIOUS MURAL PAINTING OF GHEORGHE IOANID, CASE STUDY: CHURCHES FROM CRAIOVA AND VASLUI-ROMANIA

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ABSTRACT

For the Romanian art, the 19th century represented a stage of consistent accumulations and major transformations in the ecclesiastic painting. Formed at the Italian academic school, Gheorghe Tattarescu (1820-1894) generated a real revolution in the ecclesiastic painting in Romanian Principalities, both through the new approach in this domain of visual arts and through the impact of his numerous works (more than 50 churches painted). Tattarescu created a school in the real sense of the term, with disciples who had perpetuated the manner of their master in an impressive number of painted objectives.
Our study analyses two monuments whose mural paintings are signed by Gheorghe Ioanid from Bucharest, one of the most important apprentices of Tatarescu. These two monuments are now engaged in a program of full restoration.

Keywords: Tattarescu, Gheorghe Ioanid from Bucharest, oil painting, ecclesiastic mural painting.

INTRODUCTION

By interrupting of continuity of byzantine tradition of ecclesiastic painting in the Principalities, Gheorghe Tattarescu, the one who, next to Theodor Amann, founded The Academy of Fine Arts at Bucharest in 1864, brought a new approach in Romanian ecclesiastic painting, both through the use of the oil painting technique and the neoclastic treatment of the figures and compositions.

OPERATIONAL GOALS

Through its numerous monumental works of art, created in new churches (The Cathedral of Iasi) or covering one or two century old fresco paintings (Coltea Church, in Bucharest), Gheorghe Tattarescu gave birth to a new trend extremely well represented in the 19th century in churches in the Romanian territories. Among his well known apprentices was Gheorghe Ioanid, from Bucharest, the author of the paintings of the churches from Craiova and Vaslui, the subject of our study. Ioanid perpetuated the manner to paint of his master and spread the type of the simplified iconographic programe in an orthodoxe church, realizing a new spatial relation between the mural painting and the ecclesiastic architecture. The 20th century was marked, in turn, by the impact of some major monumentalist artists, most of them beeing professors at the Academies of Arts from Bucharest and Iasi where they promoted a monumental art with a strong Romanian folk character. This set a new trend that reevaluated the creation of the past centuries, especially of the 19th and mainly the activity of Gheorghe Tattarescu and of his school.
Considered to be unusual for the bizantine iconography tradition, which is specific to the orthodox churches, the painting of Tattarescu and his school, dominated by the use of oil technique and the neoclastic treatment of characters and composition, was thoroughly analized in the case of each monument. This punctual analysis was facilitated by the initiation of complex restoration programs. The monuments to whom we refer represents, chronologically, the last works of mural paintings signed by Gheorghe Ioanid .

1. The church from Vaslui

The church "The Beheading of Saint John the Baptist" from Vaslui is an orthodox church founded by the Prince Stephan the Great (1457-1504) in 1490. Damaged by earthquakes, it was reconstructed from the basement in 1820, repaired between 1889 and 1890, and painted by George Ioanid in 1894. The painting was strongly degradated during the earthquake of 1940.

2. The church from Craiova

The church "St. Elias" from Craiova, founded in 1720 by the steward Ilie Otetelesanu and the highest traders of the city, was damaged during the earthquake of 1838. Constantin Lecca painted the church "St. Elias "between 1840 and 1841. The

church was rebuilded between 1889 and 1893. After the restoration works from 1893, it was repainted by Gheorghe Ioanid and Gheorghe Tattarescu, this last one countersigning near the signature of Ioanid on the icons of the iconostasis and on the bottom right corner of some scenes (e.g. "Baptism").

CONCLUSIONS

The analysis of those two sets of wall paintings is part of restoration projects and contributes at recovering of important testimonies of the moment represented by the Nineteenth century in the history of Romanian cultural heritage

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AN INTEGRATED MULTI - ANALYTICAL APPROACH TO THE RESTORATION OF A WALL PAINTING. AN IMMACULATE CONCEPTION OF XVIITH CENTURY IN FERRARA.

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ABSTRACT

This article is aimed to present the multidisciplinary approach applied to the case study of wall oil paintings Immaculate Conception of XVIIth century in Ferrara (Italy). On the basis of historical-artistic and scientific investigation, the restoration work has been designed.

Keywords: Oil mural painting, iconography, restoration, Bononi.

INTRODUCTION

During the last restoration of mural painting Immaculate Conception (Figure1) of XVIIth century in the Church of the Virgin Mary Nativity in Voghiera (Ferrara), historical documents, local historical literature and scientific investigations were considered to acquire detailed information about the history, the painting technique and previously employed restoration products. This multidisciplinary approach led the restoration project in a conscious manner, favouring a conservation approach with respect for authentic materials, and geared towards ensuring the adequate preservation of the painting over time.

MATERIALS AND METHODS

Artistic and historic surveys

The archive evidence of the church in Voghiera has been integrated with the only sources of local historical literature that offer data on the pictorial elements: these are the *Compendio* (1621) by Marc'Antonio Guarini, and the *Descrizione* (first half of XVIIIth century) by Carlo Brisighella and annotated by Girolamo Baruffaldi. Baruffaldi's notes offer interesting attributive references that open the door to exploring various local painters, since the author attributes the painting of the apsidal vault to Bastaroli and the scholars of Scarsellino. The particular composition offered by the trinomial symbol-scroll-angel, for which no precise and relevant reference models have been found so far, is the main theme with which to begin this historical and artistic investigation. On the one hand, the research, based on the stylistic and cultural influences at the heart of this creation, examined the iconography of the Immaculate Conception in its didactic meaning, in relation to the representation of the symbols paired with the scrolls; on the other, it examined the depiction of the illusionistic space, created by the sky and the backdrop of angels. An iconographic choice that should be interpreted as the outcome of the fusion between various models.

Scientific analysis

X-Ray fluorescence (EDXRF)

EDXRF analyses were performed by means of a portable spectrometer composed by a Tantalum X-ray tube (Innovix Systems) working at 15 kV and 7 µA or 40 kV and 6.5 µA. The fluorescence X-rays are detected by a thermoelectrically cooled SiPiN detector with an energy resolution better than 230 eV at 5.9 KeV to Mn K_{α}..The analyses were carried out with the X-ray tube working at 40 kV over a measuring time of 70s.

Micro-Fourier Transform Infrared Spectroscopy (FTIR)

Micro-FTIR spectra were taken in attenuated total reflectance (ATR) mode employing a ThermoNicolet "Continuµm" Nexus line micro-spectrophotometer, equipped with a mercury-cadmium-telluride (MCT) detector. A micro-slide-on ATR silicon crystal directly connected to the objective has been used. Infrared spectra were recorded in 4000-650 cm^{-1} range, resolution 4 cm^{-1} and 120 scans.

Gas chromatography–mass spectrometry (GC-MS)
A Focus GC (Thermo Scientific) coupled to DSQ II (Thermo Scientific) with single quadrupole and split-splitless injector was used.

RESULTS

Artistic and cultural evaluation

Guarini's *Compendio* outlined a significant chronological interval within which the creation of the painting can be placed with certainty: 1603-1621. The painting is already present in the latter year (Guarini saw it and briefly described it) but, since it was commissioned by the archpriest Antonio Bertolazzi, who arrived in Voghiera in 1603, it can only be concluded that it was begun after this year. The *litania in figuris* in Voghiera should be interpreted as a specific liturgy that the faithful could contemplate and recite, in line with the counter-reformation policy that characterised Giovanni Fontana's bishopric (1590-1611), constantly characterised by a revival of the dictates of Trent. A book known by Fontana is *De Historia Sanctarum Imaginum et picturarum*, by the flemish Molanus (1570): in the chapter devoted to *De pictura Conceptionis Mariae*, he describes an iconographic style very similar to the one used in Voghiera [1], with the Virgin surrounded by symbols with writing on the scrolls. If Molanus' instructions can be considered the basis for the iconographic idea for the creation of the Voghiera picture, the painting itself is related to other graphical sources, which were the starting point for the formal resolution of the composition. The first engraving that should be viewed as the definite reference for the creation of the Voghiera painting was made by Cornelis Cort and was based on a drawing by Bernardino Passeri (1567): the Virgin standing with the child, surrounded by the same identical Marian symbols that appear in Voghiera, and quite comparable not just in type, position and number, but in the writings on the scrolls as well. The figure of the dragon is a clear connection to the rendering of this beast in Voghiera. Instead, the model for the creation of the Virgin is another: an engraving by Cort was used, this one made in 1574 and based on a drawing by Federico Zuccari [2]. The person who completed this project faithfully copied every stylistic solution: the cloak draping the shoulders from which the clasped hands protend is reproposed with the same drapery and the same decorated borders; the lightly tilted head is recaptured, though the hint of a smile is slightly eliminated, opting instead for an expression that does not gaze downwards and which, perhaps due to the artist's inability to rearrange the facial features in function of this change, gives the Virgin an awkward cross-eyed look. This model would later become very successful, as witnessed by the countless versions all around Europe thanks to the Flemish editions.

Analytical, diagnostic and intervention methodologies

The architectural structure of the apsidal vault is made up of wooden centrings covered with a lathing support. A gypsum plaster has been spread on the structure of reeds tied, on which a finishing of white lime and sand was applied by a wood trowel in order to achieve a rough surface. On the plaster surface a white lead ground layer was applied as support for the superimposed painting layers characterized by a very wide range of pigments spread by oil medium. The employ of the oil mural painting in Ferrara started in the XVIth century by means of Garofalo (1476-1559) that painted two depictions in the St. Peter's church, *St. Peter* and *St. Paul*. Other two examples of oil mural paintings are dated at the end of XVIth century: *Virgin with the Child* on the portal of the Church of Our Lady of Consolation, painted by Bastianino (1563) and the decoration of *The Bacchanalia chamber* by Leonardo da Brescia (1581). The seventeenth century is the period of utmost experimentation of this technique thanks to the painter Carlo Bononi (1575-80? -1632) that frequently painted with an oil medium on a dark ground layer obtained by a mixture of yellow, red and brown ochre with a little amount of lead white; this ground layer is very similar to the reddish one found on the Immaculate Conception [3]. In order to preserve the integrity of the artwork a first non-invasive investigation by portable XRF of many painted areas was carried out [4,5]. This technique allowed the identification of inorganic pigments, showing itself very right to point out the elements that characterize the employed pigment. The detection of mercury in many red areas with different hue (reddish, intense red and flesh tone) attests a widespread use of cinnabar; the cobalt signal in many areas with different shades of blue (such as the dress of the Virgin or the sky) points to the use of smalt blue; the tin is the element that suggested the employ of lead yellow ("giallorino") in the yellow areas; the detection of copper together with iron and potassium in the vegetal decoration suggested the use of a green copper pigment likely

used for the shading of the under-painted layer obtained by green earth. The XRF spectra acquired in the gaps of polychromy highlighted the abundant presence of lead, together with iron and manganese; the co-presence of these elements in the ground layer suggest the use of a mixture of brown earth and lead white. The examination carried out in view of the restoration work highlighted a bad state of conservation of the polychrome surface, with loss of painted layers and traces of varnish and coating employed in previous conservation works. The FTIR spectra of the samples show typical bands of lipidic and proteinaceous materials. Based on these first indications gas chromatography coupled with mass spectrometry detector was used to identify the lipidic and proteinaceous materials [6]. Proteinaceous fractions are present in every sample revealed by their amino acid profiles. To identify the binding media, the percentage content of amino acids in each sample was compared to those from a dataset of 43 reference samples of egg, casein and animal glue, belonging to the reference collection of the Opificio delle Pietre Dure of Florence. Principal component analysis (PCA) was performed on the correlation matrix of the relative percentage contents of eight amino acids (alanine, glycine, leucine, proline, hydroxyproline, aspartic acid, glutamic acid, phenylalanine) [7]. The evaluation by means of PCA locates all the samples in a new cluster suggesting a mixture of animal glue and egg binders. Lipid fraction gas chromatograms of every sample are characterized by the dicarboxylic azelaic acid, and saturated fatty acids, principally palmitic and stearic acids. The amount of azelaic acid, whose formation is due to the oxidation of unsaturated acids, suggests that the observed lipid fraction can be attributed to siccative oil. In the sample kept from Immaculate Mary blue cloak the concentration ratio between palmitic/stearic acid revealed the presence of linseed oil. In correspondence to Immaculate Mary figure, a terpenic resin has been detected, whereas in the other surface areas wax ester has been noticed. The ATR FT-IR analyses revealed urea aldehyde resin in the sample kept from the little angel rosy complexion, and polyvinyl acetate in Immaculate Mary red dress. The original painting surfaces was concealed by the varnish, the overpaintings, the decay products and the yellowing due to the alteration of organic products applied during past conservation works. After a general inspection of the surface, a facing with Japanese paper and cellulose pulp was applied in areas with cleavages due to the loss of adhesion between painted layer and picture support. Afterwards these areas were consolidated by reattaching and securing cleavage processes with a mixture of a polyvinyl alcohols infused by injection, filled substance (diatomaceous earth) and cellulose. The surface cleaning, performed to remove the widespread varnish layers and the oil of overpaintings, was carried out in two steps. At first an alcohol and acetone solution (1:1) was employed, afterward an alkaline gel was left in contact about ten minutes. Finally the gel was removed by sponges and water after a massage by brush. A tempera retouching has been used to integrate small filled defective areas of the original painting surface. A final coat of mastic varnish diluted in a solution of purified turpentine oil was applied by brush and spray gun.

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Fig. 1 – The vault of the apse of the church of the Virgin Mary Nativity in Voghiera (Ferrara). The oil mural painting of Immaculate Conception after restoration.

EXPRESSIONAL QUALITIES IN ANATOLIAN OTTOMAN MOSQUE ARCHITECTURE AS A PART OF INTANGIBLE CULTURAL HERITAGE

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ABSTRACT

A culture's aesthetic understanding in terms of expressional qualities that cannot be expressed visually, namely, the symbols, messages, and icons reflects much about its history, religion, as well as its social and cultural perspective. Anatolia's great mosque architecture is shaped and shows the successful whole of those qualities, combining elements and materials of traditions that clearly mark the region's contact with elsewhere as a part of a continuum of experience. Yet, at the same time it adds its own sense of expression refraining from being a mere synthesis. Hence, this manuscript aims to lighten the aesthetic understanding of the region with regard to mosque architecture in terms of expressive qualities, religious philosophy and the role of the craftsmen with an emphasis on its intangible heritage value.

Keywords: mosque, symbolism, expressive qualities, intangible heritage

INTRODUCTION

Giedion claims that '[b]efore art, man created the symbol[s]' either simple, complex or abstract sometimes standing alone, and often intertwined with each other even in primitive times [1]. He further argues that symbolization is a need to make the imperceptible forms as perceptible wholes [1], which is also a case in Anatolian mosque architecture. As in all periods and regions in Anatolia as well, craftsmen constructed buildings and engraved decorations skillfully. Hence, it is not much possible to think craftsmen independent from the architecture. Customs and faiths of a society affect the craftsmen and in turn craftsmen reflect the social structure of a society in his masterpieces [2]. Expressional qualities such as symbols, icons and meanings are reflected mostly in the decorations of craftsmen. In Ottoman period the craftsmen and architects were raised in a craft-apprentice system and with the effect of this system, especially in Classical period the Ottoman craftsmen searched for the beauty and love of Allah and tried to reflect it into his art, namely, a kind of mystic integration with Allah was created [2-4]. In this period, the craftsmen engraved scripts and verses from Qur'an on the walls and domes of mosques to catch the aesthetic pleasure [2, 5] and a kind of an abstraction was used instead of pictures from nature or any kind. The aim was to reach to the invisible beyond the visible with his motives and scripts. Thus, in this manuscript light, geometry, form, and decorations are evaluated in terms of their expressional meanings associated with Anatolian mosque architecture.

OPERATIONAL GOALS

Ottoman period mosque architecture is not a style emerged suddenly; rather it has been affected from the styles and symbols of previous civilizations such as Seljuk, Principalities and from regions like Middle East, Central Asia, Europe, and even Far East. Nevertheless, it reinterpreted all those styles according to the needs of the time, Imperial understanding, and religious philosophy of the period. Iconographical symbols used by many civilizations in the history sometimes with different meanings continued to be used in Ottoman period as well, with their new meanings. In this manuscript first, some of those expressional qualities have been introduced briefly and then their importance with regard to representing the culture's and region's intangible heritage is evaluated.

RESULTS

Assessment of Expressional Qualities

In Anatolian mosque architecture, light, geometry, form, wall paintings, scripts, stone engravings and such qualities are used not only for visual but also for their expressional values. These qualities tell another story in many ways.

Among the expressional qualities, in Anatolian mosque architecture, ***geometry*** and ***forms*** are used extensively in terms of language of symbols. For instance, according to Karamağaralı, the octagonal drum transition of the dome symbolizes the sky, the square and rectangular base symbolizes the earth and the stalactites are the symbol of descending of celestial space towards the earth [6]. The most distinctive feature of Ottoman period mosques is that, it represents the unity/integrity/completeness with the 'dome'. Here, by collecting the whole interior under a dome, it is aimed to symbolize the 'Tawhid' –oneness- of Allah, in other words reaching to Him by praying to Him in His House under His Celestial Sky-dome- and thus catching the integrity and completeness [7]. Erzen interprets the relationship between dome and square forms of the 16th century Ottoman architecture as the 'principle of constant change within permanence'. To her, "square or rectangular symbolizes the directionality and is constantly moves within the permanent universe symbolized by the circle" [4].
In Ottoman architecture, the fundamentals brought about by Holy Qur'an gave rise to the form of the mosque. In Qur'an and Hadiths 'Arş' in other words the 'Throne' meaning 'Divine Sovereignty, Dignity' is the most important one of these fundamentals [7]. Allah rules the World and Throne is the highest point of the cosmos. There is a strict relationship between the elements and formation of Islamic mosque and the verses of Qur'an. For instance, the fountains and pools inside the mosques are highly related with the verse Hud:7- "and HIS Throne was upon the water"- and the abundant use of polygonal forms in the mosques as in the drums and such is also related with the verse Hakka:17- "And the angels on the sides thereof, and eight shall bear the Throne of the Lord above them on that day" [7, 9].
In addition, there is a relationship between Throne and Mandala, which means circle, a kind of symbolic drawing, in Sanskrit language and used in Hindu and Buddhist rituals in the form of circular diagrams to reach the cosmic and physical energy. Mandala is also used as the representative of cosmos of a sacred area in which the gods dwell. In architecture mandala is represented by circle and square, one within the other; circle meaning God, cosmos, eternity, mystical life and world of eternity and square meaning, world, and material life [7].
Similarly, ***light*** is used not only to illuminate the space but also for its symbolic meaning. Karamağaralı argues that the candle handles located on both side of the mihrab of the mosques symbolize the 'light' and 'luminous' attributes of 'Allah' reflected on the spaces and elements thus sanctifying it [6], besides, candle used as the light source in mosques symbolizes the 'divine light' [8]. On the 35th Ligth Verse of Surah an-Nur of Quran it is written that [9];

"*God is the light of the heavens and the earth! The likeness of HIS light is a niche in which there is a lamp- the lamp is in a glass, the glass as, as it were, a glittering star; it is lit with from a blessed tree, an olive is neither of the east nor of the west; its oil would well-nigh give light although no fire touched it, Light upon light! God guides to HIS light whom HE pleases…*"

Thus, this divine light is carried into the mosques with the help of candles and candle handlers. A similar attitude with regard to usage of light with a different symbolic meaning is also observable in European Baroque architecture. Bernini was the great inventor of the illusional decoration and the dramatic light, whereas Borromini and Guarini used architectural form itself to imply the expressive qualities [10]. Manipulation of light to enhance the richness of the interior and to draw attention to the sculptural and painting decorations was an important feature of that period [11]. Bernini's representation of Saint Terasa in Cornaro Chapel, Santa Maria Della Vittoria, Rome, is a good example of illimunation of an enframed sculpture and making it fully visible as if inviting the viewer to participate in the vision [12]. Furthermore, in Bernini's S. Andrea Quirinale, with the opening of an oculus in the vault and use of lantern, a new source of light is provided to focus on the whole iconography [13].
Wall paintings and scripts are the other expressional qualities used extensively in Ottoman mosques. In Classical period, script was an important component in mosques. In this period, in addition to the use of tile as decorative element, there was an increased use of scripts especially on the wide cornices, dome centers and skirts and in the oval medallions hung on the first level windows [14]. There is a strong relationship with the use of scripts as the decorative element in the mosques and symbolizing the dominance of Islamic beliefs. For instance in many mosques on the walls, cornices, mihrab or domes the verse of Ayet-el Kürsi, Surah Al-Fatır, the Verse of Ihlas, scripts of the names of four Caliphs, Allah

and Mohammed, and other scripts are written representing the dominance of Islamic focal of architecture in Ottoman period.

As for the wall paintings, in Classical period geometric decorations and hatai and rumi motives were the most predominant elements. Yet, in Ottoman Baroque period flower motifs in the vases, motives from nature, Kaba, The City of Medine, mosque, kiosk depictions landscape paintings, ship depictions, flowers in medallions and such kind of wall paintings are observed [15]. Western influence has been accepted and absorbed in the 18th century Ottoman mosques especially in ***stone engravings and decorations*** where scallop, volute and leaf forms are expressed in a manner new to the Ottoman architecture [16]. In Baroque period mosques three-dimensional naturalistic floral ornaments with stylized rumi motifs and scrolls, shells, molded cornices, concave-convex details were the predominant decorative features [17].

Intangible Cultural Heritage Studies in Turkey

In Turkey, UNESCO Convention for the Safeguarding of Intangible Cultural Heritage of 2003 was accepted in 2006. Before that date, in legislations there was no emphasis on intangible [18] (non-physical) heritage. Despite the increasing awareness of the preservation of tangible historic monuments, meanings expressed by those monuments and values and meanings attributed to them by people, namely intangible values and heritage, have no consideration neither in the main preservation Act of 2863 (1983) nor in the Foundation Act of 5737 (2008) and in Foundation Regulations (2008) [19-20]. After the acceptance of UNESCO Intangible Cultural Heritage Convention, a responsible body for the preservation and promotion of intangible heritage in Turkey was established, which is Department of Research and Education affiliated to Ministry of Culture and Tourism. Today in Turkey there are two inventory studies maintained by this Department within the context of intangible cultural heritage, which are Intangible Cultural Heritage National Inventory Project and Living People Treasury National Inventory Project. Civil society organizations also arrange some projects and education seminars related to this field. As an instance, since 2008 Foundation for Conservation of Natural and Cultural Heritage (ÇEKÜL) organizes seminars in different cities on intangible cultural heritage to the local municipalities thus increasing the awareness for neglected values [21].

Above mentioned expressional qualities observed in historic mosques are also parts of this intangible cultural heritage transferring messages from Islamic culture of their period of construction and even before, carrying deep meanings and are never merely decorative. It should be noted that "a full understanding of heritage can only be achieved through the study of the multiple reciprocal relationships between tangible and intangible elements" [22]. Hence, first, an awareness is to be gained and disseminated emphasizing their intangible cultural value among the people who will execute their conservation and among many others who are interested. In addition, during their preservation extra care is to be given for their survival. Finally, fake replicas for the sake of modern-historic integration are to be strictly avoided.

CONCLUSIONS

I have attempted to explain how certain forms and qualities encountered in Anatolian mosque architecture reveal and reflect Islamic understanding, culture and basic values of the society, as well as craftsmen. I have also tried to clarify the forms, decorations, geometries and architectural elements observed visually in historic mosques have certain deeper values and meanings. Finally, I briefly described the developments in intangible cultural heritage studies in Turkey and their relation with the expressional qualities of mosque architecture with some suggestions towards their longevity and preservation.

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CANVAS SUPPORT AS MATERIALIZATION OF RELIGIOUS-PEDAGOGIC PROPAGANDA

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ABSTRACT

In Portugal, over the centuries, religion used painting on canvas to evoke its sacred mysteries. Despite paintings are primarily pictorial, their back can reveal a lot about their contribute for the religious-pedagogic propaganda of the Catholic Churche. Based on a interdisciplinary collaboration among art history, conservation, science and on the topic of the material and technology of the weaved support in the Portuguese painting, this paper focuses on how canvas appears to be an exceptional medium for visual materialization of such power and glory.

Keywords: canvas support, religious painting, religious-pedagogic propaganda, weaved structure.

INTRODUCTION

Religion, whose Latin etymology *religare* highlights the role of gathering, tying and binding, has long been recognized as deeply related to art. Over the centuries, religion used painting, as a means of bringing the believer to God. Painting, on its weaved form, gathers an exceptional sensory, emotional and intellectual vehicle for those who want to achieve spirituality [1]. In fact, the words "text" and "textile" both derive from the Latin *texere*, to weave [2]. And weaving can function as a metaphor for many aspects of life, including the religious one. Thus, Christianity, which became the predominant power influencing European culture, after classical antiquity, inspired artists and patrons to evoke the nature of these sacred mysteries in visual terms. One of these terms was painting on canvas [1].

Despite paintings are primarily pictorial and, consequently, the image is the starting point, the back of it can reveal a lot about its history and function. But what sort of information can be derived from the back of it when dealing with art and religion? Our paper presents results of an interdisciplinary collaboration among art history, conservation, and science on the topic of the material and technology of the weaved support in the Portuguese painting, since its implementation to industrial production. The particularities of the fabric support used, its dimensions, and whether it is framed, suspended or rolled may help in the interpretation of religious artwork. And it also may enhance the relashionship between religion and art. Therefore, in this article, we show, through this comparative study of canvas supports, how it strongly contributed for the religious-pedagogic propaganda of the Portuguese Catholic Church.

OPERATIONAL GOALS

The use of canvas support in Portuguese religious painting

In Portugal, by the late sixteenth century, artists began to replace panel to canvas support for oil painting. The cultural circles embraced the Italian art solutions, while not ignoring the artistic influences from Flanders or Spain. Also through the cultural sponsorship, the exchange of artists was motivated, allowing the sharing of experiences, knowledge and documents between Portuguese and foreign artists [1]. The replacement of tempera by oil was driven by technical and expressive possibilities afforded by oil and the canvas support. Dynamic and flexible, they were able to translate a new notion of space, with strong dramatic intensity, typical from the new modern conscience [3]. Nevertheless, paintings were already executed on textile supports during the later Middle Age [4]. Indeed, painting on wood and textiles could even be carried out in the same workshop, but relatively few have survived. The demand increased due to changes to liturgical practice and an upsurge of religious fervour [5]. These early works were practiced for the making of banners, hangings, altarpieces, palls and painting on linen [6], and most likely they were not envisaged as ephemeral objects[4]. Treatises of the period such as Cennini's *Il Libro dell'Arte* (c. 1390) or

the Manuscripts of Jean Le Begue reveal that this practice, principally on linen, but also on silk, was already widespread [6].

Since the transubstantiation was an instrument of special reorganization of Christianity, the ceremony was an extraordinary ritual, surrounded by the highest mystery and solemnity [7]. The place of celebration became the place with the real presence of Christ, which came greatly solemnize the memory space and community meeting of Christianity [7]. Gradually, the painted textile support replaced the murals, the heavy panels, the costly tapestries and embroidered pieces [3]. Larger sizes, portability, and versatility for religious objects constituted a strong justification for the emerging of fabric as a painting support [Tab.1]. In Portugal, few of these early works survived, partly due to their delicate and vulnerable medium of glue-size. An example is the coarse plain linen cloth altar representing *Our Lady of Rosary*, from the Machado de Castro National Museum, Coimbra.

Thereby, due to fabric's versatility, scenarios of new experiences for the use of it could be more open - the procession - or closed - the private chapel, the convent, the cloister [7]. For instance, the oldest Portuguese oil painting on canvas is, in fact, a portable banner of *Our Lady of Misericord* (c. 1555-60), painted by Francisco de Campos and belonging to the *Misericórdia of Alcochete* [8]. Founded in the sixteenth century and still in activity, this brotherhood have on its fabric banner the gregarious symbol of Mary's protective mantle covering the whole society. Along the centuries and during its annual processions, banners like this are a way of marking urban places as sacred, during the Holy Week.

In fact, the fabric support has been employed in multiple ways whether stretched or hanging, or created to be used as processionals or as a fixed element [5].

After the Counter-reform, the art of painting served, as never before, the dogmatic purpose of the decorous precept of *nihil profanum, nihil inhonestum* (nothing profane, nothing dishonest) [9]. From the seventeenth to eighteenth centuries, the centralized power of Catholic Church promoted the evolution of a pious and devotion art painting to an apotheosis and strong theatrical content. Allied to the technical and expressive possibilities of the oil, which allowed working more freely, larger canvases were increasingly used. They materialize the national interpetation of the Council of Trent (1525-1563) principles and are intrinsically associate with the introduction of the Eucharistic throne in Portugal [13].Through these large paintings, the church reinforces the image of strong and glorious institution. The support appears to be therefore an exceptional medium for visual materialization of such power and glory, especially when integrated into architectural space [1].

OUTCOMES

Manufacturing history and religious-pedagogic propaganda

During Middle Age, important technological innovations were carried out in the field of textile manufacture. One of them was the horizontal loom of pedals [10]. It had the big advantage, compared to the vertical loom, of weaving more cloth in a higher speed. Curiously, one of the oldest traces of a horizontal loom known was found in Portugal, in the archaeological ruins of Conimbriga [11].

In the traditional loom, the warp yarns are set up along the length of the fabric with transverse weft yarns at right angles. Plain and twill weaves are the two most commonly found in Portuguese canvas paintings, whether in fine or coarse canvas. Their weave geometry plays a major role in the fabric, as the density of yarns, in each direction, influences fabric's behavior and, therefore, of the painting [5].

In a plain weave picks and ends of weft and warp yarns pass alternately under and over each other, creating a homogeneous pattern. When the warp yarn or the weft goes over some threads, whose interweaving makes a diagonal, a twill weave is create.

The establishment of broader looms allowed larger fabrics and more complex patterns. Since these required a time-consuming process to set-up each pattern, they were more prized and expensive [5]. The more complex damask patterns were manufactured for purposes such as ceremonial use. Because twill and diaper fabrics were invested with religious meaning and were also expensive, it is not impossible to think them as being chosen as high-quality painting supports [5]. Symbolic, pragmatic and aesthetic significances may have therefore determined their selection, as it seems to have happened with the religious work attributed to Francisco Correia (1568-1616) on linen fabric with diamond shape damask weave whose undulating texture is evident through the paint.

Also in the larger altar paintings from seventeenth and eighteenth centuries, the weaving loom

limitation on the fabric width was surmounted by sewing canvases together. Ancient and overcast seams appear to have been the most widely practiced, and a trend towards coarser canvases has been observed for larger works.

Regarding the constituent materials, in the pre-industrial period, linen was the main fabric for religious paintings, but also hemp and ramie were used, as it happened with Bento Coelho da Silveira's (1617-1708) paintings [12].

Furthermore, in the study of the religious Portuguese canvases, in addition to visual assessment, observation by optical microscope is being carried out, for the identification of fibre morphology, through longitudinal view and cross section.

CONCLUSIONS

It is a fact that paintings are primarily pictorial. Nevertheless, their back can reveal a lot about their contribute to the religious-pedagogic propaganda of the Catholic Church. In Portugal, this strong relationship between religion and art was implemented allong the centuries. Product of transubstantiation and later based on the counter-reform, the weaved support was used as an excepcional medium for visual materialization of religious power and glory. The development of textile technical and material aspects allowed to invest fabrics with religious meaning. Symbolic, pragmatic and aesthetic significances may determined therefore their selection since they represent an important way to evoke the nature of the sacred mysterious of the Portuguese Catholic Church.

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Reasons for the preference for canvas
• Convenience, as it weighed less, was flexible and easily transportable;
• Greater ease of handling;
• Greater ease of application to the intended function;
• Portability, facilitating the transportation and exportation;
• Adequacy several occasions either religious or civil;
• Versatility of functions: one piece procession could be used / exposed, throughout the year, in the Church;
• Ease of large-scale production, stimulating trade in small sizes, which are sold in bulk at low prices;
• Possibility of large dimensions, by joining seams for presenting continuous surfaces and less weight;
• More flexibility and ease of housekeeping: parts of certain ceremonies could be stored rolled or folded;
• Speed of execution: a piece of altar painted cloth would be potentially cheaper, lighter and faster than painting on wood;
• In principle, cheaper than tapestries and embroideries;
• Flexibility and three-dimensionality of the screen allow a more vibrant painting;
• The texture that gave the painting met the new artistic taste.
• Durability: preservation for the future, when painted in oil, unlike tempera on canvas.

Table 1 – Preference of weaved canvas support for painting.

WHEN DENDROCHRONOLOGY IS PROVING THE ART HISTORIAN RIGHT

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ABSTRACT

The paper deals with the use of dendrochronology for dating and linking a small group of late mediaeval triptychs in Norway. A short introduction to dendrochronology is given, the triptychs are described as well as the photo dendrochronological examination method used in the project. The results of the dendrochronological examination correspond with the dating given to the triptychs by art historians.

Keywords: dendrochronology, polychrome sculpture, mediaeval art

INTRODUCTION

In 1936 the Norwegian art historian Eivind Engelstad published a book with the results of his research on late mediaeval polychrome wooden objects in Norway [1]. The publication includes a catalogue of 174 late medieval polychrome ecclesiastical art objects still kept in Norwegian churches and museums. The dating and provenance in his catalogue is, still today, only questioned for a minority of the art objects. Polychrome mediaeval sculptures, with no written documented attribution or dating, is in general dated or given a provenance by art historians. Examination of the decorative layers on a polychrome artefact may add information to the art historians' dating and provenance, by identifying the painting technique and the applied materials. A dendrochronological examination can potentially date an object very precisely, give provenance and link elements made with wood originating from the same tree together. For the art historians this is invaluable as it enables them to confirm or correct former views, and to make more acute evaluations of other similar objects.

A group of imported altarpieces

This article aims at inspecting the art historians' dating, and if possible the given provenance, of a selection of imported late mediaeval triptychs in Norway using dendrochronology (see figure 1). The four examined triptychs, named after the churches in Norway where they still are kept, are quite simple. The Røst, Leka and Hadsel triptychs have a rectangular shape, while Ørsta is rounded on top. The central part, the caisse or corpus, in Røst, Leka and Hadsel is divided into three niches with a sculpture placed in each niche. The niches are crowned by an open-worked carved arcade. The undivided corpus of the Ørsta triptych comprises a Crucifixion scene. The sculptures in the four triptychs were made from "blocks" of two or more oak planks glued together. Røst, Leka and Ørsta still have their painted wings. The Hadsel triptych is the biggest, at 190 cm high and 161 cm wide, while the ones from Røst and Leka are the smallest, at 114 cm high and 113 cm wide (with wings closed). The wood used in all the four triptychs was recognised as Baltic oak, on account of engraved marks that can be related to wood sorting and shipping through Gdansk in Poland [2], [3]. The art historian Engelstad was the first to recognise a connection between the four triptychs. In his opinion they belonged to a group of five altarpieces, which he named the Leka group and gave a North Holland provenance, but claiming that only some of these might have been made in the same workshop [1]. He dated them to the first quarter of the 16th century, closer to the period's last part. The Dutch art historian Jaap Leeuwenberg supported Engelstad, and pointed at a connection between the altarpieces and the so-called "Master of the female head in stone from Utrecht" [4]. During conservation of the four triptychs the conservators were looking for characteristics in the decorative layer that might confirm Engelstad's dating and provenance. No benchmark for this group of altarpieces was found, but several common features were observed both in the decorative layer and in the construction [5].

Dendrochronology - a short introduction

Dating by dendrochronology is based on the

principle that trees from the same climatic area produce growth ring widths that reflect the variation of summer temperatures. The felling year of a tree can thus be found by measuring the growth ring widths and search for the same variations in a dated master chronology developed for the same area. The method is described by a number of authors (see for example [6], [7], [8], [9], [10]) and applied on built structures and art objects. Dendrochronological examination of artefacts gives, at least, a terminus post quem for the making of a wooden object by giving the felling year for the tree that provided the wood used in the object [10]. The results of a dendrochronological examination may connect works of art, as boards originating from the same three may link different paintings or sculptures to the same artist or workshop [11], [12], [13].

In Europe there are several persons or environments that have contributed to the development of the tree ring dating methods and their dissemination. For Norway the National Museum in Denmark has been of major importance. The dendrochronological laboratorium at the Norwegian University of Science and Technology (NTNU, University Museum) is the center for tree ring dating in Norway. One of the center's main cooperative partners is the Norwegian Institute for Cultural Heritage Research (NIKU) [14]. The dendro dating work in Norway has from the beginning in the 1980s been concentrated on buildings made from pine [14], [15]. Dating artefacts, as opposed to buildings, started in Norway in the 1990s as a cooperation between The Directorate for Cultural heritage, NTNU and NIKU. The methods used for dating planks made from Scots pine (Pinus sylvestris) in stavchurches were then tested on smaller objects, including altarfrontals, and details of buildings [16]. NIKU, in cooperation with NTNU, dendro dated for the first time in Norway a polychrome oak sculpture in 2006 [3].

THE PHOTO DENDRO CHRONOLOGICAL METHOD

The dendrochronological investigation of the artefacts was done using the photo dendrochronological method. The method is based on measuring the growth ring widths on photo prints. For oak wood the method can only be applied on the end grain. As for the triptychs this translated to the bottom of the sculptures and the edges of the planks in the caisses. The year ring widths must be measured with a precicion of 1/100 of a millimetre. This demanded preparation of a measuring path on the endwood where the surface is smoothened in an about 15mm wide area across the wood so the radii may be recorded and documented. In general the smoothing of the surface was done using a spokeshave with an industrial razer blade, adjusted for the purpose. This plane shaved off just a few tenth of a millimeter of the surface, and so heightened the contrast between the annual rings while minimising the intervention on the object. The contrast of the annual rings was helped by adding chalk to the measure path; carefully avoiding chalking the sapwood if found. On a narrow papertape placed next to the path each annual ring was marked, numbering every 10th ring. The prepared measure path was scanned with a regular flatbed scanner. This is very useful as a pre photo check of the radii and supplementary to photography. The final photographing of the finished path was done using a digital single lens reflex camera, with a 60 mm macro objective, macro blitz and additional photolight. Printed photos with a glossy surface were used for the dendrochronological examination. All photos, digital files (Raw/JPG) as well as prints, were named and systematised in a way that makes future use of the information possible.

RESULTS AND DISCUSSION

44 of the selected 46 elements in the four triptychs could be dated against standard Baltic master chronologies Baltic1 and Baltic 2, chronologies based on paintings from Leiden as well as other Dutch paintings, and a chronology based on ecclestiastical art from Eidersstedt in Slesvig-Holsten [17]. The felling year for the youngest wooden part in each examined triptych varies between 1475 and 1503. The estimated corresponding felling year ranges between 1504 (Røst) and 1516 (Hadsel). The latter had sapwood preserved, which gives the most precise felling year (see figure 2). The procedure of determining the felling year is not standardised. This is discussed by among others P. Klein [10] and C. Haneca [18]. In this project 20 years were in general added to the dating of the last annual ring provided no sapwood was detected. The felling year does not date the artefact. Time for transporting the wood from the forest to the workshop, the potential drying of the wood and the time for making the object need to be added. Research is done by among others P. Klein [10], De Boodt & al. [12] and L.F.Jacobs [19] that help to estimate the production year of the artefact when the felling year for the

wood used is known.
Wood originating from the same tree is found in different elements in the same artefact in two of the examined triptychs. In the Hadsel triptych wood from the same tree was found in elements in the Maria and Stefanus sculptures, and the wood in another element in the Stefanus sculpture is from the same three as elements in the Katarina sculpture. In the Røst triptych, wood from the same three was found in two of the tree sculptures. In the Ørsta altarpiece, the two sides of the caisse are from the same tree. More interesting is the fact that wood from the same tree is found in Leka and Ørsta triptychs. One board in the back wall of the caisse in the Leka triptych is from the same tree as two boards in the back wall of the caisse in the Ørsta triptych. The connection between the two triptychs is confirmed by the fact that wood from the same tree is used in all the sculptures in the Leka triptych and in the Maria sculpture in the Ørsta triptych.
The results of the dendrochronological examination must be connected with the results from other examinations of the objects. The art historian's idea of a common workshop for two of the altarpieces; Leka and Røst was strengthened by the results of the conservators'examination of the triptychs and the scaled measuring drawings. The dendrochronological examination on the other hand, confirmed the supposed link between Ørsta and Leka.

CONCLUSIONS

The result of this project proves that in situ photo dendrochronological examination of polychrome objects, may potentially give a very precice dating of elements, and thus, in this project, of complete triptychs. The method is cost effective, minimises the invasion and may be used when core samples is not possible.
Wood originating from the same tree connected different elements within the same triptych, and connected two of the triptychs to the same workshop [11].The provenance of the oak is confirmed to the Baltic area. The dendrochronological dating of the altarpieces proves the art historians right; the triptychs are made in the first quarter of the sixteenth century, and together with other examinations, confirms that the triptychs in Røst, Leka and Ørsta churches most possibly originates from the same workshop.

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1

Fig. 1 – The altarpiece from Leka.The original paintlayer dominates the surfaces, but secondary paintlayers adds to the total impression of the piece. Photo: Birger Lindstad © Riksantikvaren2001.

Triptych	Dating of last annual ring in the youngest element		Estimated felling year
	Sculptures	Caisses	
Røst	1484		1504
Leka	1475	1493	1515
Ørsta	1485	1486	1515
Hadsel	1503		1516

2

Fig. 2 – Dating results. In the Hadsel triptych sapwood was found in the last 7 annual rings in the youngest element, which gave the more precise felling year 1516.

THE SACRED AND THE PROFANE IN THE EIGHTEENTH AND NINETEENTH-CENTURY ROMANIAN ART: INFLUENCES, REPRESENTATION AND PRESERVATION IN IASI (I)

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ABSTRACT

This paper presents some case studies which examine, from an artistic and cultural perspective, some works of art of the Romanian cultural heritage to be found in the city of Iasi. The paper focuses on the interconnection between the local and the Western-European tradition of religious painting in the ecclesial and secular milieu of the eighteenth and nineteenth centuries Iași. Iasi accommodated various forms of visual art, which eventually led to the cooperation of Romanian and foreign artists' in the institutionalization of modern art studies. The paper presents some images which come to support the idea of a need for the conservation and restoration of the artistic image, not in the least for its power to convey a complex educational message.

Keywords: sacred and profane images, 18th-19th-century art in Iasi, influences, representation, preservation, educational message.

INTRODUCTION

In the eighteenth and nineteenth centuries, the painting in Romanian Provinces falls under the influence of Western-European artistic trends. It gradually grows more and more secular and adapts the oil painting technique, which corresponds more efficiently to the visual materialization of the new concepts. Frescoes are replaced by encaustic or oil painting, even for vast surfaces. The artwork functions not only to serve the cult but also to embellish the walls of sanctuaries; it ceases to fulfill exclusively its utilitarian aim of moving emotionally and instructing the faithful. Art often becomes a way of uplifting patriotic feeling by offering images of some major scenes in the history of the people' [1].

In the Romanian Principalities there existed a Byzantine-based traditionalism, mostly in provincial towns, represented mainly by church painters: Nicolae Polcovnicul (1788-1842), Nicolae Teodorescu (1786-1880) in Wallachia, Ion Balomir (1794-1835), Mihai Veleceanu (1810-1873) in Transilvania and Eustatie Altini (1772-1815) in Moldova (Figure 1). New works created under the influence of Italian Renaissance and later Academism replaced the bi-dimensional space of the icon with the linear perspective, introducing *chiaroscuro* effects and anatomic naturalness. Artists resorted to a plastic language 'under construction', with influences ranging from Classicism to Academism, via late Baroque, Rococo, Classicism and Romanticism; this resulted in various provincial variants of an eclectic nature, depending on the artists' own or their commissioner's personal taste.

With the setting up of the Prince Mihail Academy (Academia Mihăileană) in Iaşi in 1834 by Gheorghe Asachi with the support of prince Mihail Sturza, higher art education developed; painters and professors were invited from abroad to teach the new artists how to paint 'according to nature'; J. Müller and the Italian artist Giovanni Schiavoni were among them (Fig. 2) [2].

In 1860, the Museum of Painting opened in Iaşi, thanks to professor Panaitescu Bardasare. The museum stored an important Western European collection: Caravaggio's *Pompey's Head*, many

nineteenth-century works by Giovanni Schiavoni (*The Crucifixion, Virgin with Child, Archangel Michael, Thomas and Jacob, Andrew and Mark, John and Peter, Paul and Matthew, Luke and Bartholomew, Simon and Philip*), and many copies made after Schiavoni's works [3].

OPERATIONAL GOALS

The process of secularization of artistic expression continued, leading to aesthetic and technical innovation in religious painting. One can assume that by accepting, if transitorily, such ways, the Orthodox Church indirectly contributed to maintaining its attractiveness for the generally well-travelled (mostly for education purposes, particularly to south-western Europe) revolutionary generations who wished to see changes everywhere. The Neoclassical and Romantic stylistic influences assimilated in Romania replaced for quite some time the Byzantine-style iconographic tradition. As a result of the artists' emancipation from the medieval stylistic canons, their iconographies, religious and genre paintings as well as documentary sketches exhibit Western-European, particularly Italian, influences. Some of the foreign artists who settled down and worked in Iasi also were actively involved in the establishment and improvement of higher artistic education; others only visited the city, earned from private commissions or represented the town out of their own pleasure, in document sketches. Eustaţie Altini (1772-1815), Giovanni Schiavoni (1804-1848), Nicolo Livaditti (1804-1860), Gheorghe Asachi (1788-1869) and Gheorghe Tattarescu (1818-1894), among others, command attention and deserve appreciation.

LOCAL ARTISTS AND FOREIGN GUESTS GRIGORESCU AND TATTARESCU

The two church painters who carried out an important artistic activity in Moldova are Nicolae Grigorescu and Gheorghe Tattarescu. With his experience acquired in painting the churches in Băicoi and Căldăruşani, Grigorescu who painted the Holy Princes Church at the Agapia-Neamţ Monastery in a combination of the Byzantine canon of representation and the new neoclassical tendency. Tattarescu painted the Metropolitan Cathedral in Iaşi in 1884-1886 (Figure 3) under a vicariously Western stylistic influence; he acquired this manned during his visit to Moscow and Saint Petersburg and maintained a naturalist symbolism in his approach. Both Grigorescu and Tattarescu were indebted to Eustatie Altini.

Realistic influences which seem innovative in the ecclesial art can be found in the work of Eustatie Altini. In 1802-1814, Altini, who studied in Vienna, painted the iconostases in the Banu and Saint Spiridon Churches in Iaşi.

At the end of the nineteenth century, the cultic monuments and monasteries in Iasi underwent a process of restauration; the process was carried out by architects and artists from Western Europe. The architect André Lecomte du Nöuy reconstructed the Saint Nicholas Princely Church in Iaşi after the plans of the original church erected on the site by Stephen the Great in 1491-1492. In this controversial restauration everything was remade with substantial changes. The murals were painted by Jean Jules Antoine Lecomte du Nöuy (1842-1923) (Figure 4), the architect's brother, who came to Romania in 1895, at the request of the government. Montgailhard quotes the painter as follows: 'The Romanian government has commissioned me to decorate several churches with frescoes, which I did according to the local custom, in a Byzantine style; in my compositions I added the portraits of sovereigns to the saints. I decorated the chapels and choirs of churches in Arges, Three Hierarchs and Saint Nicholas of Iasi in this way" [5]. The westernizing influence of the styles of the time put an imprint on the eclectic nature of the painting in the Saint Nicholas Princely Church in Iaşi.

THE SACRED AND THE PROFANE ALTINI

Both the religious paintings and the icons in the altar pieces of the Banu and Saint Spiridon Churches in Iaşi, painted at the request of metropolitan Veniamin Costache, and secular paintings, particularly portraits (mostly of women and a portrait of metropolitan Veniamin Costache) were made by the painter Eustatsie Altini. A Greek by origin, he emigrated to Iaşi with his family in 1780. Altini was the first artist who settled down in Moldova to have made the transition from the painting in Byzantine tradition to the realist painting. As the first modern artist who belongs neither to the tradition of medieval Romanian painters, nor to that of the Phanariot period in Romanian history, Eustaţie Altini is considered a forerunner of other painters: Tatarascu, Lecca, Mişu Pop and Nicolae Grigorescu. His personal manner of treating church painting connects the art of the nineteenth-century

Romanian Principalities to European Academism [6]. In his works, Altini acts as an innovator of traditional sacred painting; observing the Orthodox *hermeneia*, he does not hesitate to abandon some conventions and presciptions of post-Byzantine plastic language and anticipates in this respect the efforts of Gheorghe Tătărăscu, Nicolae Grigorescu and Nicolae Tonitza [7]. Secular works grow more and more numerous next to religious painting; some have anonymous authors, such as the icons at the Saint Sava Church.

THE NATIONAL THEATRE

Other secular pictures of major importance were made at the same time.The National Theatre in Iaşi treasures a curtain in oil painting technique designed, in 1896, by the Viennese master painter M. Lenz. This composition is made of two scenes: an allegory of the three ages of human life in the centre and an allegory of the Unification of the Romanian Principalities (Moldova, Transylvania and Wallachia) to the right. The same pastel tones are peculiar to the paintings made by Al. Goltz on the other curtain in the same emblematic building in Iaşi.

One can notice Neoclassical, Romantic and Baroque influences brought in by the painters educated outside the Romanian territory. These influences give an obvious imprint of modernity, both in the religious and the secular works. A preference for details was exhibited in the landscapes of Iasi of those who took a pleasure in representing some parts of the town.

CONCLUSIONS

In the eighteenth and nineteenth-century Romanian art, in Iasi in particular, the Neoclassical and Romantic influences add to the beauty and spectacular energy of some religious and secular representations, mostly characters and landscapes. The church master painters' artistic availability and receptivity was also demonstrated by their accepting secular commissions. One can witness an 'adapt-as-you-paint' plastic modernization which created opportunities to relate to and connect various tendencies and alterations.

Retrospectively, one can see that by accepting, if transitorily, such ways, the Orthodox church indirectly contributed to maintaining its attractiveness for the generally well-travelled (mostly for education purposes, particularly to south-western Europe) revolutionary generations who wished to see changes everywhere.

A large amount of anonymous works, either religious or secular, requires similar considerations, as important evidence for the history, art and education of the time. These values need careful and sustained preservation, which is currently being carried out in a concentrated, laborious and dedicated way, as a result of joint preparations, by several institutions; the iconostasis of the Saint Sava Church in Iasi is one such example.

Different aesthetic influences and educational messages inform the religious and secular images, contributing to their value. The art in the eighteenth and nineteenth-century Iasi, as in other places in Romania, accumulated changes. One can witness the progressive replacement of precious sacred works with profane subjectmatter. This poves the artists' conceptual openess to new cultural and educational values.

ACKNOWLEDGEMENTS

The authors of this papers have found particularly useful some Romanian and foreign publications which mention some momuments of religious and secular art in Iaşi. In time heritage valuables were restored in order to be physically maintainde and included in the cultural tourist routes offered.

We would also like to express our gratitude both to the parish priests who serve in the churches in Iasi mentioned in this paper.

The authors would like to thank the professionals involved in the preservation and restauration of paintings in some of the churches mentioned in this paper, who have agreed to be photographed at work.

Last, but not least, we are grateful to dr. Mihai Margineanu, the parish priest of the Toma Cozma Church in Iasi for kindly accepting our photograph taking of Giovanni Schiavoni's paintings.

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Fig. 1 – Theotokos with Child, Eustatie Altini, narthex, Banu Church, Iaşi: neoclassical style

Fig. 2 – The Holy Apostoles Andrew and Mark, Giovanni Schiavoni, Toma Cozma Church, Iaşi, neoclassical style

Fig. 3 – Jesus Christ, Gheorghe Tattarescu, royal icon, iconostasis, Metropolitan Cathedral, Iași: neoclassical style

Fig. 4 – JVotive painting: King Carol I and Queen Elisabeta, the Prince Heir Ferdinand and Princess Maria, Prince Carol II, Princesses Maria and Elisabeta – narthex of the Saint Nicholas Princely Church (Sfântul Nicolae Domnesc), Iași: eclectic style (Neoclassical approach on the basis of a neo-Byzantine compositional and stylistic intention).

HISTORIC, THEOLOGICAL AND SOCIAL PERSPECTIVES (PAST AND PRESENT)

"PASSION CLOCK"S IN NORWEGIAN CHURCHES. ICONOGRAPY AND CONDITION

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ABSTRACT

The *Passion Clock* is a religious motif that spread during the 18th century, and they were placed in homes and in churches for devotion. Paintings of the Passion Clocks are only known in Denmark and Norway, but the motive (like woodcut broadsheets) exists in Sweden, but strangely not in paintings. Today we know of approximately 40 paintings, in museums, churches and privat collections, all painted in the middle of the 18th century. The Passion Clock depicts Christ on the cross in a semi-circular scroll with Roman numbers. Each number is connected to 13 medallions with scenes from the Passion of Christ. The Passion Clock can be seen as a Lutheran "Way of the Cross" or "Station of the Cross". The Station of the Cross is a way of memorizing and reliving the Passion of Christ. In the 18th century the Stations of the Cross, as a semi-liturgical practice, was revitalized, and religious communities beyond the Roman Catholic Church found spiritual nourishment in it. During the 18th century the Pietism piety had strong parallels to Catholic devotions. And a motive like the Passion Clock emerged as an instrument in Lutheran devotion in the Scandinavian countries. The paintings have identical iconography and almost the same color scheme.

Keywords: Passion Clock, 18th century, Painting, Religious motive, Art history, Condition report

INTRODUCTION

In late medieval piety the focus on Christ suffering aroused. Passion literature was eagerly copied and translated into vernacular languages. Representation of The Way of the Cross flourished at the end of the 15th century. During the later Middle age participation in the Passion became the principal act of Christian piety. Images of Christ's Passion and the Resurrection occupied the center of a devotional practice both private and public. The task was to transform the pathos or suffering of Christ's Passion into a sensation of compassion, - a suffering with, - in the viewer [1]. The Stations of the Cross originated in pilgrimages to Jerusalem, and for those who could not go to the Holy Land, could make a spiritual pilgrimage by use of prayer, through meditating upon the fourteen station of the Way of the Cross. Since the Pietism demand a personal, emotional and devotional response to official Christianity, the Passion Clock was like a medieval Way of the Cross; by looking at the scenes and reading the text on the painting, the spectator could contemplate and be reminded of the suffering of Christ.

The seven paintings in the Norwegian churches can be devided in two grops: Group 1, Western Norway: materials used in these versions are similar, there are not a lot of details in the paintings, and they strictly follow a scheme. The paintings are in good condition. Group 2, Eastern Norway: materials used in these versions vary, details are executed in different colours and the painters have taken some liberty in choosing colours. The paintings are in relatively good condition except from one.

OPERATIONAL GOALS

Seven of the Passion Clocks are situated in Norwegian churches; Strandebarm church in Hardanger county, Skånevik church in Hardanger county. Vassenden church in Sogn og Fjordane county, Langestrand church in Vestfold county, Drøbak church in Akershus county, Asak church in Østfold county and Tranby church in Buskerud county. Little research has been done of them [2], espesial from a conservator's perspective. First we want to examine the iconography of these almost identical paintings; which passion scenes are depicted and why? What is the correlation between the text and figures?

Secondly we will look at how the paintings in general are executed, and what condition they are in. The seven known versions have been examined

in normal light and in ultra violet light. Where needed, cross-sections have been taken. A colour scheme in each painting is made. The manual skills are studied and condition reports are surveyed.
The undertaken examinations have the main goal of getting a better knowledge of this Scandinavian phenomenon. It is needed to be able to undertake good decisions for further caretaking of the Passion Clocks left in churches.

OUTCOMES

Iconography

All the Passion Clocks are almost identical, and must have had a specific model (Fig. 1). The Passion Clock depicts Christ on the cross in a semi-circular scroll with Roman numbers and text field under and above each arms of the cross. Each Roman number is connected to 13 medallions with scenes from the Passion of Christ. From the cross there are beams pointing to each number, like a clock starting six o´clock in the morning, ending with the 12th hour at sunset, six o´clock in the afternoon, with the number VI to VI. The 13 beams have a text describing the scene: VI: Christ before Caiaphas, VII: The Trial, VIII: Flagellation, IX: Mocking of Christ, X: Crown of Thorn, XI: Before Herod, XII: Condemned, I: Carrying of Cross, II: Praying for His enemies, III: Comforting the thief and his mother, IIII: Death, V: Deposition, VI: Entombment. The various scenes are often rendered as small monochrome silhouettes. The motif is flanked by two columns, or more common: the two columns are a continuation of the medallions. On the top of the column at the left side is Moses with the Ten Commandments, and on the right column a cock of St. Peters denial, with the texts, Lamentation 1, 12, from its beak. At the bottom there are two verses placed in ovals surrounded by roses**.** There is also text on the extension of the scroll around each arm of the cross.

Condition of the paintings

Research showed that the paintings from Western Norway are painted with the same materials, colour structure and manual skills. In Eastern Norway the motif, technique, colours and manual skills differ more. One can see more personal character. The same colour scheme seems to have been used, but details and the finishing touches are done in different ways. Only one of the seven versions is in poor condition.

CONCLUSIONS

The Passion Clock arose in a time of increasing interest in the Passion, and the important pedagogic and emotional ascpects contributed to personal application of Christ suffering. Step by step the spectator could meditate on forgiveness, repentance and mercy. Together with the story-telling medallions, the written text appealed to the heart of each beliver ("O stony heart, break. Because of the death of your Saviour"). Like the medieval Station of the Cross, the Resurrection is not included. The focus was on the Atonement, and that there was no suffering like the suffering of Christ.
The paintings are in general executed with the same type of materials and colour scheme, but some of them differ in manual skills. Only one of the seven paintings differs a lot in the use of colours, which can be a sign of personal character. This version is also the only one found in Norwegian churches that is signed. It is clear that even if there were different craftsmen that executed these motifs, there has been a strict way of building up the layers of paint, in addition to the strict iconography that is followed more or less in all the versions we have looked at. The Passion Clock became almost a mass production during the middle 18th century, and the handcraft was most likely executed by local painters. This is probably the reason for finding local differences. There is found no correlation between the lack of interest for the motif and the condition of the paintings.
The results show us that it is important to attend to all the Passion Clocks that are left in the Norwegian churches because they show us a glimpse of the Lutheran way of presenting the Passion. They also represent use of pictures for popular piety; this was not only art, , but it was a way of practicing a Pietistic life in the 18th century.

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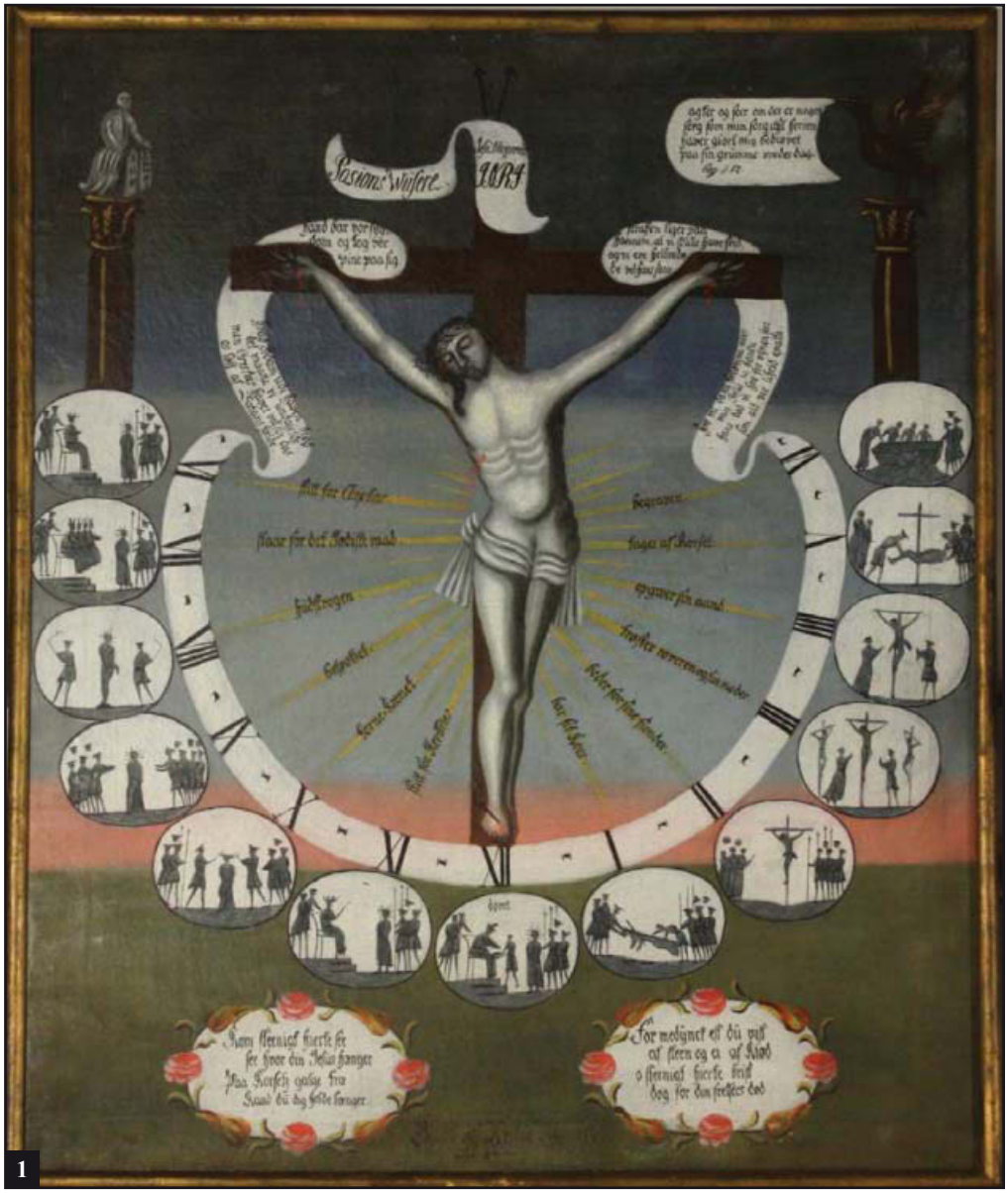

Fig. 1 – Passion Clock from Langestrand church, Vestfold county

AN IMAGE WHATEVER THE COST?

ABOUT THE KIND OF IMAGE, THAT DESERVES ALL THE COSTS TO PRESERVING IT IN THEODORE THE STUDITE'S WRITINGS. THE BEAUTY AND THE ANTICHRIST OF THE ICONODULES AND OF THE ICONOGRAPHERS

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ABSTRACT

In this study, we analyzed and compared different passages from Theodore the Sudite's writings concerning the decision of preserving icons during the times of iconoclast persecution.
As the subject of beauty worth saving was among the firsts to come in mind when evaluating/looking at a religious painting, we searched to asses if the beauty of an icon for the iconodule writers had the same meaning with the general concept of beauty for the Fathers of the Church. We add to that a parallel to John of Damascus' vision on men as images, christs and places/dwellings for God.
Traces of the iconophiles' concepts were searched for in the Moldavian iconography. The ways of imaging the pagans, the heretics, the Antichrist and those who lead a good life or a good battle were briefly examined in different iconographical compositions, such as *The Last Judgment*, *The Last Supper* and *Only-Begotten Son*. Furthermore, associations with the image of the Antichrist in the byzantine iconography as the essence of the heretics' appearance were established.
Conclusions about the significance of icons for moral life according to Theodore the Studite's letters were stated.

Keywords: icon, Theodore the Studite, beauty, Antichrist

INTRODUCTION

This paper reports on the results obtained during the study of the deification in and through the iconography.
The prominence given to the θεωσις in Eastern Church theology has been asserted through different studies on the subject. Lately, Andrew Louth developed an argumentation of interest to this study, concerning the place of the *theosis* in Orthodox theology. He insisted: "deification belongs to a broader conception of the divine οικονομια, deification is the fulfillment of creation, not just the rectification of the Fall. One way of putting this is to think of an arch stretching from creation to deification, representing what is and remains God's intention […]. The loss of the notion of deification leads to a lack of awareness of the greater arch from creation to deification, and thereby to a concentration on the lower arch, from Fall to redemption […] with the result that Incarnation is seen simply as a means of redemption, the putting right of the Fall of Adam." [1]
However, little research has been undertaken on the view of the iconodule writers over the (spiritual) costs one can assume when trying to preserve the holy images, given the life goal Christians have: deification, although conservation and restoration of religious cultural heritage is nowadays of a great extent.
This paper examines Theodore the Studite's paradoxical affirmation from one of his letters [2], concerning the futility of preserving churches and images. We have taken into account the context of Theodore's all correspondence and that of the writings of John of Damascus concerning the notions of *beauty* and men as *images* or *dwellings for God*, integrating the larger picture of the Moldavian iconography.

MATERIALS AND METHODS

The most appropriate methods to use, given the importance of Theodore's letters [3] and our general interest for the Moldavian iconography were the analytical method, the synthetical method and the deductive method [4]. The starting phrase for this research paper where Theodore sustained there was no use in saving churches and icons if we, *temples of God*, were left to profanation [5] led us to think of the special understanding or rules Theodore might have had for the preservation of icons, as an iconodule writer. So, was this contradictory affirmation consistent with his entire correspondence? What kind of beauty or ornament did Theodore intend to defend? What place did beauty, esthetics have in Theodore's writings? Did John of Damascus's point of view differ on this

subject? At the same time, we wanted to emphasize through our investigation the nature or the traits of an icon worth keeping to iconodule writers and its links to human perfection.

For John of Damascus' corpus of literary works, we primarily referred to his writings against the iconoclasts and to his citation from Leontios of Neapolis, giving the example of the icon not having anymore the face of its prototype depicted on it [6].

As the passage from Theodore's letter spoke about a false protective attitude towards the icons, we tried to refine a portrait of the one who becomes an antithesis to an icon. We searched for the symbolic image of the false follower of Christ in Moldavian iconography.

We gave our attention to the symbolic composition of the Justinian hymn *Only-Begotten Son* (Fig. 1) from Sucevița Monastery, as it showed the image of a soldier having the traits of Christ who was getting out from Hell, sustaining himself with a cross. This image was originally interpreted as showing the figure of Christ himself [7]. We analyzed the possible antithesis between a follower of Christ and the devil, taking into account the image of the devil riding a lion from the same scene.

We referred to Probota's iconography [8] for the *The Last Supper* (Fig. 2) and to *The Crucifixion* from Humor Monastery (Fig. 3), for the study of proximity, which does not guarantee similarity of choice and resemblance.

Additionally we mentioned briefly the the ways of imaging the pagans, the heretics, the Antichrist and those who lead a good life or a good battle in the scene of *The Last Judgment* from the Moldavian monasteries.

OUTCOMES

We studied Theodore's particular perception of the iconoclasm as a final heresy with an "updated" case of a nonrepentant lapsi. In addition, Theodore's iconoclasts as Antichrists and as the last phase in the evil's influence on human nature – the ultimate figure of the human failure as an image of God – in Theodore's writings gave us new leads in further research. John of Damascus' insight on the deteriorated icons and the case of the Moldavian iconography helped us understand the limits Theodore as a fearless iconodule writer imposed to the preservation of icons. We understood what kind of divinization remains the recommended objective for the Christian worshiper of icons, in the iconodule literature.

CONCLUSIONS

Following the Tradition of the Church, Theodore the Studite imposes spiritual limits to the defense and the preservation of icons. Nevertheless, these limits are not determined by the danger of idolatry, but rather by the concerns for one's struggle for divinization and for a subtle falling into heresy.

ACKNOWLEDGEMENTS

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Fig.1 – Scene illustrating the Justinian's hymn *Only-begotten Son*, naos, south apse, Sucevița Monastery.

Fig.2 – *The Last Supper*, chancel, south wall, Probota Monastery.

Fig.3 – *The Crucifixion*, naos, north apse, Humor monastery

CONSERVATION AND RESTORATION OF ST JOHN'S CO-CATHEDRAL THE CHALLENGE OF RECONCILING PAST AND PRESENT USE

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ABSTRACT

This paper presents the history of the changing uses of St John's Co-Cathedral from its initial construction in 1577 by the Knight Hospitallers of the Order of St John to the present day, that is, the reason for its construction and how it came to be one of the most magnificent and lavishly baroque embellished interiors to be found anywhere in the world. It will also discuss the challenges that have been presented by the natural deterioration of this monument by the passage of time and how the conservation and restoration of the various decorative materials were addressed. The challenges of the changes of its use from being exclusively the religious headquarters of the Knights of St John, to a religious shrine and a place of worship and also as a cultural touristic attraction will also are discussed.

Keywords: St John's Co-Cathedral, Knight Hospitallers of the Order of St John, changing uses, challenges.

INTRODUCTION

The Order of the Knight Hospitallers of St John of Jerusalem, of Rhodes and of Malta built this edifice as their Conventual church in 1577 [1]. The Grand Masters and the Knights donated gifts of high artistic value and made enormous contributions to enrich the church with only the best works of art by leading artists of the time, thus rendering St John's an outstanding treasure house. The numerous artefacts by artists including the renowned Caravaggio and Mattia Preti, which embellish the interior, are the artistic and religious heritage of hundreds of years of history. Hence, St John's Co-Cathedral became a gem of baroque art and is today recognised as a unique monument of international importance [2].

The mannerist style of the exterior architecture is sober in style and reflects the military mood of the Knights after the Great Siege[3]. It is an outstanding contrast to the glorious baroque interior of rich marbles, monuments, and lavish decorative ensembles that overwhelm the visitor with an impressive but harmonious vision (fig.1). The interior which consists of a wide nave with a barrel vault and two aisles divided into side chapels was originally equally simple. However, in the seventeenth century, Grand Master Nicolas Cotoner ordered the complete redecoration of the interior. The dawn of the seventeenth century had ushered in the new baroque style and its flamboyant and demonstrative character provided ample decorative material. The Italian artist Mattia Preti, who was commissioned the embellishment work, transformed the interior into a celebration of baroque art. Preti was one of the most outstanding artists of the seventeenth century, starting with the vault, he depicted episodes from the life of St John the Baptist. On designs prepared also by Preti the plain walls of the nave and the chapels were carved and gilded with elaborate baroque motifs, transforming the walls into a riot of foliage, flowers, angels and other symbols.

OPERATIONAL GOALS

The changing uses of St John's Co-Cathedral

Sustainability and quality control

St John's served as the Knights' physical expression of not only their religious fervour, but more importantly their military achievements. As a result it soon became a showcase of their artistic patronage and an expression of their powerful dominance in Europe. Following the Order's expulsion from Malta by Napoleon's troops in 1798, Malta became a British colony, the British government had little use for it and hence the Bishop of Malta set its claim on it. Although it remained functioning as a church its use changed considerably[4]. With the new prevailing neo-classical style of the eighteenth and early nineteenth centuries, baroque soon lost its lustre being viewed as distasteful. Hereafter the church was not given the maintenance it required and deterioration set in at a fast rate. Without the proper maintenance the domed roof of the chapels suffered extensive deterioration caused by rain water that had seeped through the stone work thus eroding the gilt layer and the carvings.

The recent rise in cultural tourism during the 1970s started to give a new dimension to St John's Co-Cathedral, especially when the City of Valletta was included in the UNESCO World Heritage list in 1980. St John's Co-Cathedral, at the very centre of the city, soon became the most visited site on the Maltese islands. It became obvious that action had to be taken to restore the cathedral. The Government and the Church of Malta agreed to put the ownership issue aside and formed The Foundation in 2001 with the main aim to conserve the priceless works of art preserved in St John's Co-Cathedral. The church was in need of urgent restoration in several fields therefore a plan had to be drawn up in order of priority.

The sustainability of St John's Co-Cathedral and the awareness of the heritage of this monument which outweighed its value as a tourism asset were addressed to stop further disintegration. Its enjoyment by future generations and its long term survival could not be prejudiced by short-term considerations [5]. In order to minimise the impact of visitation several measures were taken, such as installing a protective carpet covering the inlaid marble tombstones along the tourist route along the nave and chapels, controlling the number of visitors in the oratory and the lux levels of lighting installations.

Looking after St John's as a sacred place and as a historical monument posed many ethical and practical challenges regarding its use, conservation and display. Sacred places are at the heart of the emotions of religious believers and that had to be respected. A key concern was how to deal with the situation when a sacred place becomes a touristic attraction because its artefacts and sacred objects then become *objets d'art.* Other considerations had to do with selecting the right conservation treatments and materials. There are many pressures particularly those brought about by visitors and tourists and the conflict that can arise between the traditional values of a religious community and the goals of modern conservation and how the artefacts should be exhibited[6]. However, these issues were resolved through dialogue and general understanding that St John's is a sacred place and an important cultural monument that should receive special attention and consideration. Therefore appropriate solutions were developed within the particular context and in compliance with religious needs. Procedures and policies were formed by the curatorial department to manage the conservation of the architectural fabric and artefacts within. The aim was to deal with the changing use of St John's and to implement the appropriate care for the building and its artefacts.

OUTCOMES

Restoring the past to serve the present

Restoration is a costly affair and The Foundation's first concern was to raise the revenue for such a vast restoration scheme to restore all the decorative walls of the chapels and nave. This was accomplished through The Foundation's continuous generation of revenue mainly derived from visitors' entrance fees, sponsorships and donations from generous benefactors.

Priorty was given to the decision on a restoration philosophy that would be followed and the best methodology to apply that would satisfy the requirements of the church as a place of worship and as a historical, artistic monument [7].

The starting point was the exterior fabric of the church which required restoration on account of the deterioration caused by the natural elements and to mitigate the infiltration of rain water. On the interior, one of the most pressing issues was the deterioration of the gilding of the chapels. The project started with several studies to determine the exact type of deterioration and the methods used in the original decorative scheme (fig. 2). The studies showed that a series of deterioration phenomena had manifested itself throughout the years and that the structure had suffered extensively. It became immediately evident that the deterioration was typical of damage induced by the crystallisation of soluble salts inside porous stone walls. The expansion of salt crystals and repeated fluctuations of relative humidity had been the cause of damage including micro-decohension, disintegration of the stone structure, lifting, detachment and losses of fragments of the paint and gilding film, blooming, staining and encrustations. Further still, the carvings were also covered with several layers of dust and candle soot which had accumulated over the years. Large areas of the wall carvings had also been over-painted in tempera and treated with linseed oil which exacerbated their deterioration. The behaviour of salts in porous walls and their damage to the structure and painted surfaces was studied since salts crystallize at different heights depending on their solubility and ambient conditions. Carbonates, being the most soluble crystallised at the upper levels. The lower strata of the walls also suffered deterioration caused

by rising damp through the stone courses resulting in the capillerisation of nitrates and sulphates that formed efflorescence and crusts causing the loss of the gilding layer whilst leaving a noticeable white salt deposit on the surface. Another phenomenon resulting from the movement of soluble salts in extensive blanching was evident on the gilt and painted elements of the walls. These conditions had a severe impact on its aesthetic appeal which had to be reversed (fig. 3).

The restoration commenced with cleaning that consisted of the removal of loose dust by vacuuming, whilst dirt and grime were removed by using aqueous solutions followed by thorough rinsing with de-iodized water. Lower areas suffering from rising damp were treated for the salt deposits by using absorbent materials. The layers of linseed oil were removed using poultices of alkaline solutions. Unstable stone carvings and detached films of the paint layers were consolidated. Loose mortar joints were removed and replaced with an appropriate plaster. Cracks and other losses were restored with plastic repair to attain continuity of the decorative surface.

Once the cleaning process and repairs to the structural work was completed, it was noticeable that large areas of the gilded carvings and the decorative paint layers were lost. Therefore, the surface was graphically documented and photographed to assess the situation. Areas that had losses in the paint layer were retouched with water based colour pigments. The question that arose was whether the areas that had lost the gilding should be re-gilded. The options were: to stop at the application of the red aquarelle layer: to use mica dust to suggest the presence and luminosity of gold - or to re- gild. This situation gave rise to much deliberation between the curatorial department and restorers.

This was an important decision which the Foundation decided upon after deliberating on all the recommendations made by restorers, art historians and experts in the field. Further still since this was the first contemporary restoration undertaking the decision would affect the restoration methodology and procedures that would be carried out in the future. A decision was finally taken by the Foundation that re-gilding should take place in order to retain the original splendour of the church, based on the criteria that the church had remained in constant use as a sacred place that hosted the most important church and state religious events, and was also a historical monument that attracted many tourists. Therefore, in order to retain the authenticity of the monument the gold applied was to be of the same quality and applied in the same manner used in the seventeenth century. Only the areas that lost the gold layer completely would be re-gilded with conservative integration applied to severely abraded areas.

Test results revealed the original methods used for gilding which was a mixture of resins, *a missione* preparation or the bole, water gilding technique. Therefore, it was possible to re-gild using the original techniques and attain satisfactory results (fig. 4). The various types of gilding techniques and gold leaf qualities which could be used were then reviewed. The gilding of the lower sections was in a poor state of preservation and this required integration with some additions of the new gold leaf according to the original gilding. A slight difference between the types of gilding is still evident at close examination. The restoration interventions were supported with graph and photography records and detailed restoration reports for future reference.

CONCLUSIONS

The Foundation's mission to restore and transform St John's and its treasures to its original splendour for the enjoyment of visitors, be they regular or casual, tourists, and scholars has so far been accomplished. The most satisfying aspect of the recently completed 14 year programme of works is that almost imperceptibly the Cathedral has become better looked after, more welcoming, and consequently better loved and appreciated. Visitors' numbers have held up despite the negative state of the economy of these last few years. The Cathedral is busier that it has ever been with services, events, concerts and public lectures. It is hard to remember how dismal and foreboding the interior looked prior to 2001. The best reward for all the hard work is the realisation that St John's is recognisable as the formidable monument it has always been. This aspect was fundamental, not only for aesthetic reasons but also for establishing that Religious art, forms an essential part of any nation's artistic heritage. The conservation of which enables the study of its past and the understanding of the present.

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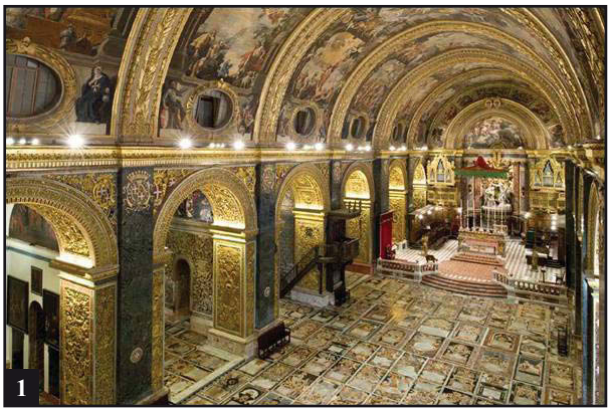

Fig.1 – The Interior of St John's Co-Cathedral after restoration.

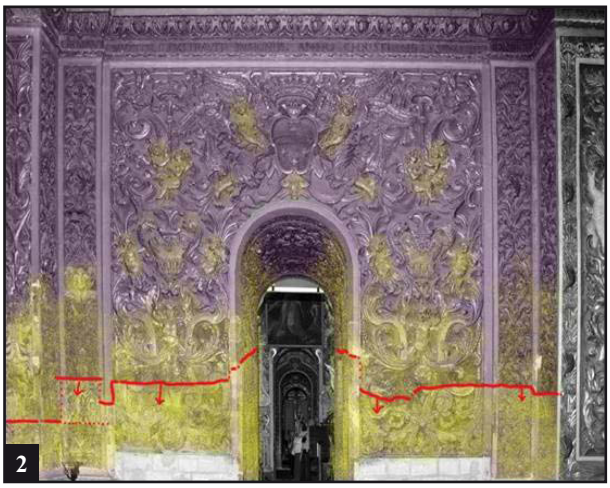

Fig.2 – Graphic Documentation - Purple sections show dust accumulation. Yellow section shows gold and colour loss – red line shows line of rising damp.

Fig.3 – State of Conservation – deterioration caused by crystallization of soluble salts, dust accumulation and superficial salt patinas.

Fig.4 – Detail of section after restoration and regilding.

COMPARATIVE ANALYSIS OF FATALISTIC BELIEFS IN THE PROPHETIC CUSTOMS OF ANCIENT SOCIETIES AND THE REPUBLIC OF MACEDONIA

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ABSTRACT

This paper provides a comparative analysis of the most common forms of future prediction used by the ancient societies. The aim of this paper is twofold. First, it uses comparative analysis to illustrate the similarities and differences in how ancient societies used divination systems to predict and interpret the future and destiny of mankind. Second, it examines the impact of those systems in modern societies. Although rudiments of the ancient systems have been modified in modern times, they remain almost unchanged in some rural areas and are evident in Macedonian folk beliefs.

Keywords: Prophesy, Antiquity, Fatalism, Customs

INTRODUCTION

The method known as *diviniatio*, based on everything *divinus*, was an attempt to tap in to the future to become aware of the fatal predestination of humans. Greek prophets, in a state of ecstasy (éksatasis) or "divine inspiration", proclaimed divine will and observed the natural and celestial phenomena in order to discover how their changes would affect human life. These prophets went by various names, including *epodoi*, *goetes*, *magoi* and *pharmakeis*, and in Latin: *magi* or *venefici*. [1] People in distress sought to protect themselves from the vicissitudes of life by pleading directly to the deities that they use their infinite power for salvation. While they prayed to the gods and offered sacrifices, people resorted to prophecies when they felt dissatisfaction with their earthly destiny and to overcome the insecurity of not knowing what events were forthcoming. They formalized this practice by creating deities for the present and the future. In the quest to understand the future, people resorted to irrational explanations, which resulted in the emergence of various customs based on superstitions. While they are generally regarded as absurd in modern society, these beliefs turned into dogma and endured for centuries. Their persistence is primarily due to the creation of religion to codify knowledge and the belief in divine powers to understand the physical laws of nature.

MATERIALS AND RESULTS (parallel interpretation)

Ancient societies had many different forms of predicting the future, but some were more common than others. Astrology is one of the most widely known forms. This practice began in Mesopotamia, and according to Jastrow, "Babylon is the mother of astronomy and astrology." [2] Astrology was first observed among the Chaldeans. [3] According to the Chaldeans, the basic idea of astrology is that as changes are observed in the heavens, they are also observed on Earth and in one's own country. [4] Over time, the Chaldeans established the personalized and individualized horoscope, [5] which used one's birthday to make specific predictions about his or her personal future. [6] After the individualized horoscope appeared in Babylon as a combination of scientific theories, ancient mysteries and beliefs, it quickly spread throughout the East during the sixth century BC, especially to Syria and Egypt. During this time manufacturers produced horoscopes, *horologoi*, *horoskopoi* to be used by Babylon priests. [7] Horoscopes even transformed ancient paganism in Greece and later in Rome, where it was regarded as the "queen of science". The Stoic understood human destiny as something that plays out at the cosmic level, [8] and largely corresponds with the beliefs of the Chaldeans. Stoics believed that everything that happens in the present and that will happen in the future is already written in the stars, which move according to an eternal law. According to the ethical principles of

the Stoics, human fate was inevitable. [9] The Church in the early Christian period, under the auspices of the Roman emperor, was largely critical of astrological determinism, and labeled all those who sought the services of astrologers as heretics. Due to the intervention of the Church, the practice of astrology completely disappeared in the West and was relegated to limited local practices in the East. During the Middle Ages, however, astrology underwent a revival, as evidenced by numerous recorded uses of horoscopes signs. Astrological iconography appeared on various monuments and works of art in the West. Despite the presence of manuscripts bearing astrological references in Orthodox countries, Zodiac signs are found only on a few Byzantine artifacts. In the territory of the modern Republic of Macedonia, the only surviving image of horoscopes and Zodiac signs are on a Byzantine monumental painting, located in the narthex of St. Archangel Michael in Lesnovo. [10]

Ancient societies considered the prophetic interpretation of dreams (*oniromania*) as the most significant form of predicting the future because the unconscious state achieved during sleep was thought to be suitable for contact with deities. The Sumerians produced the oldest such text, which described the dream of King Gudea. [11] Predictions of this sort can also be found in the Book of Daniel in the Old Testament. [12] For the Ancient Greeks, each dream had its own meaning. For Homer, the dreamer sees figures, items, and the recently deceased. If the figure of the deceased appears in the dream, it means that the person must still exist, having outlived his or her own death, but only as an airborne reflection, like *psyche*, which is the oldest means in the ancient Greek tradition to explain the following phenomena: unconsciousness, sleep, and ecstatic visions, in whose dark activities exists a special force who possesses the body and the self. [13] Plato asserted that prophets do not exist; prophecies are placed in the sphere of the divine and all that divine prophesy the transfer of certain people in a state of sleep, illness or divine inspiration and only those people who have a mind, being able to communicate the prophecy of God, and in his opinion they are the interpreters of prophecy. [14] The cult of dreams was one of the most respected in ancient Macedonia. Dreams were regarded as a sort of temporary death, symbolically represented by the poppy because of its ability to cause drowsiness and drunkenness. [15] In ancient times it was believed that every dream in itself combines animation and images filled with meaning, which over time came to be interpreted through symbols. Although symbolic interpretation began sometime in antiquity, there continues to be a whole system of beliefs that interpret dreams as a bad omen in certain parts of the Republic of Macedonia. For example, in the Mariovo territory of the Republic of Macedonia dreaming: Building a house signifies a grave, if the whole house is destroyed the owner of the house will die. [16] In the Republic of Macedonia, especially in rural areas, there is a belief that dreams dreamt on a Wednesday and a Saturday will come true, in which the sacred motive will be performed at a certain time. [17] During the second millennium BC, the dominant method of predicting the future was to observe the internal organs of a sacrificed animal (*hieroskopia*), particularly the liver. [18] This method is seen in the ancient Babylonian text, "Worship the Gods of the Night". The text mentions predicting the future through the observation of lamb intestines. A text that was discovered from the time of Hammurabi shows the merger of the two types of future prediction: prophecy through the examination of lamb intestines and through divination of celestial phenomena. [19] Predicting the future by observing the internal organs of sacrificed animals, especially the liver, was primarily an ancient Greek tradition. According to Plato, this was the only means available for humans to gain prophetic abilities, and it was not considered in the sphere of the divine. [20] Ancient Macedonians also have records of fatalistic belief in future divination by observing the internal organs of sacrificed animals. [21] Even though this method of divination has changed in modern times, rudiments of it are preserved in some rural areas of the Republic of Macedonia. For example, in the village of Porece, there is the belief that death can be predicted by examining the wishbone of a chicken. Once the meat is removed, the stains left from the meat are observed on the bone. If they are white, nothing bad will happen. If they are red, however, it is feared that someone in the family will die. [22]Observing the behavior of birds is yet another way that ancient societies used to predict the future. In Greece, predictions based on the flight direction of birds (*oionomanteia*) can be found in Homer. [23] The ancient Macedonians also observed this method of future prediction. [24] This method still exists in a modified form in rural areas of the modern Republic of Macedonia. The clucking of the chicken is considered an omen of

death in folk beliefs. It is custom in Mariovo, for example, to verify future predictions: housewives would pluck feathers from the head of a chicken, put them in water, and then wait to see what color feathers will sprout. If black feathers emerge on the head of the chicken, ill fate will befall the person who plucked it. If white feathers emerge, nothing bad will happen or ill fate will return to the chicken. [25] It is also believed that when a cuckoo lives in an abandoned house, landing in a house where people live foretells misfortune and poverty. [26] Although events in the world happens suddenly and unpredictably, folk traditions have developed skills for reading ominous signs by observing bird songs so that they can warn people about the events that will soon follow. These signs carry information from one world to the next and their messages have unique meaning, as they are intended for a certain time and a certain place. If these signs occur in normal everyday conditions and they mean absolutely nothing, nor do they mean anything to the community.

Inductive or artificial divination (*eutehnón, tehnikón*) was highly prevalent method for understanding the future of ancient peoples, used by the prophets to understand God's will by observing various phenomena that were considered to be sure signs. In Greece they appeared in various forms, including as atmospheric phenomena, which were interpreted as either good or bad, regardless of the person's will. When superstitious people saw a homeless person in the streets who was adorned with garlic and stealing food to leave as an offering to the goddess Hecate, they would immediately go home and clean themselves from head to toe and call upon priests to purify them with a sea onion. [27] The symbolism of this ritual practice draws from the popular belief that peeling an onion was an elegant and dignified way to get rid of everything that caused anxiety. [28] The ancient Macedonians placed great faith in fortune tellers, who observed various phenomena and interpreted them as either "bad" or "good" omens. There are numerous examples in ancient records of Alexander the Great consulting the prophets to interpret certain atmospheric phenomena. [29] Those signs were noticed by historians who wanted to explain his life achievements. Belief in various phenomena, like certain omens or marks indicating a "good" or "bad" future, are rudiments from the past that have carried over in Macedonian tradition.

CONCLUSION

Despite the substantial amount of time that has passed, ancient systems of future divination and ways of interpreting destiny share great similarities with those in modern society. Field research in the territory of the Republic of Macedonia finds a number of so-called "prescient" people who can foretell the future. The means by which they carry out their actions are different. Some use icons or a silver cross. Others have a procedure using a corkscrew and mud, instead of water, sugar, and coffee. Still others use tarot cards, palm reading, crystal balls or astrological maps. Although many ancient forms of divination are largely missing in modern society of the Republic of Macedonia, there are numerous other rudiments still exist in a modified state. The purposes of predicting the future is the same today as it was in ancient times: to overcome the discontent of one's Earthly fate and feelings of self-doubt, and to request relief from an illness or poverty. In an article entitled "Instead of going to a doctor and psychiatrist, Macedonians go to fortune tellers and witch doctors," it states that, "going to a psychiatrist or psychologist is still not considered normal, while going to psychics is for more acceptable to Macedonians." [30] These beliefs, however, do not contain any truth nor have any reliable basis on which to link family affairs, children's health, or the eventual death of a family member. They are merely vestiges of past superstitions that have been transmitted from paganism to Christianity and persist in the belief system of the modern Republic of Macedonia.

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PRESERVATION OF SACRAL MONUMENTS IN SLOVAKIA – HISTORY, PRESENT SITUATION AND PERSPECTIVES

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ABSTRACT

Sacral monuments represent a distinct manifestation of European identity and maintain a continuity of spiritual culture throughout the history of civilization. Therefore the restoration and protection of historical heritage in general and sacral monuments in particular, belong a mong the priorities of every civilized country.
Our study deals with the history of monuments preservation in Slovakia and is focused on architectural sacral artifacts, their present situation and perspectives. We primarily concentrate on church buildings in Trnava - the seventh largest city of Slovakia.

Keywords: sacral monuments, architectural sacral monuments, preservation of cultural heritage, history of monuments protection, modern society, the Church, categorization of monuments, monuments preservation, monuments financing, monuments fond, openness of the Church, closed Church, public interest

INTRODUCTION

Christian religion is a phenomenon which at certain time became a prehistory of the European Union, especially in reference to the fact that symbolic, as well as ritual language of this, once all-people's religion, sublimated territorial borders between individual countries, changing the European continent into a homogeneous region.
Christianity has laid the foundations of the spiritual culture of the Europeans. It has created a common cultural meta-language as a socio-linguistic category, the substance of which was to integrate different language groups on the basis of common cultural and moral attitudes and values as a seemingly homogeneous community provided that "*the concept of homogeneity will not be perceived purely in its etymological meaning."* Its homogeneity "*is based on mutual interests, relationships or affiliation with a particular group or certain region."* [4] Sacral architectural monuments give a comprehensive account of this developmental epoch. They present tangible evidence of the development of spiritual culture - in European region generally, and within individual countries separately. Therefore churches, monasteries, synagogues, chapels, Calvary and cemeteries have to be viewed in a much broader context than merely esthetic and artistic artifacts, or technical and purpose-built historical objects. In most cases they are, up to the present time, still functional and living objects, which during several centuries have continuously served their original purpose – a religious cult. This is the feature by which a sacral monuments fond differs from other monuments and emphasizes their significance and cultural legacy. What`s more, the attributive here is common historical, cultural, artistic and symbolic concept as well as a context of sacral architectural heritage that meanders throughout nearly all of Europe.
More than eleven centuries of Christian history have enriched individual European countries by the enormous amount of sacred monuments. Almost in the entire territory of the continent we can find impressive churches, monasteries, chapels, Marian and plague columns, Calvary, pilgrim places as well as other artifacts of great value which are inseparably connected with the people`s spiritual life. Not all of them are Roman Catholic monuments; many of them are the architectural masterpieces of Reformed Churches, Churches of the Eastern Rite and the Jewish community.
Preservation of cultural heritage is determined also by the socio- political situation in a given country, its cultural maturity and economic conditions. A very important factor in determining the situation related to the maintenance and preservation of sacral monuments is the structural changes within the Church itself, the changes that are contingent on social changes and the changes of people`s attitude towards the religious cult. "*Particularly*

the internet, which has become the medium of information society epoch, has changed collective mentality as well as collective structure. These changes have brought about new phenomena", [4] and the Church has had to modify its pastoral activities in this context.

Modern society has gradually shown a more and more secular character and many of the functions that Church had performed before were either discontinued or considerably weakened. In particular, these tendencies manifested themselves in the countries of the so-called Eastern Block, in which for several decades the socio-political system gave preference to the atheist world view, and faith was exposed to reprisals and societal oppression. As a result, people showed very little interest in preserving and maintaining sacral monuments in good condition. They were even intentionally neglected or vandalized - particularly at the beginning of the second half of the 20th century.

The situation in treating sacral monuments in Trnava is typical for the entire country and reveals the attitude of the society towards its cultural heritage, as well as the attitude of the Church to its own property.

OPERATIONAL GOALS

The main goal of our study wass to analyze historical, political and social aspects of preservation of sacral monuments in the unique town of Trnava - main religious metropolis of Slovakia. We have studied and catalogized the archive documents, compared the changes in the monuments after reconstructions, rebuildings and preservation attempts. We have gathered the legal fundaments of preservation laws during different regimes and their impact on the overall situation of sacral monuments in Slovakia.

We have stated that current subsidy system is far from covering real needs of monuments preservation. It works with a potential to meet less than 10% of applicants for financial aid. At present time, the Slovak Republic is simply unable to adequately sustain the monuments preservation to the effect of international agreements. It is not even able to compensate cultural monuments owners for the limitations of their proprietary rights, which is necessary for preserving the monuments authenticity. The monuments fond financing has to be elevated to the level comparable with other countries of the European Union. As a matter of fact, the monuments do not have only utility and capital value; they also represent a significant factor in development of so-called cultural tourism, as well as the country`s economy.

OUTCOMES

Trnava was and is a national center of religious life and the seat of the Archbishop. As a consequence of that, there is a wide range of ecclesiastical buildings in the relatively small town center. Starting with churches and chapels, up to the Bishop`s palace, seminaries and other historical objects.

The town is typical for its strong religious traditions and a large community of active Catholics which, in comparison with other Slovak towns, is much more consistent. This is the reason why churches are in a relatively good shape, well maintained and well preserved. Sacral monuments funding is implemented from Church resources, from public collections and parishioners` contributions.

The situation concerning other church property is different. Several decades of ideological indoctrination resulted in the fact that religious life has cooled down and the structures of the Church, which before made sacral artifacts sensible and purposeful, have changed. The buildings which were originally used by clergy for educational, religious and social activities dilapidated and became desolate. In most cases they have turned into lifeless ruins.

This situation started to change only after the changes of socio- political circumstances. Some historical objects underwent a costly reconstruction, and activities of Church started to revitalize. In spite of that, the Church was unable to restore all its property and a great number of valuable monuments still remain in bad condition and without a meaningful use. One of them is a Bishop`s palace from the 17th century, situated in a unique St. Nicholas Square.

CONCLUSIONS

A congenial attempt to give sacral monuments new meaning and a new spirit is linked with the personality of the Archbishop Emeritus Robert Bezak who came forward with an Open Church concept and the idea of approaching the secular part of the population. In the Archbishop`s palace, he opened an art gallery and put into operation a unique gastronomical shop which has instantly become a very popular place. In the premises of Marianum, he started organizing regular social events. He had other ambitious plans related to the reconstruction of the Bishop`s palace and its utilization for community purposes.

However, the Church was not ready to accept this kind of an enlightenment attitude of the clergyman. Under so far unexplained circumstances, the Holy See has suspended Archbishop Bezak, and everything that he had created was immediately

terminated by his successor. The Church fell into isolation again and despite its vast property is unable to manage its utilization and is unable to break through the state of things, characterized by the shortage of funds for restoration and preservation of precious monuments. The isolation of Church may result in the devastation of sacral monuments and the destruction of cultural values that were created by the Church itself.

Restoration of sacral objects does not depend only on technical capabilities and financial resources. More than anything else, it depends on the capability to create a new narrative which would help to revitalize the artifact. Archbishop Robert Bezak had ideas, a creative personality and capability to create narratives that could help to develop sacral cultural heritage anew. He showed the way, he could be the motivation and the main character bringing about significant changes in the area of monuments preservation in the ecclesiastical environment. This fact can be corroborated by the Bezak`s "Night of Churches", a very popular public event, which was characterized by huge interest of people in sacral monuments. This activity has become the accelerator of cultural tourism in different regions.

The key to the understanding, and the integration of cultural values, including sacral monuments, into our contemporary life is not only the level of cultural awareness and the society`s familiarity with the area of monuments preservation, but above all, the engagement of the Church establishment in the matters of cultural heritage. The Church, as well as any other proprietor, is by the spirit of the law responsible for its historical property condition. This responsibility means also finding a way as to how these historical objects can be returned to the people and how they can be used for social and culturally meaningful activity; in other words how they can be revitalized.

Sacral monuments preservation is fundamentally connected with the issue of a more open attitude of the Church, development of social marketing and the creation of new narratives of historical objects.

Monuments restoration and their appropriate utilization contribute to the improvement of the quality of life, the rate of employment and, as an essential part of the tourist industry it is linked with creating more jobs. Monuments preservation could be a significant developmental factor. In this area lies the social responsibility of the Church and for that matter, the Church has also responsibility towards itself. Its attitude to the preservation of its own historical monuments can herald a revitalization of Church life, its openness and a tendency to get closer to the secular part of the population. And that is something that should be in the fundamental interest of Christianity- if it does not want to configure itself into an isolated, marginal community which would mean the negation of the raison d`etre of its own existence.

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TRADITION AND ORIGINALITY IN THE ART OF ILLUSTRATING MANUSCRIPTS IN MOLDOVA. THE SCHOOL OF DRAGOMIRNA

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ABSTRACT

Beginning with Metropolitan Anastasie Crimca a new phase in the Romanian miniature art started. The style and technique of the miniature manuscripts of Dragomirna provide a precise note of individuality in comparison to other Romanian miniatures. In addition to the harmony of colours, which provides charm to the Dragomirna miniatures, the honesty of the straightforward way of communicating demonstrates an evolution of the previous miniatures, having a marked monumental characteristic. Anastasie Crimca's artistic work is a supreme synthesis of tradition, artistic vocation, refinement and contemporary artistic design, brought about the great achievements of the Moldavian painting, bringing more movement, more picturesqueness and a great passion for previous Romanian miniature.
Through Anastasie Crimca's contribution to miniature, he conquered an important place in the Romanian as well as universal plastic art, raising the painstaking art of miniatures to new levels in the early 17th century, facing the increasingly stronger assaults of printing and engraving.
In the spirit of illustrious predecessors, the specialties of Sacred Art and Cultural Heritage of the Faculty of Orthodox Theology in Iaşi carries on the art of illuminating the liturgical text, currently the only attempt in the Romanian academic environment at promoting religious miniatures.

Keywords: Illustrating manuscripts, Romanian miniature, Scriptoria, Romanian tradition

INTRODUCTION

The rich activity of copying and adorning manuscripts that started in Neamţ and Putna monasteries in the 15th century gradually spread to the other monasteries of Moldova to continue in the following centuries.
Beginning with Metropolitan Anastasie Crimca (1550-1629), founder of Dragomirna monastery and of a famous school of scribes and illuminators, a new phase in the Romanian miniature art started.
Running the scriptoria himself, Anastasie Crimca managed to gather around him skilled scholars and disciples who succeeded offering to the Romanian culture some of the most beautiful manuscripts, with miniatures that were special not so much due to the use of gold and the rich chromatic range, but to style and technique, Dragomirna becoming thus "*school of copying and distribution of Romanian-Slavonian books.*"[1].
A great Romanian art historian asserted about Dragomirna artists that "*nowhere else in our country were as many manuscripts as in Dragomirna copied and adorned. Nowhere was more attention paid to such artistic creations, concentrating everything to this purpose: people to work, material resources, riches for this occupation. Nowhere else were more colours, more silver, more gold used than in Dragomirna*" [2]. The manuscripts that were copied in the scriptoria of Dragomirna during Metropolitan Anastasie Crimca until the end of the 17th century are liturgical manuscripts (Liturgy Books), manuscripts of the New Testament (The Four Gospels) text manuscripts of the Old Testament (Psalms), manuscripts on the religious lives of the saints (Paterikon).
In their manuscripts, the craftsmen of Dragomirna brilliantly synthesized all the inherited iconographic data, completing them with their artistic imagination. They transposed scenes and saints from the church wall in their manuscripts and created for their miniatures a vast typology of saints, martyrs and pious people, liturgical, symbolic and mystical scenes.
The grouping of the illustrations is done in a completely original manner, deviating from the classical genre and thus underlining the artistic and theological personality of Crimca's artists in creating a new and original system of designing the illustrations of the Four Gospels, liturgical books, apostles and the Psalters.

CHARACTERISTICS OF THE MINIATURE SCHOOL OF DRAGOMIRNA

The essential trait of Anastasie Crimca's miniature consists in creating a synthesis of traditional examples of a miniature model, from which he took over the basic principles and new plastic impressions, provided by church painting - especially the monumentality that provides auxiliary elements of composition as well as a strong influence of geographic and social environment in which the artist lives and grows.
What particularly draws attention is the criterion used in choosing the iconographic themes. Metropolitan Anastasie Crimca creates a different way of grouping the illustrations, without following

a strict order strictly associated to the text. For example, the manner of illustrating the scenes of *The Passions Cycle* does not match the tight rhythm of the cycle as among its scenes there are other topics, unrelated to the text. The way this *Cycle* is arranged throughout the manuscript aims at gradually highlighting the drama and the redemptive sacrifice of Christ [3]. In his manuscripts, Metropolitan Anastasie Crimca also illustrated themes from local legends as well as symbolic themes taken from religious iconography [4].

THE MINIATURE ORIGINALITY AND THE ORNAMENTATION OF MANUSCRIPTS

Although the representation style is Byzantine, the characters were not copied from a previous model, but are the fruit of the Metropolitan's imagination, inspired by the Gospel.

The style and technique of the miniature manuscripts of Dragomirna provide a precise note of individuality in comparison to other Romanian miniatures. In addition to the harmony of colours, which provides charm to the Dragomirna miniatures, the honesty of the straightforward way of communicating demonstrates an evolution of the previous miniatures, having a marked monumental characteristic.

A particularly original creation is the Psalter of Dragomirna, 1616, whose text, apart from its religious character, was chosen by the artist to illustrate the Romanian environment and landscape of the time. The Psalter of Dragomirna remains a valuable model of local iconography through which artist Crimca created an original Romanian work. "*The manner in which it was conceived – the Psalter of Dragomirna – is the first and last work of this kind in the Romanian miniatures*"[5].

The manner of framing the miniatures in the Dragomirna manuscripts is resolved in a way that is different from the old Romanian miniatures; the frieze framing the page receives a new element – the portraits of some characters standing or sitting: *the Virgin*, *the Saviour*, *God the Father* etc.

Also, Metropolitan Crimca painted his portrait in all illuminated manuscripts, with two exceptions (Fig. 1).

In regard to the graphical presentation of the page, all manuscripts from Dragomirna present some common elements. At the onset of each major chapter, a wide frame is placed on top of the page, occupying a good part of it. The frame with a frontispiece in the shape of a triumphal arch is composed of entrelac with gold and colour, arabesque ornaments or ornaments with tassels.

The beginning of the Gospel and of the chapters are adorned with frontispieces colors perfectly harmonized with the miniature colouring while the narrower and more simple frames and decorated page shows the beginnings of the foreword and the homiliaries. Crimca's manuscript letter is uncial or semi-uncial.

The manuscripts are written with goose quill in black ink, the text is uniformly distributed on 18-20 rows per sheet, being highlighted with golden dots or red ink and letters coloured in gold and red as well. Uppercase letters book made of weavings drawn in gold and brightly coloured in red, blue and green were used.

In order to render a warmer shade of gold, the Moldavian miniaturists applied a basis of minium pigment in shade of red tone on the surface on which the foil was stuck.

The artists would transform the nature, adapting it to their decorative outlook, rendering it graphically changing its real proportions, eliminating the volume and subjectively interpreting colour, all these contributing to a very personal style.

The floral ornamentation and friezes that adorn the page are graphical transpositions of the local flora bringing a touch of authenticity and verisimilitude (Fig. 2). The first page compositions are framed by decorative strips with stylized flowers, inspired by Moldavian painting, embroidery or ceramic ornamentation. In order to strengthen the local impression, architectural elements such as towers Moldavian churches and fortresses are harmoniously associated to these elements.

A recent study suggested idea that some images with semi-stylised floral motifs coming out of a vase linked to the bottom band may have an oriental influence [6].

Another mark of originality is the very personal colouring that creates perfect arrangements by the juxtaposition of bright, almost strident colours.

The favorite colours of the Dragomirna artists are cardinal red, cold green colours that shine next to each other, gaining invaluable brightness, while ocher, neutral gray and black complete the composition. There are scenes painted in shades of red, but even in this case the complementary colour frames the scene as an ornament.

Unlike the previous miniatures, which took into account only traditional images, Crimca's school abounds in picturesque and present day details, edifices representing the Romanian architectural forms of the time, local vegetation, even local costumes (Fig. 3).

CONCLUSIONS

Anastasie Crimca's artistic work is a supreme synthesis of tradition, artistic vocation, refinement and contemporary artistic design, brought about the great achievements of the Moldavian painting, bringing more movement, more picturesqueness and

a great passion for previous Romanian miniature. Through Anastasie Crimca's contribution to miniature, he conquered an important place in the Romanian as well as universal plastic art, raising the painstaking art of miniatures to new levels in the early 17th century, facing the increasingly stronger assaults of printing and engraving.
In the spirit of illustrious predecessors, the specialties of Sacred Art and Cultural Heritage of the Faculty of Orthodox Theology in Iaşi carries on the art of illuminating the liturgical text, currently the only attempt in the Romanian academic environment at promoting religious miniatures. Thus, graduates and master students are introduced to the old and traditional techniques and technologies of miniature book ornaments as well as to the study of the materials used by ancient masters in miniature.

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1

a | b | c

Fig.1 – Anastasie Crimca, Autoportrait: a) Liturgy Books 1610, b) Psalms 1616, c) The Four Gospels 1609

2

a | b

Fig.2 – The Four Gospels 1609: a) Miniature, b) Frontispice

3

a | b

Fig.3 – a and b. Psalms, 1616: Traditional images of Romania

THE MESSAGE OF THE BOOK OF REVELATION IN THE OLD PAINTINGS OF THE NORTHERN ROMANIA CHURCHES

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ABSTRACT

The biblical message for the Christians in northern Romania was reflected in a particular way by mural iconographic representations. The wall monasteries of Moldavia and the wooden churches of Maramureş immortalized the originality of the interpretation of the last book of the New Testament of the local painters. The present study deals with St. John the Theologian's vision contained in chapter 10 of the Revelation, where a mighty angel from heaven offers as food the book from heaven as food. After the literary analysis of the text, we evaluate the contributions of the painters of Suceviţa, Budeşti-Josani, Glod and Poienile Izei to the historical contextualization of the biblical message. We believe that, although isolated from the Byzantine iconographic tradition of the Judgment, painting the Revelation in northern Moldavia was an identification factor of the Orthodoxy as well as a way of interfaith and European communication.

Keywords: The Book of Revelation, mighty angel, mural painting, wooden churches

INTRODUCTION

From the Tapestry of Angers (1373) or the miniatures of the medieval manuscripts to contemporary church painters, artists that have appropriated the Revelation can be recognized as authentic interpreters because they make to the text visible, especially when continuously dealing with this subject. The miniatures of Matthias Gerung (1532) with the Ottheinrich Bible, the engravings of Bibles printed in the West by Albrecht Durer's (1498), Hans Holbein (1531) and Jean Duvet (1555) [1] have been admired by Orthodox Christians as well, being transposed in the paintings of Dochiariou, Dionysiou and Filotheou Athonite monasteries. Chapter 10 of Revelation, that we shall present literally, after which we shall make a pictorial evaluation of four Romanian churches, uses both the terms "to see" and "book", allowing the interdisciplinary approach that is specific to religious art.

1. The inspired message of the biblical text

Chapters 10 and 11 of the Revelation book are interposed as a parenthesis between the sixth and seventh sound of the trumpet. Before action, an angel appears [2]. The angel of Revelation 10 sets one foot on land and one on sea. This mighty angel, "clothed with a cloud and a rainbow was upon his head, and his face was as it were the sun, and his feet as pillars of fire" (10.1), setting one foot on the earth and one on the sea draws attention to the universality of the message sent to the whole earth. The mighty angel descends from heaven, clothed in a cloud, sign of divine glory, having a rainbow over his head, a sign that the dark days of the cataclysm passed by. His face is like the sun and his feet like pillars of fire, his right foot on the sea and his left one on the earth. The elements of this image are borrowed from Daniel 12.7, where Archangel Gabriel is mentioned (Dan 8.16). His legs, one on the sea, one on the earth, show the extent of his power. Here there are also elements of the description of the Son of Man (Dan 7.13) and Yahweh (Ez 1.26-28) [3]. Their feet, like pillars of fire, remind us of the pillars of fire that protected Israel in the wilderness, either from cloud or from darkness (Exodus 13.21-22).

The similarity of Ez 2.1-10 and Rev 10 becomes obvious when a divine being offers, by means of a hand, the book that the prophet has to eat that is sweet in his mouth like honey [4]. The scroll was written both on the inside and outside and contained "laments, complaints and groans" (Ez 1.10), which was to embitter the womb and the life of the prophet the moment he began to preach because he is told that those who would hear the message would reject it. The prophetic message that Ezekiel was to utter foretold the punishment for people who remained in the country and over the Holy City. In the case of Ezekiel, God himself gives the roll, as direct communication with the prophet, sign of the authenticity of the message; in

the case of the Revelation, the voice from heaven commanded to John to ask the booklet from the angel sitting on the sea and the earth. The Prophet himself takes the booklet and swallows it, taking it to his mouth with his own hands, experiences the bitter – sweet change. The prophet's belly will become bitter, but his mouth sweet. The sweetness of honey symbolizes Jesus' victory (the victory of the Church over the devil) and "the bitterness" - the persecutions endured by Christians [5].

The mighty angel "lifted up his hand to heaven and swore". According Deut 32.40, the hand lifted to the sky is a sign of promise. God is witness (Gen 21.23), the Creator Himself, a God who is responsible for the existence of all, "He that live forever" (Dan 12.7). In Rev 10.6 we read: "there will be no respite"; the angel's voice is solemn and ultimate. The angel's voice, roaring like a lion's and the seven thunders underline the significance of the angel's oath. Yahweh's voice is described in the same way in Hosea and Amos 3.8.

2. Painting the Apocalypse in the northern Romania churches

In two district of northern Romania, Suceava and Maramureş, four representative churches expose the message of John's Revelation, using expressionist and naive elements in mural paints:

2.1. The Sucevița Monastery, Suceava

Sucevița Monastery, built and testified by the Movileşti family in 1585, was adorned with two porches, interior and exterior painting as well as with a defense wall by Prince Ieremia Movilă, after 1595. To the south porch, where ample scenes of Revelation are painted, by anonymous author came from a neighboring region of Moldavia [6], Revelation's 10 chapter are showed in the middle part of the east façade from the southwest pillar of the porch (Fig. 1). The book has Greek characters, different from the Slavonic fragments that separate biblical scenes. The body of the heavenly messenger is enshrined in a cloud and the rainbow is painted in green, red and yellow. The right hand is raised on red background of the wing, having two fingers raised as if in a vow. The feet of the "mighty angel" consist only in red cylindrical, with no fingers at the lower extremity. With his left hand, he gives the book to Apostle John, who is stunned and swallows from the bottom right corner. The book has no frames, being written in a single column on each page.

2.2. The Budeşti Josani wooden church, Maramureş

The church, dedicated to St. Nicholas, built by the village community in the first half of the 17th century, was painted by Alexandru Ponehalschi [7] around 1762. Since 1999, it is included in the UNESCO World Heritage list. The scene of Revelation's 10 chapter is painted in the altar, in the second row, above the table of oblation (Fig. 2). The mighty angel's face is framed by a rainbow, rendered by three colors. With his left hand, he gives the book to Prophet John while his right hand is not held up with two raised fingers as a sign of oath, but open to the sky, as if in a prayer for mercy. The feet, painted in three segments, have the upper part painted with wings famed feathers and tongues whereas the middle is made up of cylindrical columns. John, painted on the earth, receives with both hands the open book without any intention of being swallowed. Opposite the Apostle, in the clouds, an angel blowing towards the earth is painted as simplification of the idea of angels mastering the four winds. Near the left leg of the angel we see ships with set sails marked by crosses. The inscription in Romanian, rendered in Cyrillic, towards the exterior of the scene, has the following message: "behold a mighty angel from heaven clothed in cloud, like a rainbow and his face was like fire". In the inner part of the scene, only the abbreviation of John's name appears.

2.3. The Wooden church in Glod, Maramures

In Strâmtura, on the valley of Iza, the village Glod has a wooden church dedicated to St. Nicholas, which was documented in the first half of the 18th century [8]. The interior painting was done by priest Vasile Tivadar in 1829, who introduced in the iconographic scenes of the altar [9] the representation of the angel that offers the book to Prophet John (Fig. 3). John receives the book with his hands, without the intention of swallowing it and the mighty angel is surrounded by four heavenly servants, suggests that they are masters of the winds (Rev 7.1-3). The book is open, with the text framed by a border. The legs of the angel are formed of three segments bounded by rings: on the top, there are flames burning towards clouds, in the middle, some circular columns and the ground, toes of a human foot. The sky and the sea are rendered in blue and, to mask the wrong positioning of the Prophet (above the blue sea), stylized plants were painted. Above the scene, there are the following words: "he saw behold the angel of the clouds,

clothed in the clouds". The Romanian inscription, written in Cyrillic characters, continues within the scene: "as the rainbow was and his face shone like the sun".

2.4. The wooden church of Poienile Izei, Maramureş

The church dedicated to St. Parascheva, also known as the wooden church of Poienile Glodului, was built in 1632 by the villagers [10]. The church painting, done in 1794, by a local painter, is remarkable for our study for the four angels, masters of the wind, appearing in a medallion, on the western wall of the nave (Fig. 4). They are portrayed as four winged heads, inscribed on the edge of a circle, within which they blow strongly, destroying everything.

CONCLUSIONS

With biblical revelations, word becomes image, prophet becomes predictor, God's truth is offered for contemplation on heavenly stage, the relative teaching of the historical becoming of humanity is allowed to be deciphered in a series of symbolic paintings whose meaning seems almost inexhaustible. Mural painting had a great momentum in Transylvania in the 18th century, where the art of painting contributed to the education and emancipation of Romanian faithful. Mural painting in wooden churches represent a visual and artistic wealth that connects Romanian culture in an expression of its own to the great European cultural manifestations.

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Fig.1 – Sucevita Monastery

Fig.2 – Budesti Josani wooden church

Fig.3 – Glod wooden church

Fig.3 – Poienile Izei wooden church

THE SIEGE OF CONSTANTINOPLE: FROM DEFEAT TO VICTORY

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ABSTRACT

On the wall of the Moldavian medieval churches, the association of the *Acathist Hymn* and the *Siege of Constantinople* stirred many debates about this unusual type of iconographic connection. Over time numerous historians have tried to explain this phenomenon, putting forth various hypotheses, each of them depending on the cultural, social context or the personal perception of the phenomenon. This study emphasizes a theological approach, not enough stressed so far.

Keywords: the *Akathist Hymn*, iconography, exterior paintings, the *Siege of Constantinople*, the Orthodox Church.

INTRODUCTION

Among the multitude of iconographic themes displayed on the outer walls of Moldavian churches, those of the *Akathist Hymn* and *Siege of Constantinople* are naturally associated, since the first was intoned after the victory of Constantinopolitans over the Persian and Avar attacks of 626. But the second iconographic theme aroused the interest of historians because of their failure to account for either the name of the city and the time of the siege.

THE *AKATHIST HYMN*

The issue of the *Akathist Hymn*'s origins has prompted heated debates, since what was deemed to mark its emergence actually was the moment of its intoning during a dramatic event in the history of the Byzantine Empire, namely the siege of 626 A.D. Among the alleged authors of the *Akathist Hymn* are Romanos Melodos/the Melodist (6th century), Patriarch Sergius (7th century), Georgios Pisides (7th century), Patriarch Germanos (8th century) and Patriarch Photios (9th century). However, even at present, its author remains unknown – although most opinions indicate Romanos Melodos.

Following the victory of August 7, 626 over the Persian and Avar attackers, a new *prooimion* was composed *(Queen of the Heavenly Host, Defender of our souls, we thy servants offer to thee songs of victory ...)* and it was integrated into the *Akathist Hymn*, being placed at its beginning and replacing the old one. Subsequently, Constantinople was attacked by Avars, Slavs, Arabs and Russians, but the Holy Virgin Mary always saved the city, so that the *Akathist Hymn* became „the victory hymn honoring the Mother of God." It is structured into two parts, with relatively different content: the first section is the *historical* one (strophes 1-12), concerning the events related to the Incarnation of the Son of God, while the second section is the *dogmatic* one (strophes 13-24), focusing on the consequences of Lord's Incarnation, hypostatic union, sacrifice and redemption.

THE ICONOGRAPHY OF THE *AKATHIST HYMN* IN MOLDAVIAN PAINTING

Although the *Akathist Hymn* had been adopted by Orthodox worship for a while, it was only during the Palaiologan period (1261-1453) that it began to be illustrated in manuscripts, icons and mural paintings. Its iconographic structure includes more common elements in the historical section – inspired from the *Dodecaorton* (the 12 great feasts) and the cycle of Virgin's life – while the scenes in the dogmatic section, representing a novelty in the Byzantine art, evince more freedom and diversity of the iconographic program.

The *Akathist Hymn* in Moldavian exterior painting appears in most churches with exterior paintings, but those where it is still visible – better or worse preserved, but sufficiently clear – are: Probota, St. George Suceava, Humor, Moldoviţa, St. Demetrios Suceava, Baia, Arbore, Voroneţ, Suceviţa. It is accompanied by the *Burning Bush* and the *Siege of Constantinople*, the only exceptions being Voroneţ and Suceviţa (where the Burning Bush is present, but not the Siege).

So, on the church walls of Probota, Sfântul Gheorghe, Humor, Moldoviţa (Fig. 1), Baia, Arbore, a large scene is set beneath and all along the representation of the *Akathist Hymn*. It depicts the siege of a stronghold. It is a novel theme, not prescribed by iconographers' books and, although it can be found in a few Serbian churches, it is

peculiarly Moldavian due to its complex treatment in this area. Ascertaining the historical moment, identifying the stronghold as well as the reasons for choosing this theme, have generated heated debates, given the originality of the iconographical theme and the inconsistencies in depicting the historical time.

THE PICTURE OF THE *SIEGE OF CONSTANTINOPLE* AND ITS VARIED EXPLANATIONS

At Probota, Humor, Moldoviţa (Fig. 2, 3-4) and Baia one sees a large fortress, surrounded by strong walls, under siege from land and sea, while on its walls a procession (the people led by the emperor and empress, the patriarch and the high officials) carries the Holy Veil and the icon of the Theotokos. Outside the city, a storm sinks attackers' fleet, while a fiery rain pours upon them from the skies. The city's name – Constantinople – is indicated and the presence of Turks and cannons suggests the siege of 1453. The depictions of Arbore church, however, show no cannons or Turks, and the inscription states the historical time: the siege of 626 AD, when Persians assailed the city, and were wondrously defeated by the intervention of the Mother of God. All debates were centered on the question: „what is depicted on these church walls: is it the siege of 626, namely the *saving of Constantinople,* or that of 1453, namely the *fall of Constantinople*"?

Paul Henry and I. D. Ştefănescu thought that the Moldavian painters had mistaken one siege for the other, namely the 626 siege for that of 1453. According to André Grabar, the presence of cannons and Turks, arguments in favour of 1453 event, might be "a mere anachronism", typical of 16 th century art, while Paul Henry saw the representation of the *Akathist Hymn*, if not the image of the siege as well, as the material expression given to Modavians' prayers and supplications. Sorin Dumitrescu thinks it is about the "fall of Constantinople", a representation with pedagogical purpose illustrating the work of divine Providence. A recent, remarkably insightful doctoral thesis authored by Constantin Ciobanu brings together and examines all hypotheses put forth so far on this ‚inconsistency', opining that it is an allegorical representation of fight against vice, sin and lack of faith.

A THEOLOGICAL EXPLANATION FOR THE MOLDAVIAN SOLUTION

The present study approaches the siege scene depicted on the walls of Moldavian churches from a spiritual standpoint, according to which the city of Constantinople can be understood as every Christian soul, seen as a city constantly assailed by the evil one, a city perpetually engaged in spiritual warfare till the end of time.

626 or 1453 may be, after all, mere mathematical or historical data, handled by those concerned with statistics, spectacular victories and defeats. The Byzantine Empire disappeared historically, Constantinople fell into pagan hands, but the Orthodox Church is still living and triumphant, and the gates of hell shall not prevail against it.

On the walls of Moldavian churches, the solemn, majestic scenes of the *Akathist Hymn* carries or, according to other opinions, are carried by the scene of a siege. Thus at the lower part of the huge area made up of a mosaic of various iconographic and chromatic themes, all illustrating the *Akathist Hymn*, there is a horizontal tier showing the *Siege of Constantinople*, a scene covering a much wider area than the other iconographic themes.

The besieged city may be Constantinople as well as Suceava. The explanation provided by merely political, social or moralizing concepts displayed on the walls of a place of worship would be restricted to the mundane matters, certainly important for ascertaining the truth, interesting inasmuch as it reveals mindsets and behavioral patterns, but regrettably exclusivistic and biased.

CONCLUSIONS

This city, iconographically besieged by Arabs or Turks, but also under physical-chemical and mechanical attacks from the rough climate and the barbarian „treatment" of passers-by, this stronghold, which has lived through centuries to convey its aesthetic message to us, might be compared with Christians assailed by all kinds of temptations, but overcoming them all with the aid of the Mother of God, to sing in the end: *Unto you, O Theotokos, invincible Champion in thanksgiving we ascribe the victory for the deliverance from sufferings. And having your might unassailable, free us from all dangers, so that we may cry unto you: Rejoice, o Bride Ever-Virgin!*

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Fig.1 – The Akathist Hymn with the Siege of Constantinople, Moldoviţa Monastery, Moldavia (general view)

Fig.2 – The Siege of Constantinople, Moldoviţa Monastery, Moldavia (general view)

Fig.3 – The Siege of Constantinople, Moldoviţa Monastery, Moldavia (details)

Fig.4 – The Siege of Constantinople, Moldoviţa Monastery, Moldavia (details)

ENVIRONMENTAL IMPACT

IDENTIFICATION OF BRONZE CORROSION PRODUCTS IN HISTORIC OBJECT

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ABSTRACT

The identification of the corrosion products is not only an essential requisite for selecting the cleaning procedure in restorative treatment of artefacts but also an offered information on the origin, environmental conditions, etc. of such objects. The corrosion products from different corroded zones of naturally patinated bronze artefacts were investigated by means of the combined use of scanning electron microscopy (SEM), optical microscopy, energy dispersive X-ray spectroscopy (EDS) and X-ray diffraction (XRD) trying to correlate of their nature with the chemical composition. The analyses performed on a sample from a fissured church bell built approximately 150 years ago, reveals the presence of different corrosion products, namely, $Cu_{41}Sn_{11}$, Cu_2O, SnO, malachite, atacamite, and botallackite-type materials.

Keywords: Bronze bell, OM, SEM, XRD

INTRODUCTION

The chemical and structural examination of the surface corrosion products grown on historic bronzes objects has been the subject of study for at least 200 years [1].

Corrosion of bronze artifacts yielding brown-green, reddish, yellowish-pale green, gold-like brilliant, green-blue, etc. patinas is an actuality problem in the fields of conservation and restoration of contemporary and historic works of arts (sculptures, monuments, bells, etc.). Patina is the result of the chemical interaction between traces element from atmosphere and cooper (Cu) materials. However, Cu patinas formed in the atmosphere reveal the presence of different corrosion products as cuprite, azurite, malachite, atacamite, anarakite, botallackite, antlerite, bronchatite, etc. [2-5]. The identification of the corrosion products is important for selecting the cleaning procedure, for obtaining information on the origin and environmental storage conditions of artifacts.

The case studies include a church bell built approximately 150 years ago whose patina appearance is reddish. It is the purpose of this contribution to present the applicability of surface analytical techniques such as scanning electron microscopy coupled to X-ray microanalysis (SEM/EDS) and X-ray diffraction (XRD).

EXPERIMENTAL

The fragments of the bronze bell artifact were embedded in epoxy. The microstructures were studied by optical microscopy (OM), scanning electron microscopy (SEM) and energy dispersive spectrometry (EDS). OM investigation has been carried out by using a Leica MEF 4 microscope equipped with a digital camera. Both SEM and EDS characterization were carried out by using a Quanta 200 3D scanning electron microscope.

X-ray diffraction (XRD) spectra were employed for the identification of corrosion products formed on the surface of bronze bell artifacts. XRD spectra were recorded using an X'Pert PRO MRD (PANalytical, Almelo, The Netherlands) diffractometer equipped with a Cu Kα anode.

RESULTS AND DISCUSSION

The continuous corrosion of the bronze reduces its thickness but the resulting patina is extremely hard. Figure 1(A-B) shows the OM and SEM image for the fragments of bronze bell artifact. The bronze bell artifact is almost completely coated with reddish patina. Concerning the corrosion mechanism, SEM images (Fig. 1B) revealed that the bronze bell artifact has been selectively corroded. Probably, this type of corrosion was related to fluctuations of seasonal conditions such as temperature and of environmental factors.

In Figure 2 the image of one of these bronze bell artifacts is shown with some morphological, chemical and structural features achieved by means of SEM-EDS. The EDS spectra revealed the chemical composition of the different phases of the

grown patina and the elemental maps of Cu, Sn, O, Cl and C allowed one to locate these elements inside the patina.
Table 1 summarizes the average values of chemical composition, expressed as mass percentage of elements, present in the analyzed sample. The content in Cu was estimated around of 48% and Sn around of 21% from such data.
The examination of the patina formed on bronze bell artifacts evidences its complex microchemical structure. This layer is characterized by different chemical compositions containing the alloy elements (Cu and Sn) and elements coming from the ambient atmosphere such as O, C and Cl.
XRD spectra displayed in Figure 3 confirm that the bronze bell artifact has been selectively corroded. The XRD results indicated an interaction between some atmosphere constituents, such as C, O, Cl and the bronze component which produced malachite - $Cu_2(CO_3)(OH)_2$, atacamite - $Cu_2Cl(OH)_3$, botallackite - $Cu_2(OH)_3Cl$, Cu_2O and SnO.

CONCLUSIONS

The corrosion products of a church bell built approximately 150 years ago have been investigated by means of the combined use of SEM-EDS, XRD and OM. Application of this methodology reveals that three main different kinds of deposits were formed consisting of: i) $Cu_{41}Sn_{11}$, ii) Cu_2O and SnO and iii) malachite, atacamite and botallackite.

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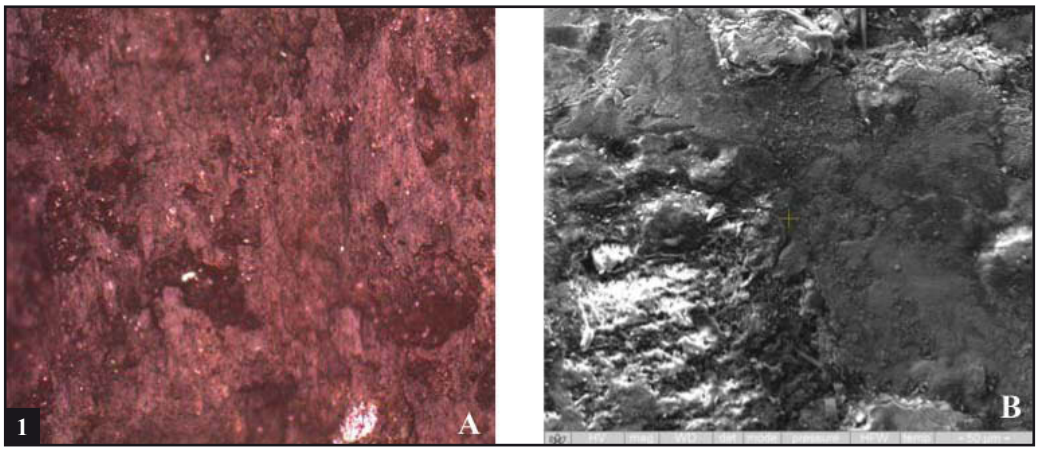

Fig. 1 – OM (A) and SEM (B) micrograph of the planar section of the bronze bell artifact

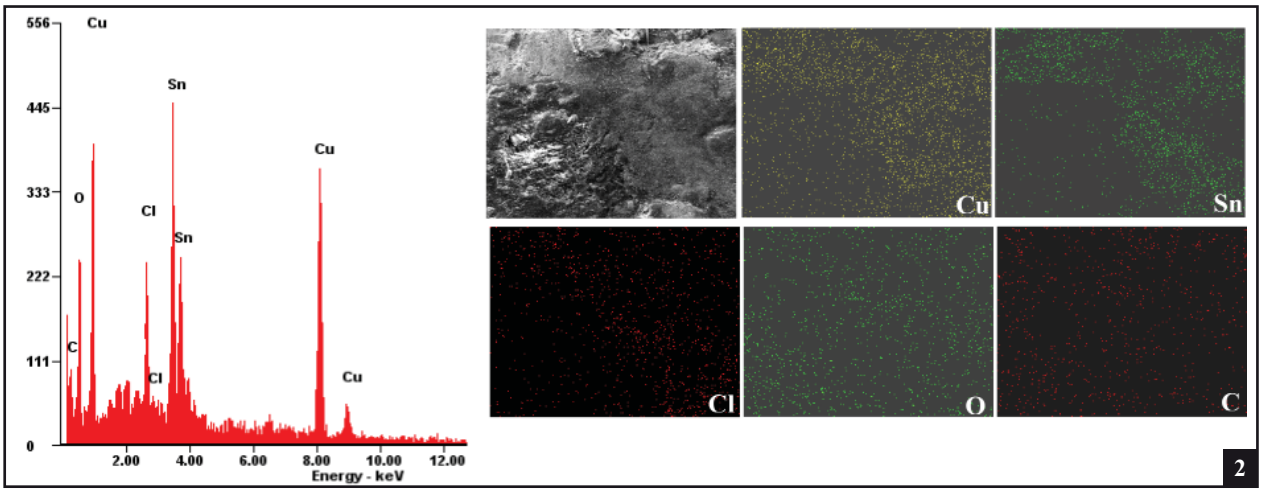

Fig. 2 – EDS spectra and maps of the bronze bell artifact

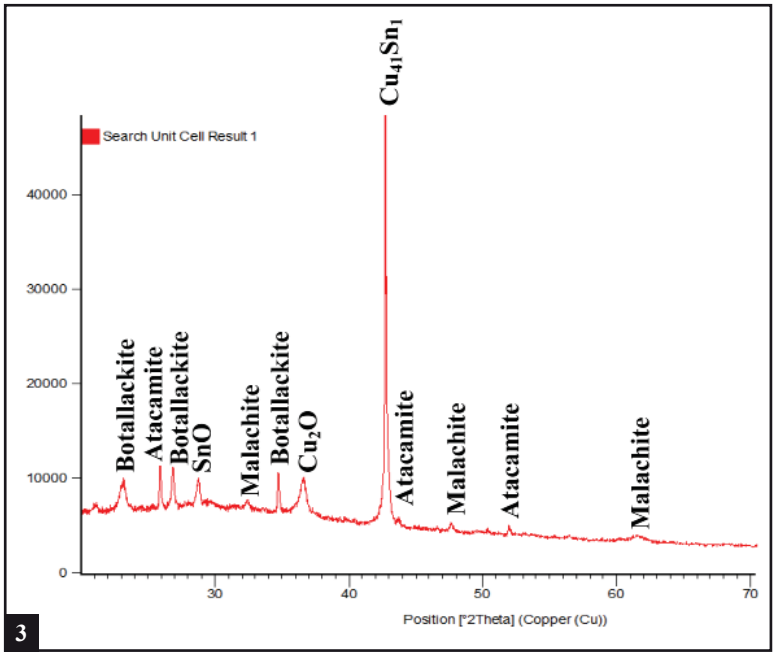

Fig. 3 – X-ray diffractogram of the bronze bell artifa

Cu	Sn	O	C	Cl
47.3	20.9	16.8	10.2	4.8

Tab. 1 - Content of Cu, Sn, Zn, Pb and Fe (wt.%) present in the fragments of bronze bell artifacts

ANALYTICAL, DIAGNOSTIC AND INTERVENTION METHODOLOGIES

ETHICAL AND TECHNICAL CONCERNS DURING THE CONSERVATION PROCESS OF A RELIGIOUS BOOK: THE BOOK OF HOURS FROM THE LIBRARY OF PALÁCIO NACIONAL DE MAFRA

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ABSTRACT

This paper concerns the ethical approach and decision making for the conservation of a French Book of Hours (cofre no.24), currently stored in the Library of the 18th century *Palácio Nacional de Mafra* (PNM) in Lisbon, Portugal. The cofre no.24 has the codex's original body dated from ca. 1420 and three folios were added later, in the second half of the 15th century. The conservation decision was taken based on the study and full comprehension of the techniques and materials present in the book and bearing in mind the significance and the role of this symbolic book, throughout its life. In fact, for the appreciation and understanding of the work involved in constructing the Book of Hours it is critical to know what materials were used, to determine its condition, testifying about the interventions suffered during the existence of the book, and understand its meaning.

Keywords: book of hours, bookbinding

INTRODUCTION

The Books of Hours are inseparable from the medieval spirituality, congregating in themselves the divine word and imagery, allowing a direct and privileged contact with the divinity. Intended for private devotion of the laity and reflecting the importance of the Marian cult at the time, these small codices were produced on a large scale during the 14th and 15th century, in studios/ workshops of urban centers of France and Flanders. The workshops were led by a master who worked occasionally in the most important illuminations, plus a group of artists who executed his orders. The selection of texts, the choice of the iconographic program and the ornamental richness that typically combines images of the natural world and medieval evocations of daily living, and may contain very rich and very expensive pigments such as lapis lazuli and gold and / or silver leaf, varied according to the taste and economic power of the commissioners representing their artistic and spiritual needs as well as their social prestige [1, 2]. The Book of Hours was used and carefully kept by its owner, who usually wrapped it in a brocade fabric, being preserved in the families during several generations [1-3]. For this reason, many copies of Books of Hours have survived to present days. However, the new owners customized it, adding or removing prayers and illuminations and consequently, rebinding it; thus rarely do we find original bindings of Books of Hours nowadays. Moreover, in earlier times, the institutions where these books are kept changed the binding and sometimes literally cut up the manuscripts so as to fit into existing bindings available in the institution. In this context, each change is an evidence of different ownership steps and is part of its individual history.

MATERIALS AND METHODS

This is the case of cofre no. 24 showing several changes of the text block and a newer bookbinding, probably produced later in Portugal, displaying decorative features and materials of the late 18th / early 19th centuries, similar to other books bound in the bookbinding workshops of Mafra Library.

A major conservation problem observed in this codex was precisely related to the poor condition of the binding, contributing to the overall deterioration of the manuscript. Concerning the development of a conservation strategy, a full study and the systematic conservation condition survey of the cofre no. 24 was carried out. The manuscript cofre no.24, measuring 197 mm x 135 mm x 50 mm, was found with pasteboards covered with a full calf brown leather binding, with sprinkling decoration, gold tooling and an inscription ('Heures de Votes') on the spine. It is exhibited paper endpapers and a dismantled sewing structure on

five raised cords, which no longer fulfilled its main objective of protection of the text block. In fact, in later bindings, from the XVII century onwards, splendor and beauty became a main concept and less attention was given to the choice of materials and to the inner elements and structure stability. These bindings are easily affected by incorrect handling, causing stress on the spine and breaking of the sewing, contributing to the distortion of the whole text block. This is particularly relevant for manuscripts on parchment, which is a very hygroscopic material, changing dimension and shape with relative humidity oscillations, resulting, besides other alterations, in loss of adhesion of the pictorial layer. Another problem relates to the oxidation and darkening of silver leaf applied in the illumination, because later bookbindings were less protective against the penetration of air pollutants and humidity within the manuscript. [4, 5]

Concerning the text block condition survey, the parchment support was subject to visual damage assessment using IDAP (Improved Damage Assessment of Parchment) parameters [6], revealing a reasonable condition. This text block consists of 23 gathering in a total of 181 parchment folios, 14 illuminations and 181 writing pages, generally in 14 lines of text, written in Latin and French. An additional technical problem to the bookbinding structure is related with the modifications of the gatherings and old restoration procedures on the text block. In the second half of the 15th century some original folios were replaced by new ones of thicker parchment, and along the book existence some original folios were removed, resulting in a discontinuity of text and the imbalance of the text block composition, contributing to the deformation and degradation of the whole codex. On folio no. 112 we can observe an unusual collage of a puzzle like decoration technique, along the edges of the sheet, which becomes very thick. Despite some efforts made we did not find any indication of the date and context of this intervention.

The Illuminations were also fully analyzed for a better understanding of the pictorial surface composition and its conservation condition, and to gather information about the color construction techniques. In addition to macro and micro photographic record and observation under the binocular microscope, in situ techniques were used, such as the Energy-Dispersive X-Ray Fluorescence, μ-Raman Spectroscopy, Fiber Optic Reflectance Spectroscopy and, when necessary, μ-Fourier Transform Infrared spectroscopy by micro-sampling selected under a microscope, completely invisible to the naked eye. A luxurious palette with beautiful, precious and lasting colors was found, but not always in good condition [7, 8]. While exhibiting an acceptable condition, the text block showed areas of ink fading and areas of loose pigment not only due to poor adhesion of the different pictorial layers to the support, related with the bookbinding condition and the parchment deformation but also connected with materials composition and application technique. The colors most affected are: green (malachite and a basic copper sulfate, which we suggest to be a brochantite ($Cu_4SO_4(OH)_6$), blue (lapis lazuli and azurite) and white (white lead), probably due to the grain size of these pigments or low amount of binder. The silver, widely applied in the backgrounds of the illuminations, presents also extensive degradation and darkening due to its oxidation, totally distorting the original appearance of the whole decorated leaves. [7, 8]

OUTCOMES

In general, materials and techniques found are in agreement with what we know from 15th century illuminated manuscripts [8-16] and are consistent with recipes found in treatises [17-20]. Cofre no. 24, although being the most luxurious and decorative of the Books of Hours of the Mafra Library collection, it is also the most deteriorated one. Nevertheless, the colors analyzed reveal the original artist's trace and no other alteration / restoration signs were observed. This fact reinforces the proposal for minimal intervention of text block, focusing on superficial cleaning and rebinding of the manuscript, only.

The decision making process for remedial conservation took into account the urgent need of stabilizing the book and reestablishing its equilibrium, by intervention in its structure, while maintaining material integrity and cultural evidence of the whole object. Several hypotheses were raised and discussed by the team and with the Mafra guardians, concerning the stabilization of the codex: (i) recovering the 18th/19th century bookbinding or making a new bookbinding; (ii) minimum inclusion of parchment leaves, signaling the detected absence of original sheets or inserting sheets of parchment on all gatherings that show some irregularities. According to the principle of minimum intervention and respecting the principle of maximum retrievability, stable materials and methods were selected and applied. Briefly, the whole book was disassembled, the text block of the 15th century was dry cleaned only, and we decide to recover the 18th/19th century bookbinding structure, since no other original binding traces were found. Conservation measures taken were targeted to a major goal: avoiding the increase in size of the manuscript spine while allowing the suitable opening of the book. No intervention was

attempted in the illumination, due to its primitive character and incomparable beauty.

Although we still have to be careful with the handling of this precious Book of Hours, since the binding is not the ideal one for a book on parchment from the 15th century and we still have areas of loose pigment, with this approach we kept the integrity of the cofre no.24 and we preserved all moments of its existence, including the curious puzzle like collage on folio no.112. The manuscript is now kept carefully in an acid free box inside a safe in the Library of the *Palácio Nacional de Mafra*, which is characterized by low and stable temperature. In addition, a complete photographic survey was conducted for further information and access, as well as to register the remedial conservation process, allowing comparisons between the state before and after the intervention.

CONCLUSIONS

In conclusion, this case study sets interesting challenges in terms of conservation decision making. The treatment required complex decisions, covering a vast range of materials and different areas of knowledge, from ownership history, past and present conservation / restoration techniques, to authenticity and ethics issues. This will be raised and fully discussed, as well as the context and need of further studies concerning the stabilization of pigments and reversibility of silver degradation, keeping in mind the singularity of these manuscripts. Maintaining bindings found versus recover old bookbinding features will also be discussed, as the main theme of the ongoing research.

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THE ISOLATION AND CHARACTERIZATION OF BIOLOGICAL AGENTS INVOLVED IN THE BIODETERIORATION OF OLD BOOKS FROM "DUMITRU STANILOAE" METROPOLITAN LIBRARY OF IAŞI

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ABSTRACT

The profound knowledge of a document, in its various aspects regarding structure and chemical composition of the material, as well as the identification of the factors that caused their degradation is an absolutely necessary step in any conservation - restoration intervention. The identification of biological agents is an essential step in determining the conservation status of a book. The aims of this study were: to highlight the contaminated microbiota acting on the analyzed materials; to isolate the microorganisms in pure cultures, to identify the taxonomy through the study of macro and micro-morphological characters. The books we analyzed in this study are an Octoih (hymn book), an Irmologhion (a book of chants) and a Chant book, all part of the rare book collection of "Dumitru Stăniloae" Library of Iaşi. In the all the samples we analyzed, we found considerable bacterial and fungal load, expressed in the number of the colonies grown in the culture medium after sampling.

Keywords: Biological agents, Bacteria, Fungi, Liturgical book

INTRODUCTION

Liturgical and preaching books have always been spiritual food for every dweller of monasteries or parish communities. In monasteries and parish churches, every book was considered a treasure, a treasure that is just as necessary and precious to spiritual life as the holy icons, sacred vessels of worship or garments. The preservation of these heritage items is for us a duty and a responsibility that should not be neglected. The profound knowledge of a document, in its various aspects regarding structure and chemical composition of the material, as well as the identification of the factors that caused their degradation is an absolutely necessary step in any conservation - restoration intervention.

The identification of biological agents is an essential step in determining the conservation status of a book.

The aims of this study were: to highlight the contaminated microbiota acting on the analyzed materials; to isolate the microorganisms in pure cultures, to identify the taxonomy through the study of macro and micro-morphological characters.

The books we analyzed in this study are an Octoih (hymn book), an Irmologhion (a book of chants) and a Chant book, all part of the rare book collection of "Dumitru Stăniloae" Metropolitan Library of Iaşi.

The Octoih (Fig. 1a), a Slavonic manuscript, dating from the 16th century, handmade paper produced from textile fibre, metallo-gallic black ink, red ink based on cinnabar.

The Octoih is the book of worship which contains the order of morning and evening masses during the church year which is called "Octoechos", starting on the first Sunday after Pentecost and ending on the Sunday of the Publican and the Pharisee. The name of this book comes from the order of worship according to which every week the chants are sung on a single different voice, from the first to the eighth voice, then the first voice being resumed. In its current form, the Octoih dates from the 13th century, becoming standard, among other things, due to the emergence and use of the print [1].

The Irmologhion (Fig. 1b), dating from the 18th century, hand-made paper produced from textile fibre, red and black ink. The Irmologhion is a book of liturgy, including chants called "irmoase" and other chants for the use of choir chanters.

Book of Chants (Fig. 1c), dating from the 18th century, handmade paper produced from textile fibre, red and black ink. The Irmologhion that contains musical notes originates in chant books.

MATERIALS AND METHODS

The experiment stages for the identification of the microbiological agents present in the old books were: sampling (the fingerprinting method), sowing on specific culture media (agar, Sabourand, malt extract agar), incubation (37^{0}C, 24-48h for bacteria, 7-14 days for fungi), reading, isolating the microorganisms, obtaining cultures, examination of the macro morphological characters / examination of the micro morphological characters, taxonomic identification [2]. Different types of bacteria and fungi species are obtained.

a. *Bacteria*

The study of macro-morphological characters*:* The macro-morphological description consisted in characterizing the bacterial colonies, using the following criteria: colony type, form, appearance of the edges, colony profile, consistency, transparency / opacity and colour.

The study of micro-morphological characters*:* In order to study the micro-morphological characters of the isolated bacteria, smears were made from pure obtained cultures, that were stained according to the Gram method. The smears were examined with an Olympus microscope with an immersion objective, observing the peculiarities of the microscopic appearance of microorganisms.

b. *Fungi*

The study of macro-morphological characters*:* In order to determine the main types of fungi that appear on the analyzed media, the morphology of colonies grown on the culture medium was researched, an analysis that provided important information for later determination, based on microscopic examination. Thus, the main colony types were identified on the basis of the macro-morphological characters.

The study of micro-morphological characters*:* The microscopic study of fungi is indispensable and compulsory; it can be carried out on living material or set material (in microscopic preparations). For these studies, the microscope is used. For a thorough investigation of the fungi structure, it is necessary to obtain microscopic preparations.

The microscopic examination allowed the identification of the main types of fungi by investigating various microscopic structures (hyphae, conidiophores, conidia, etc.). The observations were made with a stereomicroscope with SZM2 Optika fototub and a Nikon trinocular research microscope.

RESULTS AND DISCUSSIONS

After examining the macro-morphological characteristics of the isolated bacteria from the investigated items, we found that most of them form type R rough colonies, with irregular, non-pigmented edges. The edges of the colonies had various aspects (irregular, wavy, lobed, cogged or rhizoid shaped) while their consistency was mucilaginous or dry. In regard to the profile of the colonies, two types were highlighted (flat – in most stalks and raised – in the stalk taken from the Irmologhion).

The results of the micro-morphological analysis from isolated bacterial strains from the investigated items revealed the morphological bacillary type with different ways of grouping: Gram-positive, isolated, diplo, sporulated rods (with undistorted central spores) – the stalk taken from the Octoih; Gram-positive, isolated, sporulated rods (with undistorted central spores) – the stalk taken from the other three books; Gram-positive sporulated rods, ocurring in short chains (with undistorted central spores) - the stalk taken from the Octoih (Fig. 2a); Gram-positive sporulated isolated rods (subterminal undistorted spores and fully formed spores) - the stalk taken from the Irmologhion (Fig. 2b)

The main morphological types identified in the isolated samples were Gram-positive, undistorted spores (genus *Bacillus*) and distorted spores (genus *Clostridium*) at a rate of 72% and 7% respectively, and Gram-positive, unsporulated (genus *Cellulomonas*) - 21%. The frequent occurrence of sporulated rods at a high rate (79%) explains the resistance of these bacteria in the studied samples, confirming the data provided by the literature [3].

In all analyzed samples, we found a considerable fungal load, expressed in the number of the colonies that developed in the culture medium after sampling.

The identified fungi belong to the *Penicillium, Alternaria, Cladosporium cladosporioides, Fusarium* genera, according to specialized literature [4,5].

The *Alternaria* genus is considered a cosmopolitan one, presenting a major feature, which is the production of melanin pigment. The conidia are pigmented, more dilated towards the apex, with rough or smooth surface, septate in two directions – muriforms. The colonies grow rapidly and are flat, covering in time with gray aerial hyphae. The colony surface is light gray at first and then becomes darker – dark green or dark olive brown, maintaining a lighter shade on edges. Hyphae are septate and amber, just like the conidiophores. Sometimes, they are also zigzag distributed and bear muriform conidia.

Macroscopic and microscopic description of the Cladosporium cladosporioides species (Fig.2c)

The colony presented a moderate pace of growth in the 2% MEA environment *(*malt extract - agar), reaching 2 cm in diameter in three days and covering the board in 12 days. It presents a rough-velvety, creamy coloured mycelium that in time becomes creamy reddish and reddish brown colony reverse. No exudates on the surface of the colony, conidiophores and conidia were observed. Colony edges are smooth.

After 14 days spherical or subspherical microsclerots begin to develop, creamy coloured at first, then dark

brown and then turning black. The microsclerots are below 1 mm diameter.
Mycelium is septate, yellowish or ocher-brown. The hyphae connected to the microsclerots are pigmented. The microsclerots are covered by black appendages, by the thickened walls of the hyphae, being unbranched, rarely septate. The cells located on the surface of the sclerotia have the shape of tanks, being oval or irregular, with thickened walls a dark brown color, becoming pink towards the interior of the microsclerots.
Macroscopic and microscopic description of the Penicillium species (Fig. 2d)
The diameter of the colony reached 3.6 cm in 6 days after inoculation on Sabouraud medium at 25 °C. The colony surface is initially smooth, white, later becoming powdery pink to reddish-brown in the center, green-gray at the edge, with flocculent aspect at the center. The colony edge is relatively smooth. The reverse of the colony is white, wrinkled in the middle after 6 days. It shows yellow exudates which are surrounded by conidiophores. The conidiophores are ramified, of 250-320 µm, biverticillate, rarely terverticillate. The phialides are flask-shaped, of 5-6.5 x 2.5 µm. They form philialosporus chains that are spherical, hyaline, with a smooth surface, of 2.5-3 µm.

CONCLUSIONS

In the all the samples we analyzed, we found considerable bacterial and fungal load, expressed in the number of the colonies grown in the culture medium after sampling.
The identified fungi belong to the *Penicillium, Alternaria, Cladosporium cladosporioides, Fusarium* genera according to specialized literature. The most frequent genera are *Alternaria* and *Penicillium* which are considered cosmopolitan genera.
The species of the *Alternaria* genus produce on the substrate the on which they grow melanin pigment that cause evident changes of colour. The colonies grow rapidly, are flat, being covered in time with gray aerial hyphae. The species of the *Penicillium* genus grow on a wide range of media, having a very high dispersion capacity due to the small size of the conidia that can be easily carried by air currents. The colonies of such species grow more slowly than those of the *Alternaria* genus.

ACKNOWLEDGEMENTS

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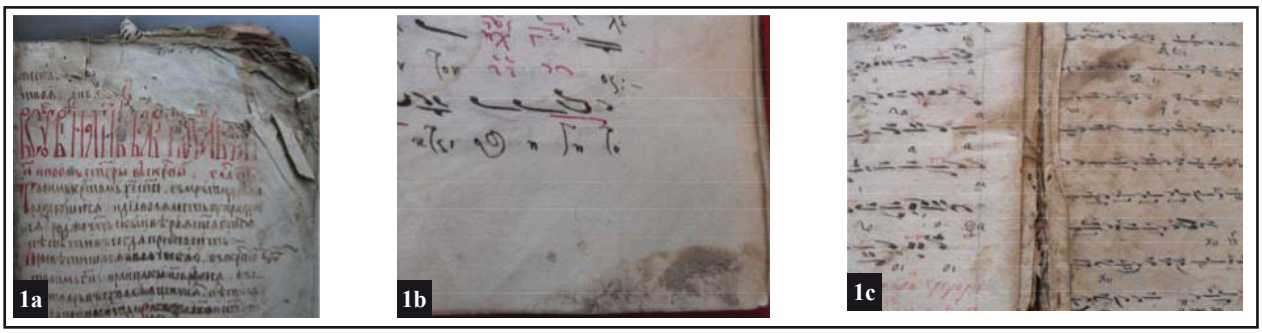
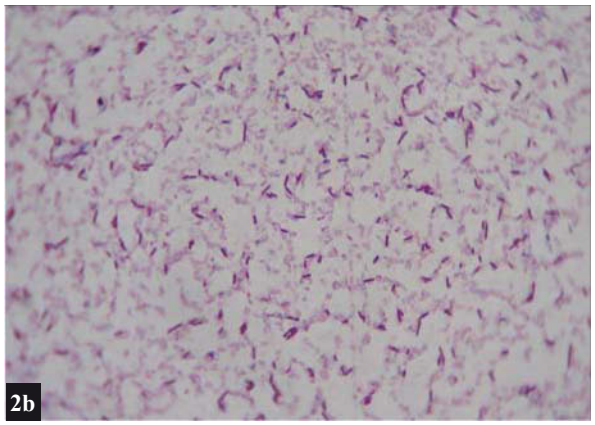


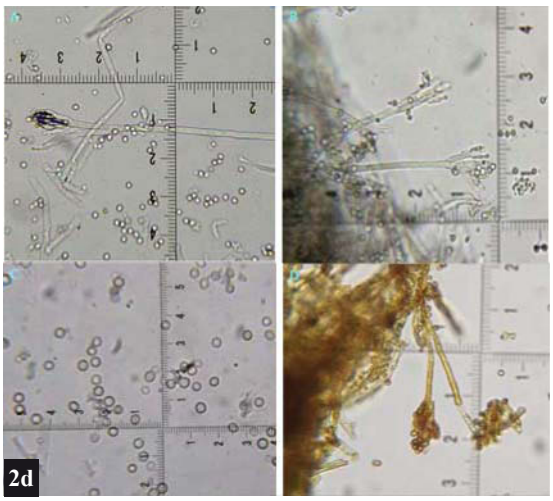
Fig. 1 – Fig. 1. Old books studied: a) Octoih, b) Irmologhion, c) Book of Chants

a.*Gram-positive rods* ocurring in short chains, with undistorted central spores (Octoih)



b.*Gram-positive isolated rods bacilli* with subterminal undistorted spores and fully formed spores (Irmologhion)

c. *Cladosporium cladosporioides*. A and B - hyphae and conidia slightly pigmented, optical microscope image (400x); C and D - hyphae and conidia colored with reagent Meltzer, optical microscope image (400x).



d. *Penicillium*. A and B - conidiophores and conidia, optical microscope image (400x); C - conidia, optical microscope image (1000x); D - conidiophores color reagent Meltzer, optical microscope image (400x).

Fig. 2 – Bacteria (a, b) and Fungi (c, d) isolated in old book studied

POLYCHROMY OF THE MAIN ENTRANCE TO THE CLOISTER OF THE BURGOS CATHEDRAL

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ABSTRACT

Burgos Cathedral is one of the most beautiful buildings in the Gothic art style and truly deserves the title of Heritage of Humanity (1984).
In this study a careful polychromy study has been performed, and three layers have been found: a priming layer, a base layer and a finishing layer.

Keywords: polichromy, characterization, Burgos Cathedral

INTRODUCTION

Burgos Cathedral is one of the most beautiful buildings in the Gothic art style and truly deserves the title of Heritage of Humanity (1984). But the Cathedral is not just a monument. It is first and foremost a living church, a place of worship and prayer which throughout its long history has found a place for the artistic movements of each period to add dignity and solemnity to the religious ceremonies, the praise of God and the Christian life that go on inside it.
The construction of the Cathedral was begun in 1221 by King Ferdinand the Saint and Bishop Don Mauricio and it was finally consecrated in 1260. It was later enlarged and made even more beautiful with a grand cloister and numerous chapels, including the famous Chapel of the Constables (15th C.), the Chapel of St. Tecla (18th C.), the fine stone-needles on the main façade (15th C.) and the splendid dome at the crossing (16th C.). The building is mostly constructed by limestone from the quarry of Hontoria, a small village next to Burgos.
The main entrance to the Cloister is in the South arm of the transept nave. This Door is magnificent both in terms of its artistic qualities and of the theological message it conveys. The Door is built in the 13th Century Gothic style around 1270 and is dedicated on the coming side to Christ as Man. The Prophet Isaiah and King David on the right jamb predict the coming of Jesus which is announced on the left by the angel to Mary, whose family tree of kings and prophets is depicted in the archivolts, while the tympanum shows the baptism of Jesus. The leaves of the Door were made between 1492 and 1495 by Gil de Siloé and tell the tale of Christ's entrance into Jerusalem and the descent of the risen Christ to the limbo of the just.
Polychromy played a great role in the decoration of sculpted figures in Romanesque and Gothic architecture. Actually, the remains of the original pictorial layers on outdoor sculptures tend to be scarce due to exposure to the effects of time, natural weathering, and pollution. Moreover unsuitable restoration treatments, and most of all the cleaning techniques adopted, could be responsible for surface modifications leading to loss of paint layers. Besides, in the course of centuries, conservation requirements as well as the change of taste often led to repainting, or abrasion of the painting layers in order to return to the natural beauty of bare stone. Actually, antique written sources are mostly concerned with painting techniques on two dimensional supports and analytical data regarding polychrome stone, are rather scarce.

MATERIALS AND METHODS

In order to obtain a characterization of polychromy as complete as possible, a careful sampling were carried out. Before the extraction of samples an investigation of the stages of construction, plans, building materials and works after its original construction was necessary The selection of sampling place prioritized respect for the old building. Slim portions from 3 to 7 mm of samples were taken. In not very valuable areas of the building, thicker layers, (squares from 1 cm^2 to 125-343 cm^2) were taken.
To identify the nature of components, samples were dried at 40 °C, milled and sieved prior to X-Ray analysis. X-Ray Diffraction was performed using a Siemens Diffractometer (model D-501). Stratigraphies were prepared and examined using optical microscopy with transmitted and polarized

light (Nikon brand). Scanning Electron Microscopy (SEM) analytical techniques and Energy Dispersion of X-Ray (EDX) microanalysis was used to examine the morphology using a JEOL, model JSM-5400 instrument. Infrared spectroscopy analyses were performed in a spectrophotometer Nicolet, FTIR-510 model.

RESULTS

In Table 1 a list of the examined samples is reported with a brief summary of the analytical findings.

CONCLUSIONS

In all polychrome samples of the Cloister of the Cathedral of Burgos there are the same scheme: on the stone as a primer, a first layer of very fine grained mortar composed mostly of lime to close porosity and ensures the adhesion of the superimposed layers. This layer is very clear and homogeneous color. On the previous layer, another one was placed, usually thicker and of light color , of basic lead carbonate , also known as white lead , widely used as a pigment until the early nineteenth century and for centuries has been the only white color quality . Its whiteness was highly valued , and it has been used in the Cathedral as a basis for applying color on, like a canvas. Today these layers are not shown completely white , but beige because one of the major drawbacks of this compound, which tends to darken over time due to the action upon it of the hydrogen sulfide (air pollutant) that produces sulfur black lead according the following reaction (eq. 1):

$$Pb_3(CO_3)_2(OH)_2 \text{ (white)} + 3H_2S \rightarrow 3PbS \text{ (black)} + 2CO_2 + 4H_2O \qquad \text{(eq. 1)}$$

In some samples this layer has been prepared with great care, adding quartz to the inner sub-layer , and placing a thin wrapper for the outside (see samples 2 and 3).

Final colour of the coating was provided by the final layer of each sample that was extreme fineness and thinness. Regarding colours, red is obtained by adding mercury sulfide and probably red lead tetroxide and hematite. Brown ocher was managed by an iron oxide pigment added to the basic lead carbonate. The clear , white and beige colors were achieved with layers of calcium carbonate white lead or adding the same to provide whiteness and color stability in the finished to avoid the basic lead carbonate darken with time (sample 5).

In cases in which artists should increase the feeling of volume, the finishing layer was carefully divided into sub-layers of different intensities of color.

ACKNOWLEDGEMENTS

The financial support of the Spanish Commission interministerial de Ciencia y Tecnología (CICYT) under project BIA2009-12618 and the Junta de Andalucia (TEP-6558) are acknowledged.

Sample	Function	Colour	Composition
1	Priming layer	White	CaCO3
	Base layer	Beige	(CO3)2(OH)2Pb3 (White lead)
	Finishing layer	Red	Lead oxide (red lead) and red mercury(II) sulfide (cinnabar)
2	Base layer	White*	(CO3)2(OH)2Pb3 and quartz
	Base layer	Beige	(CO3)2(OH)2Pb3
	Base layer	Beige	(CO3)2(OH)2Pb3 (homogeneus)
	Priming layer	Goldish-brown	(CO3)2(OH)2Pb3 and Fe based-pigment
3	Priming layer	Beige	CaCO3
	Base layer	Different colours	(CO3)2(OH)2Pb3 and quartz
	Finishing layer	Different colours	(CO3)2(OH)2Pb3
4	Base layer	Beige	CaCO3
	Finishing layer	Red	Lead oxide (red lead)
	Finishing layer	Red	Red mercury(II) sulfide (cinnabar)
5	Priming layer	Beige	CaCO3
	Base layer	Beige	(CO3)2(OH)2Pb3 and CaCO3
	Base layer	Beige	(CO3)2(OH)2Pb3
	Priming layer	White	(CO3)2(OH)2Pb3 and CaCO3
6	Priming layer	Light beige	CaCO3
	Base layer	Beige	(CO3)2(OH)2Pb3
	Finishing layer	Ocher-reddish	(CO3)2(OH)2Pb3, CaCO3 and Fe oxide-pigment
7	Priming layer	Beige	CaCO3
	Base layer	Beige	(CO3)2(OH)2Pb3
	Base layer	Beige	(CO3)2(OH)2Pb3
	Finishing layer	Red	Lead oxychloride and feldespars
	Final colour	Intense red	Red mercury(II) sulfide (cinnabar)
8	Priming layer	Beige	CaCO3
	Base layer	Beige	(CO3)2(OH)2Pb3
	Finishing layer	Negro	Lamp black
9	Priming layer	Beige	CaCO3
	Base layer	Beige	(CO3)2(OH)2Pb3 y CaCO3
	Finishing layer	Beige	(CO3)2(OH)2Pb3
10	Priming layer	Beige	CaCO3
	Base layer	Beige	(CO3)2(OH)2Pb3
	Finishing layer	Ocher-greenish	(CO3)2(OH)2Pb3 and pigments

1: layers arranged from the inside to the outside

Table 1. Samples and main experimental results

THE BURGOS CATHEDRAL: CHARACTERISATION OF LIME-BASED MORTARS

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ABSTRACT

This work focused in the study of coating mortars from the Burgos Cathedral (Spain). 24 samples of lime-based mortars were studied. Samples were taken from exterior and interior of Burgos Cathedral. Samples can be divided into four main groups: plaster mortar, coating mortar, and intervention mortars. Mortars samples have been carefully described and characterised to study the technological aspects involved in the manufacturing of mortar with hydraulic properties. Physical tests (apparent bulk density and porosity, pH), grain size distribution, mineralogy of samples by X-Ray Diffraction (XRD), and chemical determination of major and minor components were conducted according to standardized tests. Analyses of stratigraphy were performed using Scanning Electron Microscopy (SEM) analytical techniques and Energy Dispersion of X-Ray (EDX) Microanalysis. The hydraulicity and the cementation indexes were calculated.
The mortars are mainly composed by SiO_2 and CaO, with a high content of lime and sand. Quartz and calcite are present in almost all samples. According to the present study, there probably were very strict rules and an extensive knowledge of the components of mortars and their performance. The secret of the quality of these mortars was the wide range of selection of raw materials as well as aggregates with appropriate dosages for each application.

Keywords: mortar, characterization, Burgos Cathedral

INTRODUCTION

Burgos Cathedral is one of the most beautiful buildings in the Gothic art style and truly deserves the title of Heritage of Humanity (1984). But the Cathedral is not just a monument. It is first and foremost a living church, a place of worship and prayer which throughout its long history has found a place for the artistic movements of each period to add dignity and solemnity to the religious ceremonies, the praise of God and the Christian life that go on inside it.
The construction of the Cathedral was begun in 1221 by King Ferdinand the Saint and Bishop Don Mauricio and it was finally consecrated in 1260. It was later enlarged and made even more beautiful with a grand cloister and numerous chapels, including the famous Chapel of the Constables (15th C.), the Chapel of St. Tecla (18th C.), the fine stone-needles on the main façade (15th C.) and the splendid dome at the crossing (16th C.). The building is mostly constructed by limestone from the quarry of Hontoria, a small village next to Burgos.

MATERIALS AND METHODS

Each sample is accompanied by its identification (the number corresponds to the sequence of sampling), in its description of its location in the building, the results of tests, as well as various figures to supplement their knowledge. Mortars are grouped by uses: coating and bearing mortars and by location: the facades, factories, the cloister, the chapel of the Condestables, the golden staircase and Cimborrio.
Bulk density and porosity were determined according to UNE 83-820-94. EX procedure. The adherence was performed according to standard test described in UNE 83-822. The granulometry of aggregates was determined according to the standard UNE 146110 specifications. Major components and lost on ignition (LOI) in mortars were determined according to standardized test described in UNE-EN 196-2.
Cementation (eq. 1) index was calculated using the results for the chemical analysis. These indexes are measurements of the waterproofing of the mortar, the higher the index, the higher the waterproofing of mortar. A discussion on the use of these indexes can be found elsewhere.

$$CI = \frac{1.1 \cdot \%Al_2O_3 + 0.7 \cdot \%Fe_2O_3 + 2.8 \cdot \%SiO_2}{\%CaO + 1.4 \cdot \%MgO}$$

(eq. 1)

X-ray diffraction (Siemens D-501) of finely pulverized samples (after drying and grounding) was used to identify the mineral crystalline phases. Thin sections were consolidated with epoxy resins and examined using optical microscopy with transmitted and polarized light (Nikon brand). Scanning electron microscopy (SEM) with energy dispersive (JEOL JSM-5400) was used to examine the morphology, microstructure, and the texture of the mortars. IR spectra (Nicolet FTIR-510) were recorded.

RESULTS

In Table 1 and 2 a list of the examined samples is reported with a brief summary of the analytical findings.

CONCLUSIONS

Cathedral builders chose materials with great skill. The lightness, transparency, and stability achieved by the Burgos Cathedral was achieved by bonding the stones with lime mortar.
Lime mortars in this building made numerous important missions such as:
- Unions and the stony seat elements.
- Cladding stone for protection from external aggressions.
- Decorated by thin layers of stucco of ocher pigments

ACKNOWLEDGEMENTS

The financial support of the Spanish Commission interministerial de Ciencia y Tecnología (CICYT) under project BIA2009-12618 and the Junta de Andalucia (TEP-6558) are acknowledged.

Sample	Density (kg/L)	Porosity (%)	pH	LOI (%)	Lime/arid/plaster (% weight)	Lime/arid/plaster (% volume)
1	2.3	13	8.8	22.1	41.61/57.88/0.51	61.01/35.61/0.38
2	1.43	33.2	8	7.6	12.51/85.35/2.14	26.23/71.61/2.16
3	1.53	22.4	8	8.1	12.87/85.95/1.18	26.92/71.90/1.18
4	2.08	13.9	8	33.2	69.40/30.60/0.00	85.01/14.99/0.00
5	1.62	21.4	7.8		29.72/68.10/2.18	51.24/46.96/1.81
6	1.87	16.6	7.7	25.7	46.63/44.8/8.57	67.91/26.10/5.99
7	1.66	20.5	7.9		60.66/36.9/2.44	74.2/19.27/1.53
8	1.63	22.9	8	15.5	27.91/71.62/0.47	49.15/50.65/0.40
9	1.84	16.9	7.5	20.2	40.92/54.95/4.14	63.06/33.88/3.06
10	1,95	19,3	7,9	42,1	90.30/1.99/7.71	95.26/0.84/3.90
11	1.88	18.3	7.4	28.5	49.97/34.91/15.12	70.19/19.62/10.19
12	1.43	31.7	7.5	29.2	29.01/70.28/0.71	50.49/48.92/0.6
13	1,63	28,2	7,7	40,1	83.24/8.01/8.75	91.83/3.53/4.63
14	1.9	23.3	7.6		63.44/34.71/1.86	81.11/17.75/1.14
15	1.65	27.7	8	19.1	32.09/61.62/6.30	53.7/51.24/5.06
16	1.65	21.2		36.7	65.77/28.55/5.68	82.3/14.29/3.41
17	1.79	14.4	6.5	31.3	52.62/27.45/19.93	71.92/15.00/13.08

Table 1. Physical properties of samples. Composition of mortars (%)

Sample	Lime	Silica	Aluminium oxide	Sulfates	Clorures	Amonium	Nitrites	Nitrates
1	26.5	50	0.3	0.2	0.03	t	t	0.05
2	9.7	81.4	t	0.95	0.03	0.001	t	0.04
3	9.6	81.4	0	0.95	0.035	0.001	0.0001	0.042
4	42.1	24.5	t	0	0.3	t	t	0.12
5	20.6	60.4	t	0.9	0.5	t	t	0.14
6	32.5	28.2	t	3.4	0.03	t	t	0.06
7	37	31.4	0.5	0.9	0.03	t	t	0.09
8	19.3	64.9	t	0.2	0.3	t	0	0.11
9	32	42.3	t	0.2	0.5	t	0	0.13
10	24.5	52.5	0.7	0.9	0.2	t	t	0.12
11	53,4	1,5	t	2,7	0,02	t	t	0,01
12	35.9	29.3	t	5.9	0.02	t	0	0.02
13	50,2	6,1	t	3,1	0,04	t	t	0,01
14	26.9	48.1	0.6	1.6	0.08	t	t	0.14
15	30,8	38,1	0,4	4,6	0,5	t	t	0,16
16	23.4	54.7	t	2.6	0.08	t	t	0.1
17	39.1	21.6	t	2	-	-	-	-
18	22.5	38	0	7.6	0.32	t	t	0.18

Table 2. Chemical analysis of mortars (%)

AN APPLICATION OF MULTICRITERIA DECISION METHODOLOGY TO RELIGIOUS HERITAGE CONSERVATION. THE CASE OF THE CATHEDRAL OF JEREZ DE LA FRONTERA (CÁDIZ)

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ABSTRACT

In this study a new methodology for conservation treatments evaluation is presented. In this methodology each treatment is valuated considering different evaluation factors previously ordered according an importance based hierarchy. The total value of each alternative based on these weights was calculated and the rating of each alternative are calculated using a distance-based multicriteria decision methodology (MCDM) method. This technique is based on positive ideal solution, which is determined with respect to the distance of each alternative to the best performing one.
The paper is structured as follows: firstly the designed methodology is summarized and the conservation treatments evaluation framework is presented. Secondly, we present a real case and the best alternative for the Conservation of the Cathedral of Jerez de la Frontera is selected using the MCDM-based method.

Keywords: MCDM, built heritage conservation, consolidant, water repellent

INTRODUCTION

The evaluation of treatment products and techniques, prior to their application in the building, aims to determine the behavior of the treated material and its response to weathering factors with the ultimate purpose of selecting the most suitable for use in the restoration process. It can be done in two ways: by making controlled applications in small areas of the monument and determining the effects produced, or by applying treatments to samples of the stone materials and measuring different characteristics to determine their effectiveness and weathering resistance.
In order to apply this second alternative, we developed a methodology [8] performing several tests for measuring the properties and characteristics of the treated stone. This procedure concludes with a qualitative assessment of the results for each treatment, having a global vision that allows the best "average" behavior to be chosen. In this work, a different last step is proposed. The last step is a decision matrix that makes the methodology clear and systematic. The decision step employs numerical tools that provide a global quantitative result evaluating the effect of each treatment.
Taking into account that the treatment selection can be considered a complex multi-criteria decision problem, the main objective of this study is to propose a mechanism to decide on the most suitable conservation treatment for a given type of stone.
The Multi Criteria Decision Matrix (MCDM) is a powerful tool widely used for evaluating and ranking problems containing multiple criteria [9]. The MCDM techniques generally enable a problem to be clearly and systematically structured. The MCDM attempts to find the best option from all of the feasible alternatives in the presence of multiple decision criteria.
In this paper we apply this method to Jerez Cathedral. It is a seventeenth century building; in particular, its construction was developed between 1695 and 1778. The cathedral was built originally as a Collegiate Church, raised over the original Great Mosque of Jerez and the ancient Church of the Saviour, whose origin dates from 1264 (Ríos, 1980).

MATERIALS AND METHODS

We propose a simplified MCDM-based approach. We have adapted the methodology to make it suitable for heritage conservation characteristics. The evaluation procedure of this study consists of six main steps:
Step 1. Identifying the evaluation criteria of treatments
Step 2. Determination of criteria hierarchy, calculating the criteria weights
Step 3. Evaluating conservation treatments (performance matrix)
Step 4. Computing the evaluation criteria matrix
Step 5. Computing the decision criteria matrix
Step 6. Implementing the MCDM-based method to achieve the final ranking results
The proposed method is based on choosing the best

alternative compared with an ideal treatment (one that minimizes the negative effects and maximizes the positive effects of material treatments).
The treatments characteristics are summarized on Table 1. Consolidant and water repellent products have been studied.
To evaluate the treatments and select the most adequate, three aspects were identified (Table 2):

- Compatibility of the treatment with the material, measured by compatibility indicators (CI) because it´s fundamental to know how the treatment modify some characteristics of the material, among them : porosity, water desorption rate, and color . If variation of the above mentioned characteristics is very high, the treatment could be discarded.
- Effectiveness of the treatment, measured by effectiveness indicators (EI), because treatments are applied with the object of getting an improvement of certain characteristics. This category can be divided in two different sub-criteria:

1.1. In the case of water repellent products, the diminishing of water entrance in the stone. This can be measured through the absorption of water by capillarity and immersion, drop angle or drop absorption time.
1.2. For consolidant products, the increasing of cohesion of the materials. This criterion can be measured by mechanical properties indirectly through ultrasonic velocity.

- Resistance of the treated stone to weathering, measured by Resistance Indicators (RI). The last step in the evaluation on treatments consists on submitting the samples to conditions that simulate the alteration mechanisms observed in the building, but in a concentrated way in time. Salt crystallization is one of the usual accelerated weathering tests.

RESULTS

After the 6 steps of the MCDM-based method, the final evaluation matrix is as follows (Fig. 1). Where Pi are the properties of samples, Tj are the evaluated conservation treatments, Ik are the importance weights of each property, and Δij are the increments of the properties values compared with the blank (sample without conservation treatment).

CONCLUSIONS

The MCDM-based system provides a useful tool for determining the best conservation treatment for a particular monument.
Particularly, the proposed methodology allows an objective determination of the best treatments for a specific stone, and the comparison of different treatments with the same scale.
In addition, this method can be easily adapted to the necessities and the data available. Each researcher can define their own evaluation criteria and change the treatments to be studied.
The results provided by this method are relative, that is, the best treatment among those studied, for a specific stone and for the weathering factors considered.

	P_1	P_2		P_N	Final value
$T_{0\ (blank)}$	0	0	…	0	Σ_0
T_1	$(\Delta_{11}/\Delta_{1max})\bullet I_1$	$(\Delta_{12}/\Delta_{2max})\bullet I_2$	…	$(\Delta_{1N}/\Delta_{Nmax})\bullet I_N$	Σ_1
	…				
$T_{M+1\ (ideal)}$	$(\Delta_{(M+1)1}/\Delta_{1max})\bullet I_1$	…	…	$(\Delta_{(M+1)N}/\Delta_{Nmax})\bullet I_N$	Σ_M

Fig. 1 – Decision matrix

Product	Properties	Dilution	Composition
Estel1000	Consolidant	75% on white spirit	Tetra ethyl silicate
Estel 1100	Consolidant +		
Water repellent	75% on white spirit	Tetra ethyl silicate + Oligomeric polisiloxane	
Silo 111	Water repellent	10% on white spirit	Oligomeric organosiloxane
Nanoestel	Consolidant	30% on deionized water	Nanometric silica aqueous coloidal dispersion (10-20 nm)
Nanorestore	Consolidant	Isopropyl alcohol , ordemineralized water (max.50% vol.)	Slake lime particles with dimensions of nanoestructured materials

Tab. 1 Treatments characteristics

	Kind of evaluation of the property
Weight increment	CI
Porosity variation	CI
Capillarity absorption	EI
Water desorption	EI
US rate	EI
Colour changes	CI
Accelerated weathering	RI

Tab. 2 Properties of samples measured to the stone of the Cathedral of Jerez de la Frontera (cádiz)

PHYSICAL-CHEMICAL INVESTIGATIONS OF TWO MOLENS FROM TELCIU OLD WOODEN CHURCH, BISTRIŢA-NĂSĂUD COUNTY, ROMANIA

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ABSTRACT

Painting materials from two wooden icons (molens) belonging to one wooden church from Telciu village, Năsăud County were investigated. Actually this church does not exist and the wooden icons are located into the new Telciu church. The investigation methods were FTIR spectroscopy and DSC thermal analysis. The icons were painted on fir wood using Ca carbonate as ground and as pigments lead white, red lead and Prussian blue were identified. DSC method has identified the presence of oxalates as a proof of biologic attack on these icons, due to an inadequate storage of the investigated icons.

Keywords: FTIR spectroscopy, DSC analysis, wooden molens, wooden church

INTRODUCTION

The Năsăud County represents a unique area which bears a special significance for the Romanian historical, cultural and artistic heritage. The wooden churches that can be found here have caught the attention of many researchers working in the fields of ethnography, linguistics, sociology, history of art and culture.

The old Romanian wooden churches represent elements of national identity and history and their gradual but constant disappearance should represent a concern to everyone since very little interest has been devoted to understanding the complete significance of these sacred places.

It is important to mention that these icons are placed on the top of the iconostasis which also contains the Holy Cross and that next to it there are two depictions of Mary (Fig. 1a) and John the Apostle (Fig. 1b). The names for these special icons come from the Slavic „molenie", which can be translated as prayer.

MATERIALS AND METHODS

FTIR investigation

FTIR spectroscopic measurements were performed with JASCO 6100 spectrometer in the 4000 to 400 cm^{-1} with a resolution of 4 cm^{-1} using KBr pellet technique.

DSC analysis

Differential scanning calorimetry (DSC) was carried out by means of a Shimadzu DSC-60 calorimeter, the sample was heated in the range of 20–550°C with a heating rate of 10°C/min in crimped aluminum sample cell. The purge gas was nitrogen purged of 60 ml/min. For data collection the Shimadzu TA-WS60 and TA60 2.1 software were employed.

RESULTS

The investigation of painting materials, see Figs. 2 a and b, gives the probable composition: red-lead minium, blue-Prussian blue and lead carbonate as white "diluant". Bee wax was identifed (Fig. 2b) in John Apostle halo, also. The 'health" wood status (crystallinity and lignin/cellulose ratio changes) was also investigated both by FTIR spectroscopy and DSC thermal analysis. The wood crystallinity is lower whereas lignine/cellulose ratio increases for the historical wood as compared to modern one; DSC thermal analysis evidences the presence of the oxalate as a degradation product.

CONCLUSION

The investigated wooden icons are painted in the specificTranssylvanian style on fir wood, grounded with Ca carbonate and as pigments a restrained pigment number: lead white, red lead, Prussian blue and orripigment were employed. The presence of oxalates shows that a biological attack on these

icons existed, being due to an inadequate storage of the cult objects, a phenomenon quite frequently encountered in parishes where new churches are built. The old church and their cult objects are not preserved and restored.

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Fig. 1 – 1a - Virgin Mary Molen; 1b - John the Apostle Molen

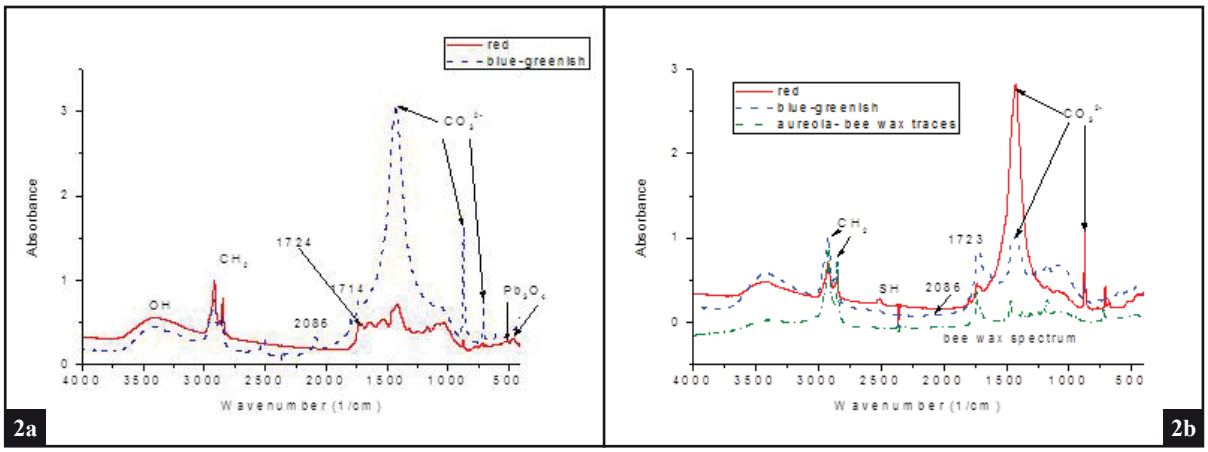

Fig. 2 – 2a - FTIR spectra of painting materials Virgin Mary Molen; 2b - FTIR spectra of painting materials John the Apostle Molen

ARMENIAN ILLUMINATED MANUSCRIPTS, A COLOURFUL TESTIMONY OF RELIGIOUS ART EXAMINED BY MOLECULAR SPECTROSCOPY TECHNIQUES

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ABSTRACT

Proceeding in the analysis of the painting materials and techniques of Armenian illuminated manuscripts we refer about a XIV century manuscript with colourful images that were under restoration. Some microsamples were analyzed with microRaman spectroscopy and showed that traditional pigments were used, but some products and mixtures are typical of Armenia illumination, such as vergaut a mixture of indigo and orpiment.

Keywords: Armenia, illumination, pigments, vergaut

INTRODUCTION

We know the history of Armenian painting almost exclusively from the study of the decoration of manuscripts. The Armenian tradition is known mainly from miniature paintings or illumination. Much of Armenian art, however, shows a style far removed from classical tendencies. Various ways have been used to describe such non-classical styles: naive, primitive, provincial, monastic, native. Manuscripts that originated in rural settings or monasteries used more modest materials, employing yellow paint for gold. The total number of individual works of art contained in Armenian manuscripts (excluding marginal decorations) in the tens of thousands. Some of the illuminated have been examined in the past by the American group of researcher of Mathews and Orna [1, 2] with the traditional chemical and instrumental analyses. Recently Raman microscopy has been applied to the study of some of the Yerevan manuscripts by combining it with an X-Ray fluorescence analysis of the pigments, but also of the metal leaves, showing that gilding was widely used on an Armenian red bole. In this research we present data on further investigations about Armenian manuscripts began some years ago.

MATERIALS AND METHODS

The research concerns a Gospel Ms.4915 Aghtamar, writer: Grigor, painter: Zakaria, Tuma priest, receiver: Murat, 288 paper sheets, sizes 26.5-27x18.5-19 cm, written in two columns (2x12.5-13), lines: 21. Cover: wood and brown leather. The present manuscript dates to 1355 A.D. and as a lithurgical book is rich of many miniatures depicting S. Mathews, S. Lucas, S. John and Procorus, the Annunciation, the Entering to Jerusalem, and images of birds and animals, etc. Colors are green, red, blue, black, violet and yellow. The manuscript has been restored, and is now in sufficiently good conditions, there are traces of foxing with yellow spots, some dirty materials, and some problems with humidity.

Through a detailed analysis of the microsamples taken with a pin from the illumination shown in figure, a good knowledge of the materials present is obtained. In Tab.I a sum of compounds has been identified and some comments are given.

Experimental conditions

The Raman spectra were recorded with a Labram instrument of the Jobin Yvon- Horiba, equipped with a 632.8 nm red laser, a CCD with 256 x 1024 pixels cooled to -70°C by the Peltier effect. Edge filters were used to cut the Rayleigh scattering and the spectra were recorded normally in the range 100-1800 cm-1 with the laser power reduced to half or one tenth of its maximum value. Measurements of some seconds were repeated 10 times.

Experimental Results

The results obtained are reported in Tab.1. From the Tab. It can be observed that for this manuscripts

illuminations are made with some precious pigments. Vermilion is frequently employed and a mixture of orpiment and indigo is represented in the right spectrum of Fig.2. The mixture could have been obtained in a form enabling both to be recorded simultaneously. Many dyed threads are seen in samples, with blue, red and violet hues. Only blue threads can be identified as silk dyed with indigo, the others exhibit a high fluorescence and could not be studied with Raman microscopy. Lazurite is frequently used to colour the sky in the background. Indigo is frequently used for vergaut, but also for pale blue tones. White is found to be only white lead like in most European illuminations of the same centuries.

CONCLUSIONS

The spectroscopic data reported are useful for the understanding of the materials and techniques used for Armenian illumination. In fact, materials already known from other researchers and from our previous data enable the great variety of pigments and dyes used in these sheets. Moreover, a mixture of materials, known with the name of *vergaut* (a name found in Jehan Le Begue's manuscript reported by Mrs Merrifield [4]), is confirmed and stressed. A new unidentified green is ascertained through its Raman spectrum. It can be said that, like the other basic sulfate we found in a previous research [3], could be an Armenian mineral.

ACKNOWLEDGEMENTS

We are grateful to the director of the Matenadaran library for permitting us to analyze the illuminated manuscripts.

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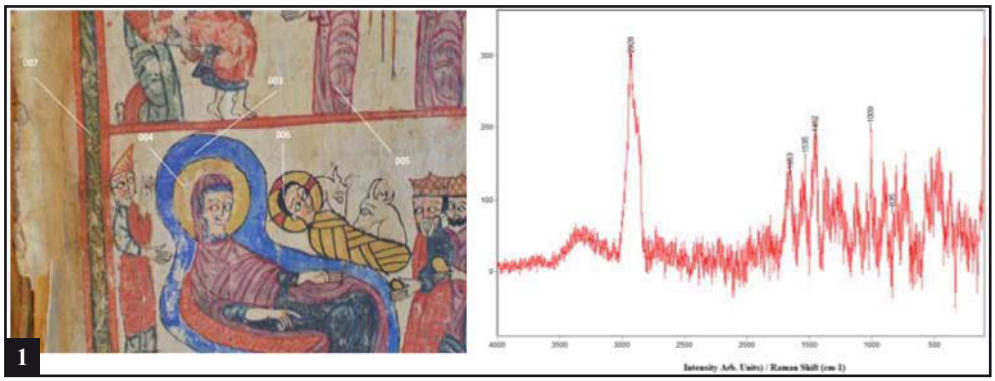

Fig. 1 – Detail of an illumination where some sample were taken during restoration (Left). Raman spectrum of a proteic violet dyed fiber (right).

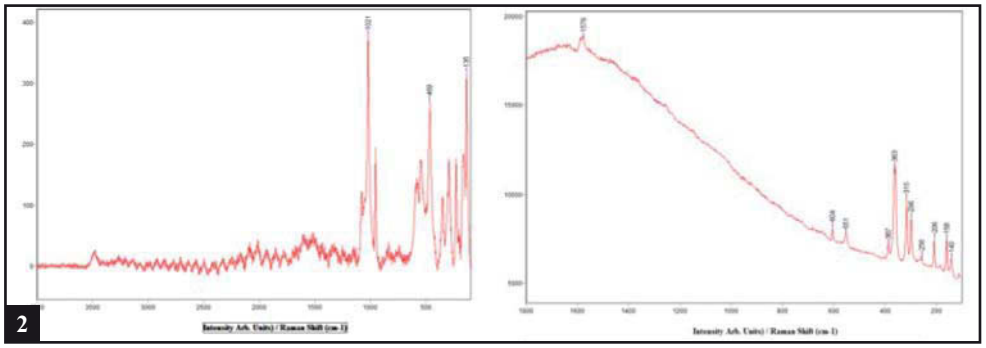

Fig. 2 – Raman spectrum of green sample 4: unidentified basic sulfate (left); Raman spectrum of green sample 7: Vergaut (right).

Sample	Color	Raman microscopy	Observations
001	red	vermilion, carbon particles	carbon is in the paper
002	black	carbonaceous material, iron gall ink	ink sampled
003	ochre black	vermilion, goethite, carbonaceous material	
004	red yellow	Vermilion, orpiment lazurite	Lazurite present as a trace, unidentified green
005	white	fluorescence	
006	red brown	carbon hematite	
007	pale blue	indigo, orpiment	vergaut already observed in Armenian ms
008	blue and red	indigo hematite	
009	pale blue	smalt?	broad band
010	dark ochre	indigo vermilion	
011	white	indigo, white lead, gypsum	
014	white with red	vermilion, quartz	
015	ochre	lazurite, vermilion, indigo, carbon	

Tab. 1 The data obtained on the microsamples with Raman microscopy.

INVESTIGATION FOR RESTORATION ON SOME MURAL PAINTINGS FROM THE CRYPT OF THE ISCHIA CASTLE

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ABSTRACT

In a recent restoration of architectural structure of some parts of the Aragonese Castle of Ischia (Italy) mural paintings dated to the XIII-XIV century were discovered. As a part of a crypt, they report images of religious subjects, with Christ, Mary and many saints and angels. In the aim of preparing a restoration plan for the paintings, a series of analyses were carried out. The main pigments and the technique used were identified and a new pigment identified, wulfenite, a mineral widespread in the Naples gulf.

Keywords: Gothic mural paintings, analysis, Raman microscopy, wulfenite

INTRODUCTION

The seat of the Istituto Europeo del Restauro is located in the Aragonese Castle of the Ischia isle. The important structure hosts a Museum and various architectural frameworks with churches and a crypt object of our present research. In the aim of preparing a restoration plan of the mural paintings of the XIII- XIV centuries a project of the Istituto Europeo del Restauro has been started for the identification of the materials and the techniques used.

The structure examined is nearby the crypt of the old Cathedral of Ischia, dedicated to Saint Peter and placed inside the Aragonese Castle.

During some works for the renovation and restoration of the architectural structure carried out in the Nineties, a room partially buried and used in the past as an ossuary was discovered. Once emptied of the earthy and organic materials, the mural paintings object of this study came to light. The relevance of the paintings was emphasized and some art historians attributed them to Giotto's area.

MATERIALS AND METHODS

After a careful examination of the painting surface with visible, infrared and ultraviolet photography, a microscopic digital examination of the surfaces was carried out. The surface appeared altered in many areas with the formation of gypsum and other deterioration compounds.

For the understanding of the pigments used, some Raman microscopic measurements were carried out in situ. A portable Raman instrumentation with a steady support in a shadowy crypt enables some good spectra to be obtained and to identify a mixture of vermilion and red ochre to paint the folds of the garments. In many points the spectrum of gypsum was recorded. In order to better evaluate the degradation of the pigments used, some microsamples were taken to be analyzed with fixed microRaman and FT-IR spectroscopy.

As a mobile Raman spectrometer, a Rigaku Xantus was used inside the crypt. The Xantus model used was equipped with a 1064 nm laser. With proper illumination and with a steady support Raman spectra in many instances were obtained.

On the samples taken, Raman spectra were recorded in the laboratory with a Labram instrument of the Jobin Yvon- Horiba, equipped with a 632.8 nm red laser, a CCD with 256 x 1024 pixels cooled to -70°C by the Peltier effect. Edge filters were used to cut the Rayleigh scattering and the spectra were recorded normally in the range 100- 1800 cm-1 with the laser power reduced to half or one tenth of its maximum value. Measurements of some seconds were repeated 10 times.

Through a detailed analysis of some microsamples taken with a lancet from the walls such as the one in Fig.1, a good knowledge of the materials present has been obtained obtained.

EXPERIMENTAL RESULTS

The results in the laboratory confirmed the identifications obtained in situ and allowed other important painting techniques and pigments to be ascertained. It is to point out that the only precious pigment present is vermilion, whereas green and blue colors appear to have been obtained by using carbon or organic degraded materials mixed with yellow ochre or white chalk. Red tones are obtained

mainly with vermilion or alternatively with hematite and magnetite for the darker hues for the painting of drapes of dresses.
The figures were painted as calcite paintings, that is both in fresco and mezzo-fresco techniques. A high percentage of calcium sulfate dehydrate is a consequence of a strong sulfation of calcite.
The most relevant finding was a yellow pigment based on wulfenite PbMoO4, sometimes mixed with a common Goethite. This finding is explained on the basis of the geological history of Ischia. Recent detailed investigations on the eruptive rocks of the Naples basin up to the Monte Somma (Vesuvius) show that in Ischia, Procida, Bacoli and all around the volcano the mineral is frequently present.

CONCLUSIONS

The simple analyses carried out, such as the multispectral and grazing angle photography, and the microscopic photography, have given an idea of the present state of conservation of the gothic mural painting. The chemical and spectroscopic analyses have enable the paintings to be classified as lime paintings, not only as frescoes, but also as mezzo-frescoes. The palette identified is not wide, but some contrivances were adopted to obtained some particular hues by mixing them, such as by mixing black and yellow materials, or by using wulfenite as a local source for the yellow pigment. These findings must be taken into considerations when ptogramming intervention on the pictorial surfaces.

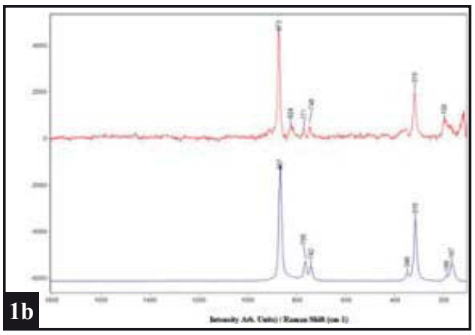

Fig. 1 – A detail of one of the mural paintings (1a) and the Raman spectrum of Wulfenite (compared with the Aist reference spectrum of the same mineral, from Slovenia) (1b).

ACKNOWLEDGEMENTS

We are grateful to the responsibles of the Istituto Europeo del Restauro for the permission given to analyze the crypt paintings.

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TECHNICAL AND HISTORICAL EXAMINATION OF *VIRGIN SURROUNDED BY FLOWERS* PAINTING OF JAN VAN KESSELI

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ABSTRACT

The Flemish still-life *Virgin Surrounded by Flowers* from Jan van Kessel I has been submitted to a conservation treatment and technical examination at Museu Nacional de Arte Antiga. The aim of the study was the knowledge of materials, artist´s practice and collaboration of artists. Technical analysis illuminates the highlights that the artists follow the rules of St. Luke Guild concerning materials and collaboration of artists. Furthermore historical analyses highlight the purpose that this kind of paintings had a devotional function.

Keywords: Still- life, Jan van Kessel, conservation treatment, scientific analysis.

INTRODUCTION

Jan van Kessel I (1626-1679) came from a very artistic family circle, the Brueghel family. His father Hieronymus van Kessel (c. 1578- 1635) married with Pachaise Brueghel. Van Kessel was the grandson, by maternal line, of Jan Brueghel "The Elder" (1568-1625), nephew of Jan Brueghel "The Younger" (1601-1678), and David Teniers "The Younger" (1610-1690) [1].

In 1644-45 Jan van Kessel became specialized on flower painting by the St. Luke Guild of Antwerp [2], and his painting reflects the influences of his family concerning the representation of flowers and van Kessel's affection for zoology and miniature painting [3].

Virgin Surrounded by Flowers, (Fig. 1), dated and signed, 1648, belonging to the Museu Nacional de Arte Antiga, Lisbon, follows the model from the earliest known garland painting with a religious theme performed by Jan Brueghel (1568-1625) in collaboration with Hendrick van Balen (1575?–1632). Federico Borromeo (1564-1631), Archbishop of Milan, commissioned the *Virgin and Child in a Garland of Flowers* (Fig. 2) to pay tribute to the paintings of the Virgin that had been destroyed during the furious outbreak of iconoclasm in Antwerp, and other cities in Low Countries during the end of 16th century [4].

MATERIALS AND METHODS

Technical examination allied to the conservation treatment of *Virgin Surrounded by Flowers* provided a deep knowledge to the main questions posed by this painting: Which materials (pigments, fillers and mediums) are present at the *Virgin Surrounded by Flowers*? Did van Kessel followed the painting practice documented on 17th century treatises? Is this work a collaboration of artists regulated by the Antwerp Guild? If it is a collaboration of artists, which artists participated?

To answer these questions it was required several exams and analytical methods such as: ultraviolet (UV) and infrared (IR) photography, IR reflectography, radiography, optical microscopy (OM), staining tests, gas chromatography, scanning electron microscopy with energy dispersive x-ray spectrometry (SEM-EDX), Fourier transform infrared micro-spectroscopy (μ-FTIR), to further supplement the technical evidence from the painting.

RESULTS

Material analysis had highlighted the use of similar materials and techniques of painting practice documented on 17th century's treatises. *Virgin Surrounded by Flowers* linen canvas has been sized and Jan van Kessel preferred a double ground (Fig. 3). The first layer is whitish-beige, composed with chalk, lead white and carbon black pigments binded

with animal glue. The second layer, a grey priming is composed by calcium carbonate, lead white and carbon black pigments in linseed oil medium. The pigments are the common used in 17th century artist´s pallet (lead tin yellow, vermilion, azurite, among others) [5]. The painting has been treated before, denoting a presence of a flour paste lining and chromatic retouching.

Combining the results from the optical microscopy (OM) and the observation during conservation treatment, it was found that *Virgin Surrounded by Flowers* was executed by the collaboration of two artists. The painting technique of the garland and Virgin were too different. Comparing Van Kessel technique to the representation of the Virgin, evidences showed that the garland painting technique was too detailed, the paint layers were thin, smooth and flatly applied, not denoting strong strokes and the rare *impasto* was well delimited. The Virgin painting technique denoted greater freedom and spontaneity in the dash. Texture was more diverse due vibrating and lively brushstrokes, where the use of *impasto* was frequent on the color layer, particularly on the Virgin´s face. Furthermore, the cleaning treatment had showed different reactions between the chromatic layer of the garland and the Virgin, where the last one was more sensitive to solvents.

Virgin Surrounded by Flowers has a golden inscription underneath the Virgin chromatic layer (Fig. 4), which has been found during the conservation and restoration treatment. Observing the radiography, this inscription exposed a religious character, possibly a Marian invocation, however the Virgin radiopaque chromatic layers did not revealed the full text. The inclusion of the inscription may have been intentional as a way to emphasize the figure of the Virgin, but at certain date, by unknown reasons was covered by the representation of the Virgin. The inscription was probably made after the Van Kessel garland, and seems to have been adapted in order not to overlap the painter chromatic layer.

It is probable that Jan van Kessel performed the garland of flowers, as it was his specialty, and that the representation of the virgin was done by another painter, perhaps someone from the van Balen family, possibly Jan van Balen (1611-1654) or Gonzales Coques (1614 or 1618- 1684). Although, further comparative studies of the above painters would help to clarify such assumptions.

CONCLUSIONS

Technical and historical examination of *Virgin Surrounded by Flowers* has highlighted the still-life in a garland with a religious motif as gender that emerged itself in a controversial era. The main purpose of this sort of paintings had a devotional function. The main characteristics of the 17th century Antwerp painting technique regulated from St. Luke Guild are clearly present in the *Virgin Surrounded by Flowers*, regarding the collaboration of artists, painting materials and techniques. Furthermore the golden inscription underneath the Virgin chromatic layer still poses questions about its meaning, function and the later covering action.

ACKNOWLEDGEMENTS

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Fig. 1 – Jan van Kessel I, *Virgin Surrounded by Flowers*.
Oil on canvas, Dimensions: 124 x 90 cm. Museu Nacional de Arte Antiga, Lisbon.
Credits: Carlota Barbosa

Fig. 2 – Jan Brueghel and Hendrick van Balen, *Virgin and Child in a Garland of Flowers*.
Oil over panel and silver.
Dimensions: 27 X 22 cm.
Pinacoteca Ambrosiana, Milan.
March, 2014.
[Online]: WWW:<URL: http://www.pinterest.com/pin/478155685408861651

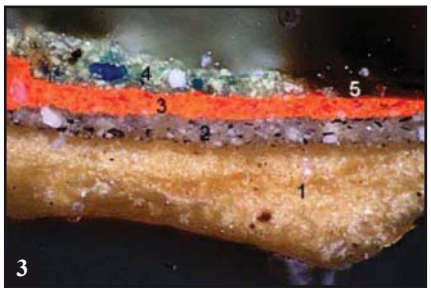

Fig. 3 – Cross section from a sample taken from *Virgin Surrounded by Flower*. Green leaf over a red flower petal, showing the use of double ground.
Credits: Enrique Parra, Larco química laboratory.

Fig. 4 – Detail of the radiography where it is possible to observe the golden inscription underneath the Virgin chromatic layer.
Radiography performed by José Figueiredo laboratory.

THE PULPIT OF ST.MARY CHURCH IN BERGEN (NORWAY): TRADING WITH VENICE TURPENTINE

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ABSTRACT

This paper presents the results from the analysis of samples taken from the polychromy of the pulpit of St. Marychurch in Bergen (Norway), a unique work in Norway dated back to 1676. Both pigments and organic materials were studied in order to determine the painting materials and techniques used by the artisans in this masterpiece and the timeline of its execution. Identification of Venice turpentine opens debate for its trading in the 17th century Europe.

Keywords: painting technique, binders, varnish, venice turpentine

INTRODUCTION

The pulpit of St. Marychurch in Bergen (Norway) is dated by an inscription on an epitaph to 1676. It was a gift from German merchants for the church of their settlement in the hanseatic town Bergen. Though in a reformatory church a pulpit is a most important and central item, the pulpit of St. Marychurch, showing a painted celestial globe as ceiling and on the underside, is quite special for Norwegian standards. The polychrome is also unique resembling lacquer work with different kinds of marble and tortoiseshell imitation of high quality, coloured glazes on silver leaf and small glass- and copper splinters strewn in on some surfaces. The artists, most likely coming from Denmark or England, are unknown.

In 2005 the preservation state of the pulpit made conservation measures necessary. The polychrome was flaking off extensively, caused by severe climate problems: not only the city of Bergen (situated at the Noth Sea Coast) is extremely humid, but during winter the church is heated. The conservation was undertaken by the painting conservators from the Archaeological Museum Stavanger (AMS).

Samples of painting layers could be taken then to get a better understanding of the layer build-up and the pigments used. This paper presents the results obtained from the identification of the painting materials both organic and inorganic, used in the pulpit.

MATERIALS AND METHODS

Some of the pigments were identified by means of Polarised Light Microscopy(PLM) and Scanning Electron Microscopy (SEM-EDS).

A procedure for the analysis of the whole content of organic materials present in painting sample has been used. The GC/MS procedure allows the identification of glycerolipids (linseed oil, walnut oil, poppy seed oil, egg), natural waxes (beeswax, Carbauba wax), proteinaceous materials (animal glue, milk or casein, egg, garlic), plant resins (Pinaceae resin, mastic, dammar, sandarac), animal resins (shellac) and saccharide materials (starch, tragacanth gum, arabic gum, fruit tree gum, guar gum, karaya gum) in the same micro sample from painted works of art [1].The GC/MS analyses were carried out with a 6890N GC System Gas Chromatograph (Agilent Technologies, Palo Alto, CA, USA), coupled with a 5975 Mass Selective Detector (Agilent Technologies, Palo Alto, CA, USA) single quadrupole mass spectrometer, equipped with a PTV injector. In all systems, the mass spectrometer was operating in the electron impact (EI) positive mode (70 eV). The MS transfer line temperature was 280 °C; the MS ion source temperature was kept at 230 °C; and the MS quadrupole temperature was at 150 °C.

RESULTS

The observation of the sample build-up highlighted the absence of a ground layer. The poychromy lies directly on wood with only a thick transparent layer between the support and the paint layers.

Results show the use of lead white in the preparatory layers, while the pigments were identified as cinnabar, smalt, orpiment, blue verditer and an

artificial produced green copper based pigment.
The analysis of the organic materials showed the presence of a mixture of proteinaceous materials and a diterpenoid resin in the pulpit samples. Diterpenoid resins are exudates from a large varieties of trees through the world. Identification of the specied origin is not straightforward as far as composition are variable and do not remain constant while ageing [2] However, the diterpenoid resin present in the pulpit could be identified as Venice turpentine thanks to the presence of compounds considered analytical markers of the resin obtained from Larix species.
The low level of oxidation observed in the resin seems to point to its conservation not exposed to light [3]. Therefore, the results obtained seem suggest the use of this layer as a preparation prior to the application of the polychromy.

CONCLUSIONS

Results from the analysis of samples from the pulpit of St. Marychurch in Bergen (Norway) shed light into the painting materials and practices used by the 17th century north European artisans. The identification of Venice Turpentine in Norway adds a piece of information about the trading of varnishes in the Europe of the 17th century. The ageing and the degree of oxidation of the resin allowed establishing the painting history of the pulpit and to to solve the questions arisen about the timeline of execution.

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LASER SCANNING FOR HISTORIC CHURCHES RESTORATION AND CONSERVATION: CHURCH OF SAN FILIPPO IN CAGLI

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ABSTRACT

The case study of the Church of San Filippo in Cagli is a single-instrument laser survey method in preservation and protection of a supposedly damaged historic church. Our research demonstrates this approach can be the only way.
The Marche region has a wealth of less important pieces of historical heritage spread across the area. Many of these churches are closed as a precautionary measure, in the wake of disastrous events or as a result of the neglect caused by a lack of funding for maintaining and restoring them. Today laser techniques means that a survey can be viewed as an independent way of preserving, protecting and understanding the church actual state of preservation. The aim of this paper is to demonstrate the effectiveness and speed of these technologies. The exhaustive nature of such data means it is possible to carry out subsequent investigations, during the processing stage, in order to understand the mechanisms that are causing the degradation or structural damages of buildings. This approach allows to reduce timescales, costs and errors in assessment.

Keywords: Laser scanner, Historic church, Architectural survey, Documentation

INTRODUCTION

The town of Cagli is located around the ancient trail of the Flaminia Way, an important Roman infrastructure. The interior of the medieval structure contains singular examples of historical-cultural excellence, such as the famous Keep by Francesco Di Giorgio Martini. [1]
The Church of San Filippo dates back to 1450, in this year it was rebuilt over the foundations of a previous church, built in 1289, which had been destroyed. The year 1728 was an important one as this was the year in which the church was embellished and enlarged with an extension of the apsidal area and the creation of the large chapel with an upright line topped by an elegant elliptical dome with small lantern and four open ellipsoidal oculi in the drum. The bell tower, which was possibly damaged by the earthquake of 1781, collapsed in 1835 and was rebuilt as it appears now. Serious instabilities in the structures, and in particular in the roofs, were detected in 1986 and the local authority ordered its closure in May of that same year. In the two years that followed restoration plan was drawn up and the work completed; this included the repairing of the roof and the reinforcing of the vault. [2]
Following a heavy snowfall that threatened to make the already poor state of the vault even more serious, a new regulatory order resulted in the closure of the church of San Filippo in Cagli in February 2012. The decision was preceded by an "appraisal report on the condition of the property" drawn up by the regional public official, in which "it was deemed necessary to prevent the public from using the Church pending decisive works". Since then everything has remained as it was. The two years that have passed since then have not only failed to improve the state of dilapidation, but have probably made things worse.
Firstly, the necessary "decisive works" will require substantial financial resources. Often, the more serious problem, is determining the level of damage, something that is normally undertaken by technical experts who carry out a visual assessment.
Hence, the poor reliability of the methods or the skills employed could lead to the hurried closure of the site which, whilst it awaits those major "decisive works", no longer benefits from the routine maintenance and repairs that were previously carried out on it. What is worse, the work that is often carried out is based on traditional methods of surveying that are inaccurate or even erroneous.
We, on the other hand, will demonstrate how laser scanner surveying is a very fast method and results in more precise and accurate assessments of the state of damage, and results in significant savings in terms of costs and resources. [3]

OPERATIONAL GOALS

The work was undertaken using a methodology which, during each of the stages, took into account all the aspects that are a feature of the building: the context, the historical development, the relationship with the adjacent block and the accurate measurement.

The purpose of the paper presented here is to demonstrate the effectiveness of a survey system that is geared towards: reducing the amount of time needed for acquiring data; making the assessment of the actual situation more objective and accurate and, in particular cases, perhaps avoiding the closure or reducing the period for which the historical artistic site will remain closed.

The tool used was the Leica C10 time-of-flight scanner, capable of capturing 50,000 points per second, with a maximum range of 300 m, resolution up to a millimetre and an accuracy of 6 mm at a distance of 50 m. The high-resolution camera, integrated in the capturing system, allows full dome images with an individual size of 1920 by 1920 pixels, while automatically exportable equirectangular images are reduced in size to 8192 by 4096 pixels. The plurality of alignment methods, through the use of targets, for morphology, inverse intersection or by the creation of traverse, ensure the operator that the scans are managed properly following ad hoc design of the campaign capturing phase. Having an instrument, therefore, that is able to ensure scalability of data together with measurement accuracy, colour quality, versatility and speed in data capturing and output realisation phases. Moreover, the remote control of the instrument used guarantees the safety of the operators in situations of danger or risk.

The acquisition phase lasted 16 hours and involved two operators. Ten stations were undertaken outside the building, around the entire block, 2 from the overlooking terraces and 4 from the adjacent terrace. A polygonal in the capture phase, which automatically aligned the scans into one single system of reference, was carried out on the ground. The elevation scans help to obtain a better acquisition of the surfaces of the vertical elements, reducing the shadow areas. Inside the building 17 stations were sufficient for acquiring the aisle, the side chapels and the spaces adjacent to the sacristy.

The data obtained in the field were processed using Leica proprietary software. We created the final points cloud aligning the free scans with the cloud to cloud method, using the ICP algorithm, with a maximum RMS value of 0.015m. As a result of the 3D point cloud model obtained, the restitution phase was much simpler and faster. [4]

Slicing the cloud on horizontal and vertical planes (Fig. 1), we extracted the 2D standard printouts. The slides guide the operator in the vector drawing of the sectioned elements, whilst the orthoimages obtained by the section plans enrich the printouts of the elements in projection. For the drawing of the elevations we used coloured orthoimages extracted directly from the cloud, therefore the editing and the drawing become unnecessary.

To speed up the analysis phase, we chose to create 3D surface model regarding to some part of the architectural structure, in order to gain a better understanding of the geometries and the structure of the vault and the dome. In the first case we generated a mesh beginning with the decimated point cloud, in order to obtain a clearer reading of the geometry and the surface deformations. About the dome, it was decided to pass from the point cloud to a model with solid elements in a CAD environment, in order to analyze the composition and arrangements of the structural elements (Fig. 2).

Furthermore, beginning from the 3D model point cloud and the spherical views acquired by the laser scanner, we exported a Truview based on the solid images and a virtual tour for the immersive navigation on the photos. These tools are valuable supports for the operators and are excellent when it comes to documenting and communicating the historical asset. [5]

Having analyzed the current situation, the materials and their state of preservation, we produced the maps of the material degradation and the situation with regard to cracking, and then went on to hypothesize the existing damage mechanisms (Fig.3). [6]

OUTCOMES

The point cloud as the finished product

All the data presented thus far constitute a veritable identity card of the current state of the Church of San Filippo in Cagli. We have demonstrated how this method of surveying, based on the use of all-in-one laser scanners, is both fast and low-cost. The few required operators and the short timescales allow significant reductions in the cost of work. We would furthermore like to point out the enormous value and the multiple potential of the same point cloud, without which a laborious and complex restitution phase would be required. The point cloud represents an information system of the building in

which the integrated picture of this dataset can be handled.

A comparison with the old surveys

The first important finding comes from comparing our survey and printouts with those of the previous survey, on which the planned restoration works of 1988 were based. Numerous discrepancies in terms of geometries and dimensions have been revealed. (Fig. 4). Overall the interior space was shorter and higher than that previously drawn. Both the vault and the dome, in terms of size and morphology, differ greatly from what was previously depicted. The same applies to the buttresses in the roofing that appear to be positioned differently. What is apparent is just how much these serious errors affect the restoration plan. In these cases all that can be done is to rely on the good work of the construction yard that finds itself in a situation of having to rectify an erroneous plan.

The analysis of the degradation and disrepair

The supporting structure consists of a mixed masonry, red stone of Furlo and brickwork on the main façade. We found significant cement loss between the joints on the façade, which has resulted in a failure of the mechanical effectiveness of the masonry. There was a significant presence of infiltrations both the small elliptical domes of the side chapels and in the surfaces of the dome. In addition to the damp, the central nave, covered by a barrel vault with lunettes, in brick sheeting, also revealed significant cracking in the area close to the wedge and keystone of the vault. The counter-façade also showed signs of deep cracking that were clearly visible.

These analyses of the degradation and disrepair allowed us to formulate a hypothesis as to the actual damage mechanisms through and analysis by macro elements. The overall tilting with the formation of the butt hinge at the base, caused by a poor anchoring to the side walls and the roof, is visible in the facade. The transverse response of the chamber is contrasted by the presence of the external buttresses visible at the top and by the metal buttress bracing added during the last restoration.

CONCLUSIONS

The single-instrument approach of laser scanner surveying allows the capturing phase to be completed with one single tool resulting in a reduction in timescales and personnel. What is more, we have demonstrated how the totality of the geometrical, morphological and photographic data acquired satisfies all the analysis and planning requirements.

This data may, at different times, be filtered and scaled according to the distinct needs of documentation, representation, interventions for conservation and restoration or communication.

The point cloud is itself a precautionary measure. It is a perfect facsimile, an identity card of the site, from which, without the need for any further printouts, it is possible to arrive at some objective evaluations on the building's state of preservation. [7]

What would be desirable would be if public bodies could: change their mentality of considering restoration as being the only possible way of protecting the asset; acknowledge that alternative methods do exist, such as the one described in this paper, and view maintenance as the first real and effective method of preservation. The effectiveness of these methods is that they can assess the actual need for restoration work or, in any event, that they are such as to provide restorers with tools that will optimize the plan, cutting down on costs and reducing timescales.

This awareness is spreading all over the world with initiatives similar to that proposed in London by the CyArk association. Their Challenge *is to digitally preserve 500 cultural heritage sites within the next five years. We are on a mission to save these cultural heritage sites digitally before more are ravaged by war, terrorism, arson, urban sprawl, climate change, earthquakes, floods, and other threats. There isn't enough money or enough time to physically save every site, but we do have the 3D technology to digitally save these sites to make them available for generations to come.*

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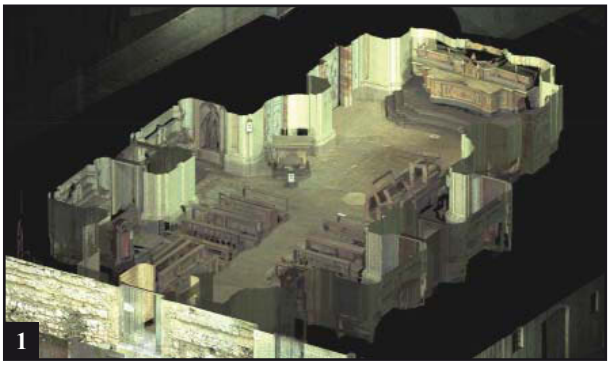

Fig.1 – Point cloud display in half space of the San Filippo Church at Cagli

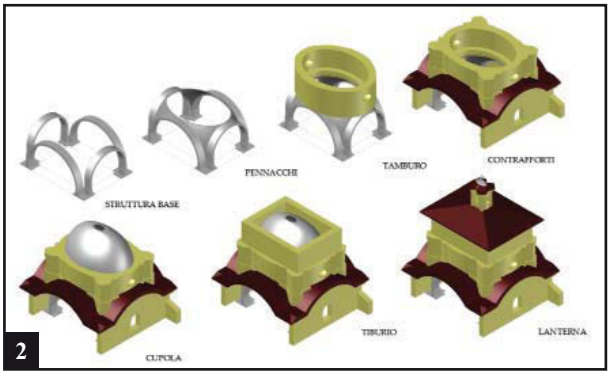

Fig.2 – The three-dimensional reconstruction of the dome

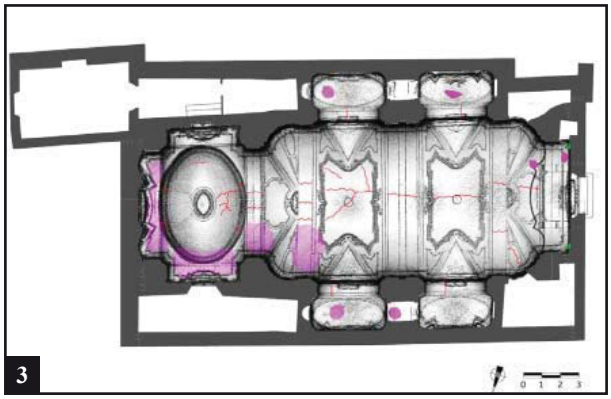

Fig.3 – Map cracking and material decay of the vault

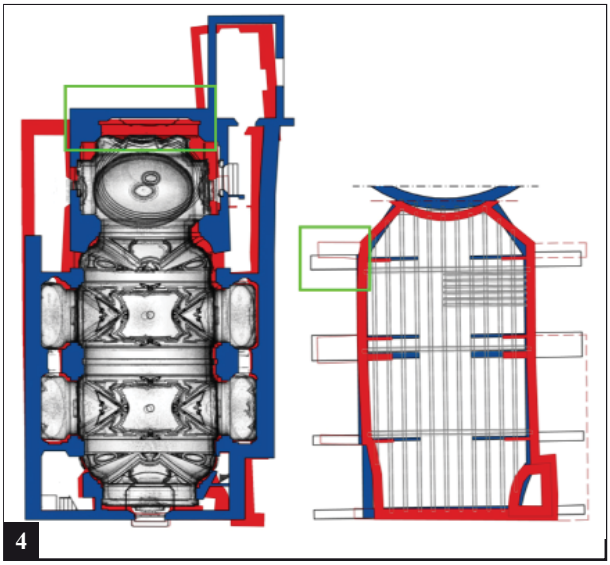

Fig.4 – Overlap of the old (blue) and the new (red) survey

THE LAPIDAZIONE DI SANTO STEFANO BY GIORGIO VASARI: THE STUDY OF THE WOODEN SUPPORT'S DEFORMATIONS AS A CONTRIBUTION TO RESTORATION AND FUTURE CONSERVATION

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ABSTRACT

The *Lapidazione di Santo Stefano* is a very large panel painted by Giorgio Vasari in 1571 and is conserved in the Church of Santo Stefano dei Cavalieri in Pisa. Until 2011 the painting was located in a side aisle of the church; the combination of the moistening induced by rainwater leaks, and of the internal stresses produced by the rigid anchorage to the wall, made the wooden support crack along two longitudinal lines. This serious damage of the support, also affecting the paint layers, separated the panel along half of its width. A restoration intervention was deemed necessary, in order to recover the panel's integrity; however the risk existed that the friction between the panel and its dovetailed crossbeams could act as a constraint so that, after the cracks were repaired, internal stresses would result from the restrained deformation and consequently induce new cracks. In order to evaluate such a risk, the deformations of the panel and the relative slippage between panel and crossbeams were monitored: this analysis showed that slippage was not impeded, and hence supported the decision of repairing the two cracks by reconnecting their separated edges. The monitoring continued during more than one year after the restoration, and showed a satisfactory behaviour of the repaired wooden support. The context, the methods and the results of this monitoring are here illustrated, together with the usefulness of protracting it in order to verify the artwork's conservation.

Keywords: panel paintings, dovetailed crossbeams, monitoring of wood deformation, restoration.

INTRODUCTION

The present work results from a collaboration between the *Soprintendenza BAPSAE di Pisa e Livorno* (responsible for the restoration), the company *Toscana Restauro Arte* (in charge of actually performing the restoration) and the Wood Technology Research Group from the GESAAF - University of Florence (in charge of the diagnostic research on the wooden support). This cooperation made it possible to develop and share some scientific knowledge about Wood Science applied to conservation of Cultural Heritage, and showed how useful this kind of technical analysis can be for the restoration.

The *Lapidazione di Santo Stefano* by Giorgio Vasari (1571) is a large panel painting (Fig. 1) made of 10 horizontally oriented boards of Poplar (*Populus alba* L.), whose dimensions are shown in Fig. 2. The boards are glued toghether along the edges and connected by three vertical crossbeams, made of silver fir (*Abies alba* Mill.) wood, whose cross-section is partly shaped as a dovetail. The panel is exhibited in the Church of Santo Stefano dei Cavalieri in Pisa, and until the end of 2011 it was located in a side aisle of the church, anchored to the wall by means of several anchorage bolts passing through the thickness of the wooden support. These rigid constraints strongly limited any deformation of the panel, which on the contrary would have needed to shrink and swell according to the climatic fluctuations. As a consequence of a severe roof damage in this side of the church, the panel location has been exposed to rainwater leaks, and hence to high humidity, producing a severe swelling tendency; later, when the humidity decreased, since the shrinkage of the wooden support was again limited by the constraints, internal tension stresses developed and produced two cracks along the wood grain, in two weaker locations: a joint (between boards 5 and 6) and a potential ring-shake (in board 5). This serious damage of the support, also affecting the paint layers, separated the panel along half of its width, on the left side [1]. The two cracks risked to propagate along the whole width of the panel, in case of further stresses produced by climatic fluctuations combined with restrained shrinkage/swelling. Although a future placement giving the needed freedom of deformation is anticipated, a restoration intervention was deemed necessary, in order to recover the panel's integrity;

however the risk existed that the friction between the panel and its dovetailed crossbeams could act as a constraint so that, after the cracks were repaired, internal stresses due to climatic fluctuations and restrained deformations could build in, and consequently induce new cracks. In order to evaluate such a risk, the deformations of the panel, and the relative slippage between panel and crossbeams needed to be accurately estimated. If the slippage between crossbeams and boards were found to be possible, the reconnection of the two cracks would not be a danger; but if the panel could not slip as to the crossbeams, it would be better to reconnect only one crack, and let the other remain as "safety valve" for the wood deformations.

The monitoring was started in May 2012. After about six months, the data collected were considered sufficient for supporting the option of reconnecting both the cracks; during this intervention, the monitoring was interrupted to facilitate the work, and then re-started after the restoration to verify the effects of the structural changes. Data collection is still continuing (now for more than one year after the restoration), so that the panel behaviour under the year-around climatic variability inside the church can be recorded; also, the usefulness of protracting the monitoring in order to verify the artwork's conservation is being evaluated.

OPERATIONAL GOALS

In order to understand the deformations of the panel subjected to environmental fluctuations, and its relationship with the crossbeams, a deformometric monitoring was planned and implemented, with the aim of measuring the dimentional variations of the wooden support and the relative slipping between boards and crossbeams. The period of monitoring was planned so as to explore the deformative behaviour in different climatic conditions including both dryer and moister periods.

The aims of this monitoring were: 1) to verify the magnitude of the constraining effect of the crossbeams on the panel deformations, and to estimate what could be the effect of repairing the cracks; 2) to estimate the magnitude of the panel's deformations; 3) to measure the width variations along the cracks; 4) to estimate the magnitude of the slipping between the panel and the crossbeams before and after the cracks were repaired; 5) to verify that even long after the restoration the slipping between panel and crossbeams continued, in order to make sure that no constraints nor internal stresses might eventually arise. For the sake of brevity the analyses (2) and (3) will not be discussed here.

Two sets of monitoring equipment were installed (Fig. 2) by means of non-invasive techniques: a set of Deformometric Kits (DKs) to record the panel's deformations [2], and a set of single transducers named Dilatometers (Ds) to record the slipping of the boards relative to the crossbeams. Climatic parameters were also recorded, so to relate the humidity variations with the panel's deformations. All the instruments were connected to stand-alone data loggers, which acquisition rate was set at 15 minutes.

RESULTS

The data collected by means of the DKs and the Ds were analyzed in connection with the climatic variations, and organized in graphs where the parameters of interest are shown versus time (Fig. 3). The deformative behaviour of the panel is derived from the combination of the data collected. The main result obtained by analyzing the Ds measurements is that a relative movement (slippage) between the three dovetailed crossbeams and the panel is actually taking place. This information was essential for taking decisions about the restoration: once the possibility of slipping was verified, the complete repair of both cracks could be accepted.

The hygroscopic deformation of the panel consists of the shrinking/swelling along the vertical direction, which for the boards is the transversal direction.

Before the restoration (Fig. 3 – left), three large areas deforming almost independently could be identified: 1- the left half (total height), 2- the upper right, and 3- the lower right; the cracks widened during the shrinkage and became thinner during the swelling.

By geometrically processing the recorded data, it was found that each area featured a zone where the slippage would be approximately zero; such zones were therefore named "zero-slippage zones". In order to evaluate the appropriateness of a reconnecting restoration intervention, it was necessary to evaluate whether the upper right side and the lower right side, if connected together, would show a different slippage behaviour and a common new "zero-slippage zone"; in other words, if the cracks were or were not a necessary "relief valve" for the hygroscopic response of the panel; if not, both cracks could be repaired.

Since the "zero-slippage zones" were identified as

placed approximately at mid-height of each area, a reasonable deduction was that no definitely localized constraints existed between crossbeams and panel. The hypothesis made was that repairing both cracks could be evaluated as a safe intervention. In fact *after the restoration* the panel showed a consistent deformation even on the right side, behaving as a single structure, with only one central "zero-slippage zone" (Fig. 3 – right); this confirmed the correctness of the above hypothesis.

The importance of a *long-term monitoring after this restoration* lies in the possibility of keeping under control the behaviour of the panel: if the wooden support remains free to slip, its reaction after a climatic variation will be similar to the previously monitored deformations; a reduced or a non-existing slippage would flag the possible arising of unexpected constraints. This would consequently be an alarm that would request closer exanimation to prevent the otherwise unforeseeable consequences such as the opening of old or new cracks.

CONCLUSIONS

The deformometric and slippage monitoring proved to be a useful non-invasive instrument to orient the restoration of the wooden support of *Lapidazione di Santo Stefano* by Giorgio Vasari. The relative slippage between the panel and its dovetailed crossbeams was measured in some detail; the data analysis brought to the conclusion that the panel is not prevented by the crossbeams from shrinking and swelling, therefore no dangerous constraints risk to arise between panel and crossbeams. The panel's deformative behaviour produced by the environmental fluctuations was monitored during over one year and a half. This study showed that repairing both the cracks would not lead to the arising of dangerous stresses into the wooden support. After the restoration, the monitoring has being carried on, thus providing the confirmation that the hypotheses previously made can be considered correct. The monitoring should continue, to verify the actual panel's behaviour in an even wider range of climatic conditions, and to provide information about any new disturbance emerging, in the framework of a forward-looking preventive conservation.

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The Authors wish to thank Dr. Alba Maria Macripò (Government Officer - *BAPSAE di Pisa e Livorno*), Masters Nadia Presenti and Mario Verdelli (Restorers - *Toscana Restauro Arte*), and Monsignor Aldo Armani (Rector of the Church of Santo Stefano dei Cavalieri).

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Fig.1 – Lapidazione di Santo Stefano by Giorgio Vasari (1571)

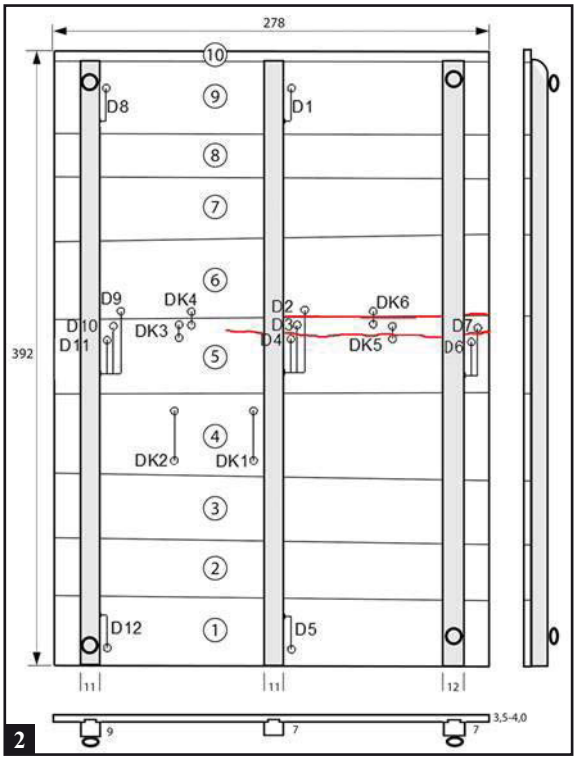

Fig.2 – The structure of the panel and the arrangement of the monitoring equipment on the back-face of the panel.

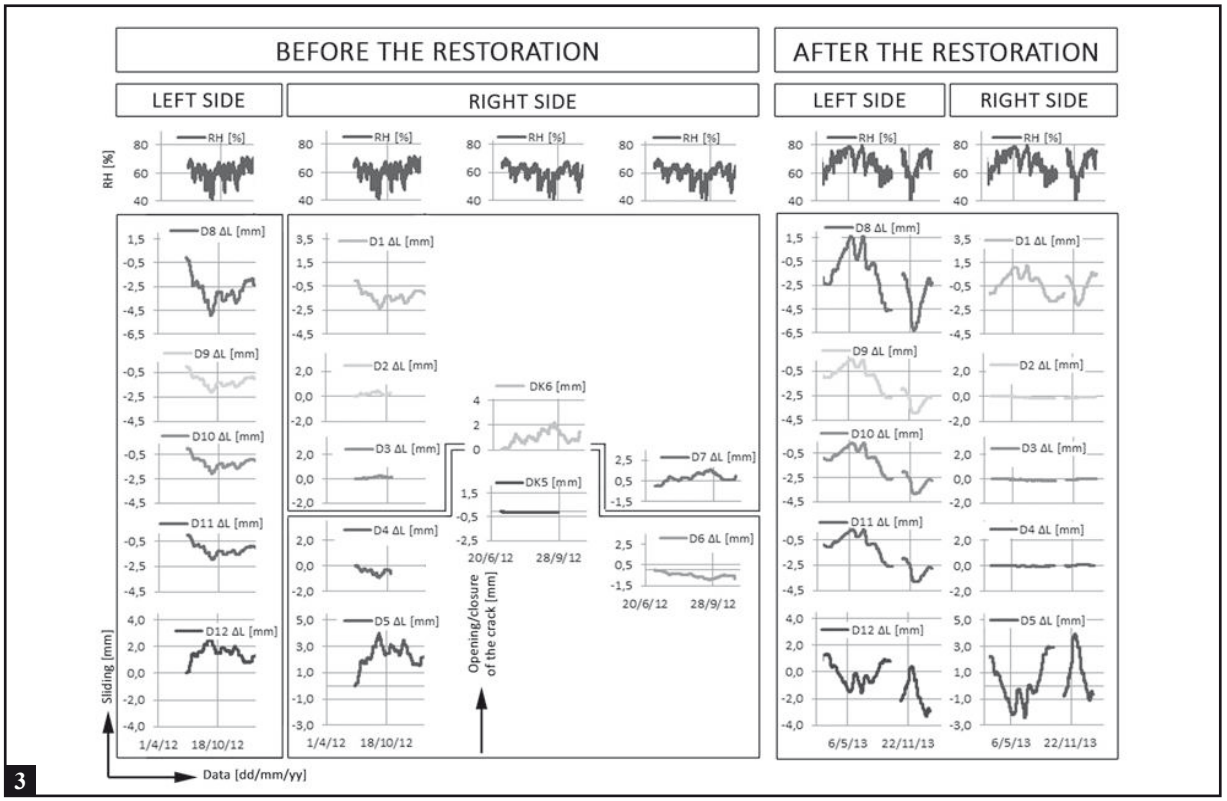

Fig.3 – Panel's deformations during the whole monitoring period. Before restoration (left) lower and upper right areas deformed independently, and the width of cracks shows variations; after restoration (right) the cracks are closed, and the whole panel deforms consistently of acess).

MULTI ANALYTICAL INVESTIGATION OF THE PAINTING TECHNIQUE IN THE CYPRUS ORTHODOX ICON TRADITION

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ABSTRACT

A multi analytical approach comprising spectroscopic, chromatographic and mass spectrometric techniques has been used for the identification of the painting materials used by the Cyrpus post-byzantine iconographers. Results showed that both inorganic pigments and organic colorants were used to create the red hues in the icons. Moreover, egg and animal glue were identified as the binder of the red ayers and preparation layer, respectively, highlighting the use of tempera in the Cyprus Orthodox tradition.

Keywords: icons, paitnign technique, organic dyes, binders

INTRODUCTION

The present work focuses on the characterisation of the paint materials used by Cypriot iconographers in Orthodox icons through the centuries. A total of 8 samples were collected from 7 different icons, dated from the 12th to the 18th century, originally placed in 3 different churches in Morphou and Nicosia (Cyprus), and currently conserved at the Archbishop's Laboratory in Nicosia.

A multi-analytical approach comprising spectroscopic, chromatographic and mass spectrometric techniques was used in order to identify the pigments and fillers, the organic colorants and the binding media. In particular, the main goal of the research was to identify the paint materials used to produce red hues.

Pigments and fillers identification was performed using micro-Raman spectroscopy and Fourier Transform Infrared spectroscopy (FT-IR). In order to determine the binding medium, Pyrolysis Gas Chromatography–Mass Spectrometry (Py/GC/MS) and Chromatography–Mass Spectrometry (GC/MS) were used. The study of the organic colorants was performed by Liquid chromatography mass spectrometry (LC-MS/MS) analysis.

MATERIALS AND METHODS

FTIR analysis were performed in transmission mode by preparing a KBr pellet while Raman was performed directly on the paint fragments. The GC/MS analyses were carried out with a 6890N GC System Gas Chromatograph (Agilent Technologies, Palo Alto, CA, USA), coupled with a 5975 Mass Selective Detector (Agilent Technologies, Palo Alto, CA, USA) single quadrupole mass spectrometer, equipped with a PTV injector. In all systems, the mass spectrometer was operating in the electron impact (EI) positive mode (70 eV). The MS transfer line temperature was 280 °C; the MS ion source temperature was kept at 230 °C; and the MS quadrupole temperature was at 150 °C. A combined procedure allowing the analysis fo three separate fractions has been used [1].

A few µg of the sample admixed with 2 µl of hexamethyldisilazane (HMDS) were inserted into a quartz tube. Detailed working conditions are published elsewhere [2].

LC-MS/MS analysis were performed with an HPLC-ESI-Q-ToF: HPLC 1200 Infinity (Agilent Technologies, Palo Alto, CA, USA) coupled to a Jet Stream ESI-Q-ToF (6530 Infinity, Agilent Technologies) detector. A mild extraction based on the use of a EDTA/DMF solution was used [3].

RESULTS

Pigment and fillers Identification

Cinnabar was identified in almost all the paint layers studied though in some cases read lead was also determined. European cochineal and kermes were identified in the red paint layers, in combination with the inorganic pigments.
Calcium sulfate was used in the preparation layer of all the icons.

Binders

The presence of proteinaceous materials in all the samples evidence the use of the tempera technique for the realisation of the icons in Cyprus.

CONCLUSIONS

The painting materials and technique used by the Cyprus orthodox iconographers has been presented and discussed allowing the comparison with other post-byzantine icons [4].

ACKNOWLEDGEMENTS

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COLORIMETRIC STUDY OF THE POST-PROCESSING EFFECT DUE TO ARTIFICIAL AGING AND GAMMA IRRADIATION OF COTTON

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ABSTRACT

The museums and religious cult institutions of Romania have a valuable old collection of ethnographic and historical textiles, many of them made with oldest embroideries of different kinds of metallic and textile threads and some of them showing polychrome ornamentation.
Irradiation of cultural heritage objects organic support is an effective method of conservation. Conservation treatment by irradiation with gamma radiation is characterized by efficiency, safety for users and for the environment and the possibility of mass treatments. Concerning the effects of gamma radiation on ethnographic and historical textiles information is reduced.
Gamma irradiation treatment is one of the unconventional treatments for organic cultural heritage conservation in the attention of specialists concerned with policies IPM (Integrated Pest Management) in museums and archives.

Keywords: colorimetric study, cotton, whiteness index, yellowness index, conservation

INTRODUCTION

This study is focused upon the influence of preservation method through gamma irradiation upon the properties of textile materials of organic nature, objectiv of the project UEFISCDI named *„Improvement of occupational environment quality in cultural heritage deposits. Validation of gamma radiations treatment of textile and leather cultural goods"* (TEXLECONS).
Chromatic changes of cotton textiles under the influence of hygrothermal aging and gamma irradiation treatment was carried out on reference of woven fabrics made of unprocessed cotton hygrothermal aging and gamma irradiation treatments with various irradiation doses were analysed.

MATERIALS AND METHODS

The samples of cotton were labelled as follows: initial samples (B0), samples aged at 24 h (B1), samples aged at 48 h (B2), samples aged at 120 h (B3) and samples irradiated at 5 - 25 kGy.
Aging Procedure. The cotton woven fabrics were subjected to the hygrothermal ageing under controlled atmosphere in the following conditions: temperature 80°C; relative humidity 65 %. The samples were kept in this atmosphere for 24 hours, 48 hours and 120 hours in a climatic chamber (Angelantoni Ind., Italy). The aged samples were analyzed and compared to the reference samples.
Gamma irradiation procedure. The samples have been irradiated at the Technological Irradiation Center IRASM/IFIN-HH, Magurele, Ilfov, Romania, using an Irradiator SVST Co-60/B type, with 5, 10, 15 and 25 kGy, D_{max}/D_{min} =1.14. The samples were labelled B0_10, B0_25, B3_10, B3_25, in accordance with aging times and Irradiation Doses.
Colorimetric study. The presence of different chromophore groups formed on the textile under the influence hygrothermal aging and gamma irradiation treatment required the objective assessment of chromatic changes by measuring the reflectance of visible radiation (400-700 nm) and the evaluating of color characteristics in CIELAB Color System [1-4].

RESULTS

For cotton samples the values of *whiteness index* - W, *color difference* - ΔE^* and *yellowness index*- ASTM E313 are summarized in Table 1.
The evolution of whiteness index (CIE) and the yellowness index E313 of cotton samples at hygrothermal aging (80°C, 65% RH) and irradiation treatments at various doses (5-25 kGy) is shown in Figures 1 and 2.

CONCLUSIONS

Artificial aging causes the proportional differences to the duration of the treatment and the wavelength of the radiation from visible spectrum.
Exposure to gamma irradiation causes a decrease of the whiteness index and an increase of the yellowness index in cotton textiles.

For the experimental conditions approached, the evaluating of the chromatic characteristics CIELAB allows the assessment of the state of conservation of cotton textiles through a rapid non-destructive method with acceptable accuracy.

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Sample	ΔE*	L	b	Whiteness index	X	Y	Z	Yellowness index
B0		81,914	8,579	56,177	63,385	67,100	67,368	7,486
B0_10	1,130	82,195	8,912	55,459	64,279	67,561	67,410	9,085
B0_25	7,180	75,567	11,725	40,392	53,185	57,103	52,475	15,540
B1	4, 535	77,675	10,118	47,32	57,169	60,625	58,262	12,315
B1_10	4,230	80,272	11,673	45,253	60,809	64,435	60,271	15,257
B1_15	4,320	81,441	12,061	45,258	62,373	66,326	61,739	15,346
B1_25	5,060	80,646	12,504	43,134	61,239	65,038	59,778	16,848
B2	1,620	82,165	9,754	52,903	63,399	67,512	66,189	9,475
B2_5	2,450	83,780	11,521	49,217	65,626	70,190	66,589	12,587
B2_10	3,310	81,319	12,355	44,254	61,963	66,128	61,128	15,648
B2_15	3,650	82,398	12,638	44,484	63,249	67,895	62,595	15,221
B2_25	6,350	82,847	14,367	39,746	63,128	68,637	60,960	17,566
B3	4,270	81,441	12,061	45,258	62,373	66,326	61,739	15,346
B3_10	1,260	82,519	12,344	45,487	63,662	68,094	63,214	14,920
B3_5	2,390	83,235	13,103	43,926	64,478	69,280	63,400	15,889
B3_15	1,280	81,629	12,679	43,592	62,216	66,632	61,212	15,878
B3_25	6,880	80,811	16,773	30,492	60,073	65,304	54,238	24,210

Tab. 1 – The values of whiteness index, color difference - ΔE* and yellowness index

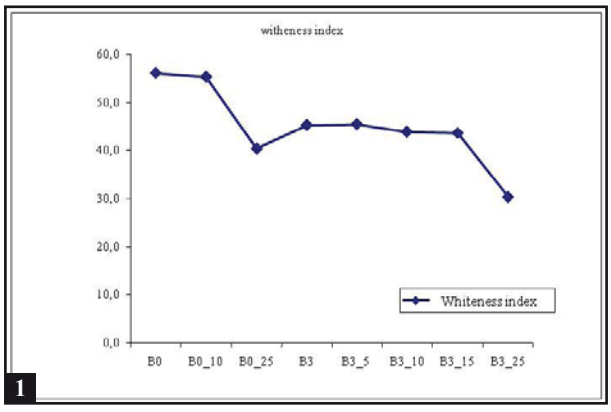

Fig. 1 – Cotton whiteness index

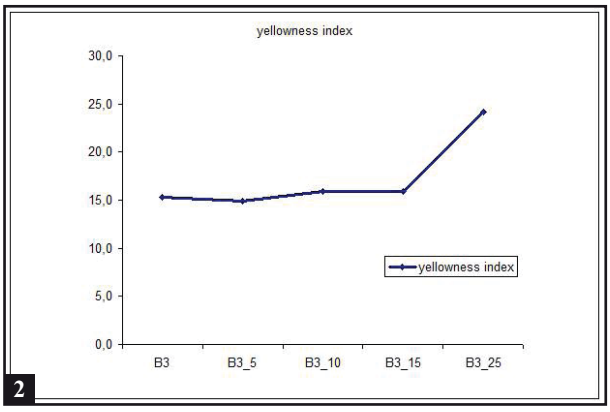

Fig. 2 – Cotton yellowness index

EGG-TEMPERA TECHNIQUES IN LATE 14TH CENTURY FLORENCE: NEW INVESTIGATIONS ON THE ANNUNCIATION AND SAINTS POLYPTYCH BY GIOVANNI DEL BIONDO (GALLERIA DELL'ACCADEMIA, FLORENCE)

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ABSTRACT

This paper deals with investigation of the painting technique used by Giovanni del Biondo in the polyptych *Annunciation and Saints* (1385 ca), Galleria dell'Accademia, Florence, Italy, to find technical explanation of the pictorial quality that makes this painting remarkable compared to artworks by coeval artists. Imaging techniques (UV, IR and IR false colour), non-invasive single spot techniques (XRF and FORS spectrometry) and analytical investigation on selected micro-samples (FT-IR, GC-MS, ESEM-EDX) have been combined to retrieve the palette and identify organic binding media. Analytical results are also discussed comparatively with those accessed from the scientific databases of National Gallery London in the framework of CHARISMA project-funded ARCHLAB visit. Stratigraphic and microchemical evidences confirm the use of a relatively simple egg-tempera technique, without complex stratigraphic superimposition of preparation and pictorial layers. These outcomes further prove how challenging is the investigation of egg-tempera recipes, especially to correlate the analytical evidence with the pictorial effect appreciated with the naked eye.

Keywords: painting techniques, binders, gilding, microstratigraphy

INTRODUCTION

Currently exhibited at the first floor of the Galleria dell'Accademia in Florence, the polyptych by Giovanni del Biondo (1356-1398 ca) is one of the most significant altarpiece produced in the 14th century Florence (Fig. 1a) [1,2]. The painting comes from the Florentine Dominican Convent of Santa Maria Novella, where it was formerly located in a chapel used as sacristy.

This chapel was dedicated to the *Annunciation* which carries the central panel of the painting, representing the Archangel Gabriel and Mary, lined by legions of feminine and masculine figures of saints, which are identifiable by iconographic attributes and inscriptions.

The polyptych dimensions (406 cm x 377 cm), the surprising number of figures painted by the artist, the passages of Holy Books inscribed in the *phylakterion* (i.e. strips of painted parchment held by the saints) and the rich architectural elements of the carpentry confirm the importance of this commission by Andreola Acciaioli in memory of her husband Mainardo Cavalcanti.

The altarpiece, which dates back to the 1385 ca, is undoubtedly ascribed to Giovanni del Biondo, a master active in Florence between about 1356 and 1398, following Orcagna's tradition. The good condition of most of the painting proves the refined technique used by the artist, who realized his artworks looking at the quality of the painting and its durability in time.

INVESTIGATION RATIONALE AND METHODS

The choice of investigating the *Annunciation and Saints* was mainly driven by the observation of its peculiar appearance, remarkably different from those of paintings produced by other artists active

in Florence at that period. This painting also allows us to explore the challenging research topic of egg-tempera binding media in the transition from 14th and 15th centuries [3], as well as the issues related to varnish in Italian tempera paintings [4] and stability of coatings [5].

Although the panel is painted according with the instructions given by Cennino Cennini in his *Libro dell'Arte* [6] and other technical textbooks [7], the painting surface looks matte rather than glossy. This matte surface possibly was not varnished and it had never been varnished even at the time it was carried out. Also, the brushwork is executed in swift and skilful movements that achieve an incredible vividness in painting figures and decorative ornaments. The surface appearance of this painting, like an illumination, is realized with a direct use of thin and almost pure paint layers.

In late February 2013 the twisted columns of the carpentry were temporarily removed from *Annunciation and Saints*, to expose the painted surfaces along the edges of the three panels (Fig. 1b-d). This intervention was undertaken based on the observations reported by Baldini [1], who highlighted that the twisted columns had preserved those surfaces from alteration, dust deposition and human interventions, thereby saving the former intensity and luminosity. The visual inspection does not provide a clear evidence of oil/resin-based varnish, except for a glue-like coating. Such coating seems to be due to past restorations, presumably carried out after the addition of the twisted columns. Indeed the surfaces behind the latter are quite clean and not affected by this coating, thereby supporting the hypothesis of past restorations (during one of the transfers of the painting) rather than an original treatment of the painted surface.

Partially disassembled at the beginning of the 17th century, the painting was moved to the storage of the Convent of San Marco in 1808, and in 1827 it was transported to Accademia di Belle Arti. On the basis of technical report we know that the restoration of OPD, from 1971 to 1982, only involved the wooden structure of the panel. We can hypothesized that only few and light interventions on the surface were executed between about 1700 and 1827, a fact which likely gives us the chance to examine a nearly original surface.

In order to answer questions both on the original materials and the brownish external cover, an integrated analytical methodology was followed. Imaging techniques (i.e. UV, IR and IR false colour) aimed to retrieve a general perspective concerning the external layer, palette, retouches and later additions, were combined with XRF and FORS spectrometry providing information about composition of the pictorial layers. Furthermore, eight micro-fragments were sampled from pre-existing *lacunae* in the right and central panels, collecting both the preparation and painted layers and documenting the surface at high magnification with digital portable microscopy (DM). Optical microscopy (OM) and ESEM-EDX analyses in cross-section aimed to the identification of both the constituting materials of preparation and the pictorial layers, while organic compounds were analysed by means of FT-IR and GC-MS.

In parallel, the research group proceeded towards the direction of the visual examination of paintings produced in Florence in the same period, especially those by Niccolò di Pietro Gerini and in particular the *Deposition of Christ* [8] currently under restoration at the OPD, Florence. Furthermore, in the framework of the ARCHLAB transnational access of the CHARISMA Project [9], a comparative study was run with the scientific results (mainly from cross-sections, microphotographs, SEM-EDX analyses and a limited number of GC-MS analyses) stored in the NGL databases and diagnostic investigation reports. In particular, the attention was focused on scientific evidence of painting materials and techniques of a wide selection of Masters contemporary to Giovanni del Biondo, very well represented in the NGL collections, including Niccolò di Pietro Gerini, Jacopo di Cione, Agnolo Gaddi, Nardo di Cione, Andrea di Bonaiuto da Firenze, Barnaba da Modena.

RESULTS

According to the data obtained, the preparation layer is composed by gypsum ($CaSO_4.2H_2O$) with some crystals of celestine ($SrSO_4$) mixed with animal glue. Indeed two preparation layers are distinguished by the granulometry of gypsum (*gesso grosso* and *gesso fine*) (Fig. 2a-b).

In the right panel, all the blue areas are composed by lapis lazuli, which was mixed either with lead white or lead tin yellow in the various bluish and greenish hues. The only green area showing a different material is in the bottom side of the central panel, where a copper based green pigment was found. For the red colour cinnabar was used and, for some special effects, as in the robe of St Mary Madgalene minium was added to cinnabar (Fig. 2c-d).

The binding medium of the pictorial layer is egg yolk based, as confirmed from FT-IR and GC-MS analyses (Fig. 2e-f).
The golden leaves were applied on red Armenian Bole for the ground or directly on the pictorial layer for the decoration of mantles. Silver leaves, now heavily tarnished, used for some details such as swords were also applied on Armenian bole.
In the *predella*, the only blue area not consisting of lapis lazuli, is the robe of the Saint on the left side of the left part, as well as the retouched areas of the Madonna's robe.
The comparative study based on the scientific databases available at NGL allowed us to highlight an important feature of Giovanni del Biondo's technique, i.e. the extreme simplicity of the microstratigraphy characterizing all the painted areas sampled from the *Annunciation and Saints*. In the Florentine polyptych, Del Biondo did not use complex superimpositions of different layers to obtain specific pictorial effects in the areas analysed (i.e. red, blue, yellow-green, orange, pink) as found, for instance, in Agnolo Gaddi's *Coronation of the Virgin* in the NGL collections. The latter shows a completely different surface appearance compared to the pictorial quality of del Biondo's polyptych. The evidence that the *Annunciation and Saints* is a quite 'simple' painting technique in microstratigraphic terms is certainly a technical element to think about carefully. The surface appearance of this polyptych like an illumination is coupled with a direct use of thin and almost pure paint layers.

CONCLUSIONS

The outcomes from the multidisciplinary diagnostic campaign conducted on the polyptych of Galleria dell'Accademia and the comparative study carried out at NGL jointly enhance the painting skills of Giovanni del Biondo. He reached an impressive aesthetic result by making the best out of the egg-tempera technique. At this stage of our investigation, we can robustly state that del Biondo's polyptych is demonstrative of a generation of painters who were bringing the egg-tempera technique to high level of quality at the turn of the 14th century. Further advances are expected from the current research aimed to contextualize this painting in the broader artistic environment of the 14th-15th century Florence.

ACKNOWLEDGEMENTS

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Fig. 1 – (a) Annunciation and Saints by Giovanni del Biondo in the Galleria dell'Accademia, Florence; (b) detail of St Mary Madgalene; detail of the right bottom corner prior (c) and after (d) the temporary removal of the twisted columns (photo credit: D. Tapete).

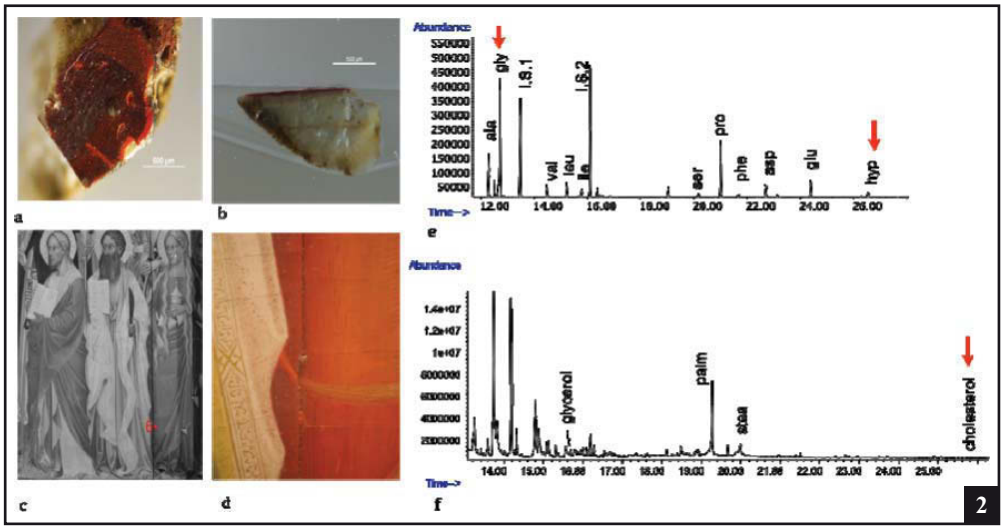

Fig. 2 – (a) Micro-fragment and b) cross-section of GdB_6 sample collected from c) the right panel, d) the red robe of St Mary Magdalene (cf. Fig. 1b). (e) GC-MS chromatogram with aminoacids analysis and (f) pyrogram with fatty acid analysis.

TECHNIQUE OF THE MURAL PAINTINGS OF THE HOSPITAL CHURCH IN HOREZU MONASTERY , ROMANIA

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ABSTRACT

This paper deals with the technique of mural paintings which cover the interior wall of the Hospital Church (hereafter Bolniţa) of Horezu Monastery in Romania (Fig. 1a, 1b), constructed in the last years of the 17th century. The original paintings being better conserved, Bolniţa of Horezu is one of the least modified parts in the whole monastery complex, known as Romanian world heritage property of UNESCO. These mural paintings basically followed the medieval texts of painting technique, known to us through Theophilus[1] or Dionysios[2], which had given thin and fewer painting layers with earthen pigments.
Close observation and chemical analysis of the painting have shown that the painting techniques of Bolniţa are classified in 3 types (*Buon fresco, Mezzo fresco, Secco*), and that the way of their application was quite consistent. It is significant that this high standard of medieval painting technique had been maintained for centuries in the area of cultural mixture which might have effected on the field of the mural painting. On the other hand, some particular decorations on the traditional frescoes were observed, especially in the west part of the church.
The mural painting of Bolniţa gives an interesting example of consistency in medieval painting technique. This study has clarified 3 types of painting techniques in Bolniţa on the basis of identification of inorganic materials, including rare materials for mural painting such as silver foil.

Keywords: Mural painting, Hospital church, Horezu monastery, Romania

INTRODUCTION

Hospital churches were originally small chapels attached to the sanatorium of Orthodox monasteries. Those chapels for aged or sick monks became independent churches under the Principality of Wallachia (1330-1859). With the diffusion of advanced medicine, the sanatorium itself became an independent institution, while hospital churches remained as modest religious attachment to the monastery. Being used by particular monks as solitary place for the last period of life, hospital churches had been left aside from occasional renovations or decorative interventions in later periods. As consequence, their original paintings by chance were preserved well and Bolniţa of Horezu is an outstanding example of it.
The entire interior surface of hospital church of Horezu was decorated with a series of mural paintings, which, on the basis of painting technique, can be classified into 3 groups: *Buon fresco,* which use pigment diluted into water and paint on wall before its drying; *Mezzo fresco,* to paint on either wet or dried wall with pigment mixed with lime and lime water; and *Secco,* to paint on dried wall with pigment mixed with binding media and watered in diluent. Although these 3 types of painting techniques have long been known among painters, scientific studies and relevant analytical information have been quite limited, especially relating to the distinction of those 3 techniques in examples of mural paintings during late-medieval era in Balkan. This study aims at clarifying scientific difference of these 3 painting techniques, and analyzing materials used for mural paintings in Bolniţa. On the basis of chronological and historical studies of art, this study has been developed to the wider comparative research of survey and chemical analysis of materials, including five hospital churches (Cozia, Polovragi, Bistriţa, Ostrov, Brâncoveni) and other churches which constructed under Wallachian rule.

METHODS

Optical imaging survey was carried out applying the following instruments: 3D-scanner (Riegl VZ400), Digital camera (Nikon D700 / Ricoh GXR), Portable Microscope (Sugitoh).
The process of chemical analysis is as follows: after close observation and on-the-spot analysis by XRF, samples were taken from other churches (Cozia and Ostrov) and analyzed by XRD (X Ray Diffraction) and EPMA (Electron Probe Micro Analyser). Some of samples were further examined by MDG (Micro

Diffract Goniometer). As supplementary analysis of painting techniques, the head author of this article made 9 samples using each of 3 techniques (6 samples using different kind of binding media were made for *Secco* technique, as organic materials of original painting have not yet been identified) and compared them with original samples.

OUTCOMES

Analyses of samples made by the head author show that the 3 types of painting techniques differ from each other in composition of calcium (main component of mortar) and pigment (Tab. 1). In sample T1, *Buon fresco* technique, a clear layer of calcium is observed on the pigment layer, which may properly be concluded to be transparent calcite layer. Sample T2, *Mezzo fresco* technique, shows calcium content in whole layers, which means that the pigment was sufficiently mixed with calcium before its application to the surface. In sample T3, *Secco* technique, the pigment layer is observed totaly separated from the supporting layer. An additional careful observation on the pigment components shows a difference in density which comes from the difference of procedure. T1 shows highest detection and T3 follows to it, while pigment layer of T2 is low in density and it is even difficult to identify the layer itself.

Following this result, the original samples are analysed in the same way, and it has been clarified that all samples have *Buon fresco* layer in the deepest part, which can be considered as an underdrawing layer. And after that, a colouring layer comes over it, from *Mezzo fresco* to *Secco* painting, decorating without being tied to time. The *Mezzo fresco* technique generally shows better adhesion applying on wet mortar, though it seems that lime is used simply as a white colour, without taking due consideration of the wall condition.

Tab.2a shows inorganic materials used for mural painting in Bolniţa. Lead-tin-yellow was detected in two churches (Cozia and Ostrov) which were examined for comparative studies. Decoration of clothes in naos or porch in those two churches, with all 3 types of painting techniques, contained lead-tin-yellow, which has not been observed in Bolniţa of Horezu. Alternatively, silver foil decoration was found only in Horezu (Bolniţa and Sf.Apostoli church). This decorative method is particularly characteristic in Bolniţa (Fig. 1c), as whole part of clothes of votive family and patrons are covered with silver foil, extending to the entire lower part of the western wall of the naos. Today we see all these silver foils oxidized and weared in black. But applying microscope, unoxidized silver foils are clearly observed and SEM images also prove that those parts have one or two layers of silver foil (Tab. 2b). The surface of silver foils was chloridated, the reason of which is yet to be studied.

The color of the underlayer of the foil is not dark as usual in case of silver foils. Instead it is a mixed red layer of minium and iron-oxide-red. Another exception is that silver foils bear a decoration of fine pattern of carbon black which is rarely seen on mural paintings. We know that medieval masters had already mentioned the defect of silver foils which are not suitable to be used in mural paintings because of discoloring oxidation. Despite of this common knowledge at the time of painting, the silver foil decoration was selected and put in practice, probably because painters in charge had no other choice to depict founders and nobles decorated in an exceptional gorgeous way. We may logically presume that certain economic problem went on during the construction of the monastery. Comparing four churches built in the Horezu complex, we observe the votive image in the first one, Main church, was decorated with plenty of gold leaves, while St. Apostle's church and Bolniţa were left decorated less gold leaves, silver foil and partially with fine patterns of red or green for clothes. In the last one, St. Stefan's church, the greater part was decorated with fine pattern of inorganic pigments. As far as the aureole is concerned, yellow ocre as the imitation of gold became more commonly used in the later examples. Beside the possibility of economical depression along with the construction, we may well suppose a probable transition of technique and style, which may be corroborated by the fact that the clothes of saints and nobles had already plentifully been decorated with fine patterns of inorganic materials or lime white even in older examples in Serbia or in Macedonia.

Concerning the red pigment, the iron-oxide-red was most extensively used. Minium was used for detail decoration of clothes in the naos, and was frequently applied for underlayer of metallic foils, mixed with iron-oxide-red or lead-tin-yellow. The color of the red underlayer seems to have had relation with the iconography of the decoration: stars and aureole should have bluish red underlayer, using iron-oxide-red as a main pigment; crowns, clothes or other fine decorations should be backed up with

yellowish red underlayer, using minium or lead-tin-yellow. The brilliant minium colour was rationally decided not to be used for surface decoration. It was well known from the medieval time that the minium was not suitable for the mural painting, and whole part of minium decorated surface had been turned black of lead dioxide.

In all churches surveyed in this study, main pigment for blue colour was smalt. Tab. 3 shows composition of the pigment samples analyzed by EPMA, including smalt of Zecchi and Kremer product in comparison. The smalt of Cozia and Horezu have been proved to contain impurities which are components of smaltite, which is the largest difference from modern industrialized smalt[3]. Between smalt of Cozia and Horezu, there is a clear difference in production process: Cozia using soda glass which contains sodium instead of potassium, and colouring with cobalt; Horezu using so called cobalt glass colouring with cobalt oxide.

The mural paintings of Bolniţa were painted mostly by creating layers of single pigments, and there are only few layers of mixed pigments.

CONCLUSIONS

On the cultural crossroads of Western and Eastern Europe of the medieval age, relatively stable principality of Wallachia inherited and integrated Roman artistic-cultural tradition and Greek spirit of Orthodox Church. Mural paintings decorating Wallachian churches were basically painted as follows: *Buon fresco* for the first pigment layer, and then *Mezzo fresco* and *Secco* techniques for detail colouring layer, all in reasonable and consistent way. The decoration was as modest and simple as possible in the 'holy of holies' space, using only few pigments known from older times, while in the porch and naos, the decoration became more vivid and challenging, using minium as fine decoration or making from 3 to 6 layers with single pigments. Analysis on lead-tin-yellow or smalt pigment has shown that each monastery or painter's group had different textual principle in producing pigments. Application of silver foil and distinction of red underlayer of metallic foil were quite unique in technique.

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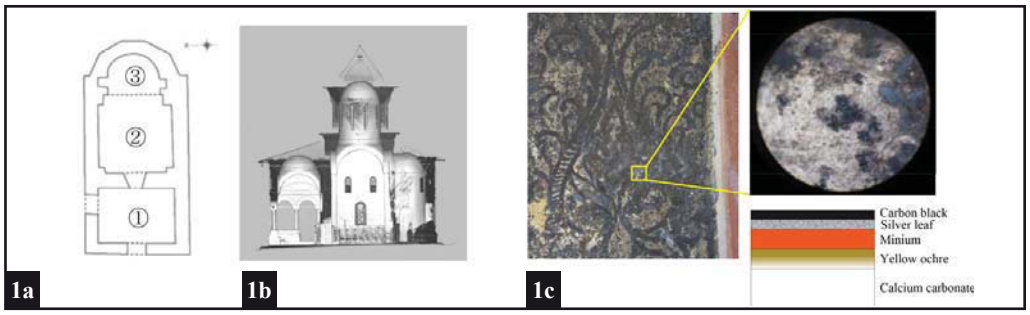
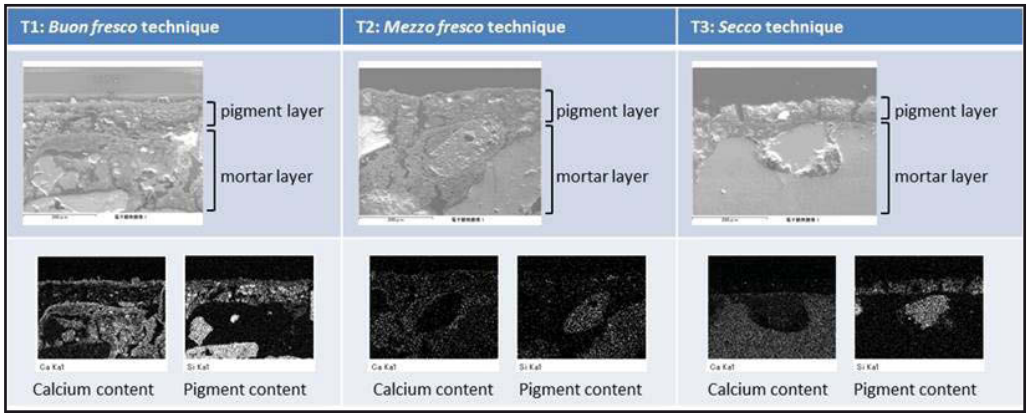
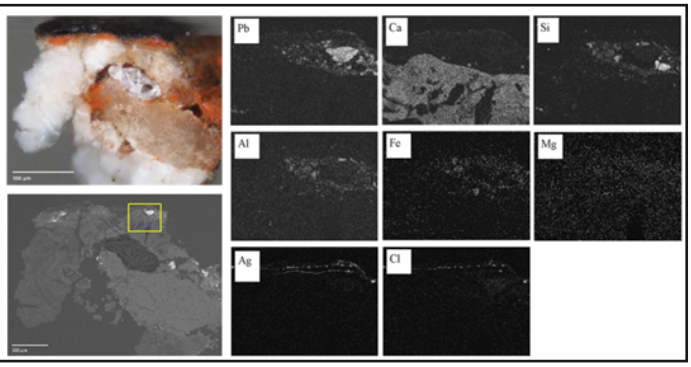


Fig. 1 – 1a- Ground plan of Horezu Hospital church (1 porch, 2 naos, 3 holy of holies), 1b- Elevation of Horezu Hospital church, 1c- Silver foil



Tab. 1 – SEM image of three painting techniques

	HOREZU	Comparison Churches
Blue	Smalt Azurite	Smalt
Red	Iron Oxide Red Minium	Iron Oxide Red Minium
Yellow	Yellow Ochre	Yellow Ochre Lead Tin Yellow
Green	Green Earth Malachite	Green Earth Malachite
White	Calcium Hydroxide	Calcium Hydroxide
Black	Carbon Black	Carbon Black
Metallic foil	Gold Leaf Silver Foil	Gold Leaf



Tab.2a (left) – Materials used for mural painting, Tab.2b (right) – SEM image of silver foil decoration

Sample	SiO_2	K_2O	CoO	As_2O_3	Fe_2O_3	Oxide of Al, Ca, Ni,Bi
Horezu 1	73.2-75.0	12.9-15.0	1.8-2.2	1.8-3.1	2.3-2.4	0.6-1.4 (Na_2O0.7-0.9)
Horezu 2	76.3-77.3	13.3-13.4	1.4-1.5	1.4-2.3	1.4-1.5	0.5-1.4 (Na_2O0.3)
Cozia 1	57.2-66.4	0.6-1.0	5.5-6.7	11.8-13.7	3.5-4.2	0.1-5.3 (PbO 0.9-3.0)
Cozia 2	54.9-60.5	0.5-0.9	4.9-6.2	9.5-13.1	3.2-3.5	0.3-1.4 (PbO 7.9-1.0)
Zecchi	76.4-81.3	7.0-14.7	8.7-11.4	-	-	-
Kremer	69.1-74.6	15.5-17.1	9.2-13.7	-	-	-

Tab. 3 – Composition of Smalt

GOTHIC CANVAS PAINTING: AN EXAMPLE OF TECHNOLOGY RESPONDING TO REQUIRMENTS OF THE LITURGY

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ABSTRACT

Materials and technological characteristics of large-scale canvas painting *The Assumption from White Mountain* (around 1450), National Gallery in Prague, have been described with the aim to determine the origin of the artwork. Application of traditional medieaval pigments, execution only the *imprimitura* instead of conventional ground layer and the shape and distribution of cracks comfirmed finally that the painting is original, not transferred, not a copy, and was probably used as a portable painting within Christian liturgy. The simplified technology of making was responding (as in other similar cases) to initially intended temporary usage of these paintings as fasting canvases, flags in liturgical processions, imitation of tapestries etc., and lead to generally worst state of their preservation with respect to more frequent wooden panels.

Keywords: Gothic canvas painting, Tüchleinmalerei, imprimitura, materials research

INTRODUCTION

Until the period of Italian Renaissance the wooden panels represented the most frequent painting supports in the whole Europe. However, much earlier than the oil became the most applied binder, paintings on canvas existed. Their relatively worst state of preservation (in comparison with much more frequent Gothic panels) is directly related with simplified technology of making responding to their initially intended temporary usage – as fasting canvases, flags in liturgical processions, imitation of tapestries etc. [1] A comparison with paintings on panel in terms of the painting's structure is not easy, since an artist does not work on canvas with a white reflective surface as the ground material, but has to construct the painting quite differently technologically. On canvas it is not possible to execute an effective poliment for the gilding, which requires a thick chalk or gesso ground. In this respect, the Gothic painting on canvas is reminiscent of a rather more modest rendering of the reverse side of altar wings, where the ground layer is thin, the paint layer more glaze-like and the gilding is in some cases either oil or replaced with ochre. Koller (1988) quotes Vasari from 1550 [2], who justified the use of canvas supports by the painting's mobility: '*... a canvas weighs little and at the same time is easy to transfer. They are worked up in oil so that they remain flexible, they are not primed with gesso for gesso would fall off during rolling…And since this method turned out to be agreeable and convenient, not only smaller transportable paintings are done, but also altar pieces and large historical paintings, as we can see in the halls of St. Mark's palace in Venice and elsewhere*.'

The oldest accounts of the use of fabrics as portable supports are probably those given in Heraclius' manuscript (12th century). Canvas impregnated with sheepskin size, without priming, was apparently laid out on a moistened board and, after drying, smoothed out with a piece of glass and attached to a wooden frame with fibre fastening. On such a prepared canvas it is possible to apply pigments bound with glue, egg or arabic gum. The oldest paintings were painted on silk or delicate linen canvas. Another preserved record comes from England from the 12th century; in the 14th and 15th centuries their production clearly increased. Recipes imported from London were circulated around France and Netherlands. There is a record from 1355 which describes canvases in St. Francis's church in Trevos and in a Minorite monastery in Venice. [2,3] Also in the middle of the 14th century and in the 15th century paintings on canvas, so-called *Tüchleinmalerei*, commonly appeared in Germany and the Netherlands. The paintings were carried out on a very fine canvas in water soluble paint, without a ground. In Italy a Venetian manuscript preserved from the first half

of the 15th century describes the preparation of raw materials for painting with water colours on fabrics. Also at that time, Cennino Cennini (1437) in Florence [4] supplied precise instructions for painting on canvas or on taffeta. In the 16th century "classic" oil painting on canvas started to spread from Venice across Italy to the whole of Europe.

The worst state of preservation of Gothic canvas paintings is one of reasons of their relative rarity in contemporary collections of European museums and galleries. If one is not familiar with a special technology of their making, could mistakenly interpret their origin – like in the case of the painting *The Assumption from White Mountain* (around 1450), National Gallery in Prague, which is particularly discussed in this contribution.(Fig. 1)

AIMS AND METHODS

The aim of this work was to describe materials and technological characteristics with respect to the origin of the above mentioned relatively large-scale canvas painting that was bought as „a late Renaissance copy of an unknown Bohemian Madonna" in 1921 by Vincenc Kramář for the National Gallery collections in Prague. No source of information about its provenance was known. The widespread and much discussed opinion among experts was that the painting was a Mannerist copy of a medieval work. This opinion was supported by the conservation research carried out in the National Gallery at the end of the 1950s and early 1960s. The other discussed question was the possibility of secondary transfer of the painting from wooden panel to canvas.

Because of many persisting doubts the painting was again subjected to examination in 2006 and 2014. Imaging methods (IR rephlectography and X-ray radiography) were combined with detailed microanalytical research on microsamples and their cross-sections embedded in polyester resin.

RESULTS

New materials analyses were compared with the findings already done on the samples in 1960s. New descriptions of the layer stratigraphy proved that no fragment of any chalk ground is present either in the newly taken samples or in the previous samples newly interpreted. A bottom layer which had been previously identified as a very thin (0.015 – 0.03 mm) grey-brown ground is most probably a protein-containing isolating layer – an *imprimitura*, which overlays a black preparatory drawing in brush. (Figs. 2, 3) [5] The *imprimitura* contains a small admixture of white lead, chalk, and, in places, earths as well. The missing ground prompts speculation as to whether it is a transfer from a panel painting. A well-preserved black under-drawing observed on the entire surface of the painting, and the nature of the paint layer, which flows perfectly around the yarn of the canvas, rules out this speculation. The 138.5 x 103 cm linen canvas is made up of three parts and is very fine (thickness of yarn is 0.3 – 0.4 mm) and densely woven (approx 16 x 18 threads/ cm^2).

Secondary materials – glue, starch, resin and wax – introduced very invasively to the painting during its previous conservation, make identification of the binders of the colour layers more difficult. For this reason it is not possible to unequivocally distinguish whether it is fatty tempera or oil. The pigments used correspond to a Gothic palette: the black is carbon-based or bone, the carbon-based is for the most part represented in the under-drawing. The blue pigment is finely ground natural azurite (as confirmed by admixtures of As-containing minerals). The red drapery of the angel is painted with a mixture of minium and cinnabar. The palette also contains iron red, white lead and chalk, green with typical verdigris often tinged with lead-tin yellow type I. Yellow ochres were also identified in the ground under the gilding. The gilding was executed on oil which corresponds to the chosen support – canvas. The absence of a ground has the effect that the combination of white lead with darkened azurite in the background gives a contrasting impression. The improperly chosen wax-resin relining, applied during former restoration, plays a part in darkening the colouring and increasing the contrasting visual impression from the painting. By a micro-structural analysis it was established that the lower layers are more noticeably cracked than the upper glazes. Also, the older glue-starch relining paste had seeped through into these cracks. These numerous areas of cracking, especially of the lower layers, could suggest that the canvas was sometimes rolled up and transported as a portable painting.

The main problem is the lack of other comparative paintings in the region, painted in the same style and technology. Iconographically it tallies with other Assumptions on a half-moon from the first half of the 15th century but it shows more conservative characteristics in conception and, of course, all the other ones are painted on the panel. Bartlová (2002-2003) draws attention to the existence of

other paintings on canvas from the 15th century in the nearby cultural sphere. [1] In the Šariš museum in Bardejov, Slovakia, there is a small-scale (91 x 73 cm) painting '*The death of St. Acacius and the 10,000 martyrs of Mt. Ararat'*, originating from St. Egidius' church in Bardejov. The similarity to the *Assumption from White Mountain* is in the absence of the ground, and the presence of an *imprimitura* on the comparatively coarse linen canvas, and also in the identical content of a fatty binder of the paint layer. The painter's interpretation, compared to the Assumption, is more schematic. A question remains about the original function of the painting. It could have been provisionally positioned on an altar of a newly built church before a representative altar piece had been prepared.

CONCLUSIONS

It is possible to classify the *Assumption from White Mountain* among artworks painted on canvas during the Gothic period – traditional pigments were used, the conventional ground layer is missing, the shape and distribution of cracks suggest that the canvas was sometimes rolled up and transported as a portable painting. It is also evident that there are in existence other paintings painted on canvas without any ground both with a water soluble binder and with a medium containing oil. Mobility, simplicity and speed during their production at the time probably gave rise to the appearance of these Gothic canvases, responding to the temporary needs of the Christian liturgy.

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Fig. 1 – Assumption from White Mountain, 138.5 x 103 cm, oil or fatty tempera on linen canvas, National Gallery in Prague (photo M. Pavlíková)

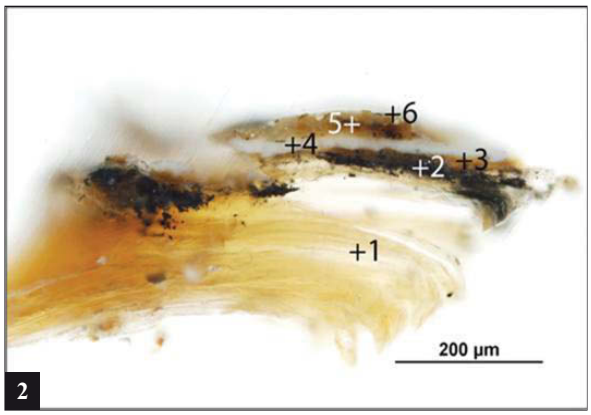

Fig. 2 – Micro-section of the sample of gilding in reflected visible light; simplified description of layer stratigraphy: 1-canvas, 2-underdrawing, 3-imprimitura, 4-painting, 5-ground for oil gilding (mordant), 6-gold leafs

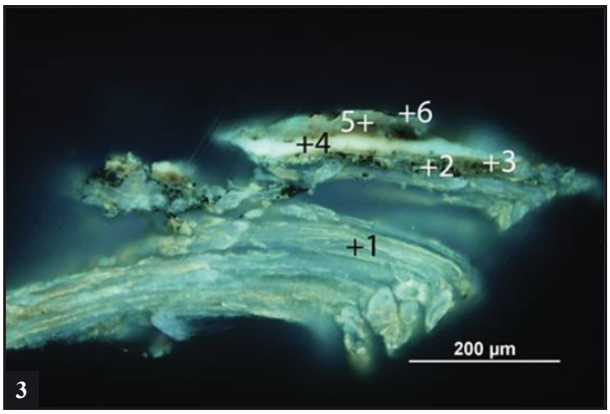

Fig. 3 – Micro-section of the sample of gilding in UV light; for the description of layer stratigraphy see Fig. 2

THE NATIVITY BY AMBROGIO DELLA ROBBIA: A MULTIDISCIPLINARY APPROACH TO THE CONSERVATION OF POLYCHROME TERRACOTTA SCULPTURES

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ABSTRACT

Polychrome terracotta sculptures are very complex artworks and a multidisciplinary approach, concerning both historical artistic and material knowledge, is necessary to perform a proper restoration work. Non invasive techniques have to be preferred because they provide a great amount of information without damaging the surfaces and allow to plan the subsequent sampling. Indeed, some micro-invasive analyses have to be performed in order to characterize stratigraphy and the binding media of the layers thus defining the working technique of the artist. The study of the Nativity group allowed restoring the sculptures maintaining the spiritual integrity of the object; in this way the light effects, scenic qualities necessary to recreate a visual and mystical bond among the sculpture, the spectator and the surrounding architectural decoration of the church desired by Fra'Ambrogio have not been lost.

Keywords: polychrome terracotta statues, Portable XRF, FORS, Raman.

INTRODUCTION

Andrea della Robbia' son, Francesco (Frà Ambrogio) received the Dominican cloak in 1495 directly from the hands of Savonarola. Probably involved in the workshop of his father from the beginning, his activity is documented only after 1508 (Fig. 1). The *Presepe* is a visual testimony of the strong bonds between Francesco and the Dominicans, as well as the only documented autonomous work conserved almost totally complete, missing only the Christ Child which was stolen more than twenty years ago. The work, executed in 1504, when Francesco was in the convent of Santo Spirito, appears to aspire towards a monumental articulation and a robust plasticism based on the painted models of Fra Bartolomeo and Mariotto Albertinelli, who were the principal promoters of the "School of San Marco." In the somber humility of the painted terracotta, not glazed, the words of Savonarola have favored a religious art of natural and domestic overtures. [1, 2, 3]

The surface of the sculpture obtained by the use of cold finishing applied on the terracotta substrate has revealed a complex decorative scheme due to the extremely fragmented state of the individual sculptures and the over-paint applied over a period of many hundreds of years. The stratigraphy of polychrome terracotta sculptures is complex, mainly due to the presence of multiple layers: paint, priming and ground spread on a porous material substrate. Furthermore, for their religious value, these sculptures were often re-painted to enhance the polychromy. The aim of this work is to assess advantages and drawbacks of the non-invasive techniques (X-ray fluorescence, visible reflectance spectroscopy, optical microscopy) compared with the micro-destructive ones (scanning electron microscopy, μRaman spectroscopy, Fourier Transform Infrared spectroscopy) to deal with three main conservation steps: the characterization of the painting layers, the monitoring the artwork's state of conservation [4] and the support to the restoration procedures during the removal of the over-painted layers and protective coatings (Fig. 2).

MATERIALS AND METHODS

Optical microscopy

The observations were carried out by means of a digital portable microscope Scalar DG2A with optical zoom 25–200×. The images were acquired at 25× (investigated area 13 × 8 mm) at 50×(investigated area 6.5 × 4 mm) and at 100× (investigated area of 3.2 × 2 mm). Images were acquired on both differently coloured areas and on the portions characterised by evident signs of alteration of the polychrome surface, such as holes, abrasions, losses, etc.

X-Ray fluorescence (EDXRF)
EDXRF analyses were performed by means of a portable spectrometer with a Tantalum X-ray tube (Innovix Systems) working at 15 kV and 7 μA or 40 kV and 6.5 μA. The fluorescence X-rays are detected by a thermoelectrically cooled SiPiN detector with an energy resolution better than 230 eV at 5.9 KeV to Mn K_{α}. The analyses were carried out with the X-ray tube working at 40 kV over a measuring time of 70s.
Fiber Optic Reflectance Spectroscopy (FORS)
Reflectance spectra were acquired in the spectral range 350nm-900nm, using a tungsten lamp as light source, and a spectrometer equipped with fiber optics bundles (Ocean Optic mod.HR2000). A measurement head with illumination at 0° and signal collection at 2x45° allowed the acquisition of reflectance spectra pertaining to an area of approximately 2mm.
μ-Raman spectroscopy
Analyses were carried out with a Labram HR800 dispersive Raman spectrometer equipped with 600, 1800, 2400 grooves/mm gratings and coupled to an Olympus BX41microscope with 10×, 20×, 50× and 100× objectives. Exciting lines used are 785 nm (Laser XTRA from Toptica Photonics) and 514 nm (Laser Ar+ Stabilite 2017 from Spectra Physics), with a Peltier-cooled CCD detector (1024 × 256 pixels). The analyses were carried out on polished cross sections.
Fourier Transfor Infrared spectroscopy FTIR
FTIR spectra were recorded by using a spectrometer Perkin-Elmer System 2000 in the range of 4000-400 cm^{-1} at a resolution of 4 cm^{-1} and 4 scans. The samples were analysed in transmission mode, using KBr pellets. The acquired spectra have been elaborated using *Spectrum* by PE.
Scanning electron microscopy equipped with energy-dispersive X-ray microanalysis
Investigations were carried out by a JEOL 5910LV microscope equipped with an X-ray spectrometer IXRF Systems/EDS 2000. Observations have been performed on polished cross sections using backscattered electrons (BES). The specimens' chamber was maintained in low vacuum and accelerating voltage was 20 keV. The EDX qualitative spectra of squared areas or spots were registered from 0 to 20 keV and at 1–3 × 10^{-7}A.

RESULTS

Artistic and cultural evaluation

The Nativity group, consisting of approximately life-size polychrome terracotta figures, is signed and dated directly through incision by Fra' Ambrogio della Robbia. The restoration procedure and the diagnostic campaign offered an unique opportunity to explore different technical problems and methodological solutions, associated with the enhancement of the cultural and art historical integrity of a group of sculptures within its own religious context. The extremely fragmented state of the individual sculptures, the heavy over-paints and the loss of the Christ Child figure, were the main factors determining the need of a critical methodology for sculptural, structural and in-painting integration used in this global restoration project. Due to the specific intention of maintaining the spiritual integrity of the nativity group, decisions regarding the restoration works were made being aware that the artwork was originally conceived of as a personal artistic expression aimed to evoke spirituality viewed only by fellow friars within the context of the church. The heavy loss of original modeled volumes as a result of continuous negligence, vandalism, theft, the overpaints, the poor restoration treatments executed in the past and the inevitable disregard and final crumbling, left each sculpture in a totally deplorable and unrecognizable state.
The restoration was addressed towards seeking out theoretically proper technical solutions to restore both the structural and aesthetic integrity of each figure. Most importantly, efforts were aimed towards the reestablishment of the fluidity of the biblical narrative, perceivable through the placement of the figures and of the quality of painted and patinated surfaces. Moreover, the aim was to focus the attention on the light effects, scenic qualities necessary to recreate a visual and mystical bond among the sculpture, the spectator and the surrounding architectural decoration of the church.
Results obtained during the conservation works by means of chemical/physical analyses and art historical research, shed new light on the materials and on the painting techniques of Fra' Ambrogio della Robbia, placing the work within an historical context of the technical development of Florentine painted terracotta sculpture. The systematic removal of over-paints and gypsum integrations revealed more than 75% of the extant and extremely refined modeling and polychromy. An

autobiographic calligraphy of surface modeling and a use of a limited palette of color to produce highly expressive individual brush marks, characterize the artistic personality.

A very delicate final cleaning sought to maintain the effects of "chiaroscuro",signs of time, devotion and use through function, all present on the original modeled and painted surfaces, characterized by surface accretions and oxidized varnishes. These varnishes and tinted glaze layers were used by the artist as an integral part of the original painting technique: their distribution on the painted surfaces aid to create intensity and vibrancy of tone in a reciprocal relationship with the highly individualistic modeling of the terracotta substructure. These glazes are characterized by a darkened patina unperceptively layered and seeped within the depressions of brush strokes of the original paint.

Structural integrations were executed on several figures for the need to consolidate the heavy weakened modeled volumes as well as to permit each figure to stand upright and to eliminate the general fragmentary sense compensating the image and color of the remaining original parts. The use of traditional modeling and surface finishing techniques used to integrate the missing parts are abstractions drawn from other prototype figures. Contemporary interpretation of the surface working of the modeling techniques used by the original artist aided in reconstructing the missing volumes of the lower part of the Virgin Mary, perfectly removable. Since each sculpture was originally conceived as an individual and movable entity, the techniques and devices used for integrating the missing structural parts, including the mounting device for each figure, were developed to facilitate eventual dismantling and movement at any time.

Analytical, diagnostic and intervention methodologies

On the carbonatic terracotta surface two different ground layers have been detected: the first one consists of gypsum and a proteinaceous organic compound, the second one of lead white spread by linseed oil. The paint palette is mainly characterized by two tones, blue and red, employed to obtain red, flesh, yellow and brown hues. In order to preserve the integrity of the sculptures, a first non-invasive investigation by portable techniques was carried out. Optical microscopy and FORS were employed to identify and mapping most of the pigments on the external surface, while the spectra acquired by EDXRF provided information about the composition of inorganic materials both of the surface and subsurface. The interpretation of the data acquired allowed addressing the sampling. The stratigraphy investigation of a blue micro fragment sampled from the St. Joseph jacket highlighted a stratigraphic sequence of seven layers (Fig. 3). From the ground layer, obtained by a mixture of lead white and linseed oil, two blue layers have been detected: the innermost is obtained by azurite while the other one by a mixture of smalt blue and indigo. All pigments were mixed with lead white and linseed oil. A white barium layer separates three more blue layers applied over the first two. From the innermost to the outer, the layer were obtained by a mixture of white lime, oil and respectively Prussian blue, Scheele's green and Thenard's Blue; all these pigment have been introduced between 1700 and the early 1800 's. The red tones and the flesh hues were obtained by a mixture of cinnabar, lead white and oil and plus or minus ochre. Moreover, on the faces, hands or animal fur, an upper beige-pinkish coloured layer, due to a mixture of barium sulphate and zinc sulphur (Lithopone) charged with ochre has been detected. The presence of such white pigment dates the re-painting at the end of 1800. FORS and EDXRF spectra recorded on the red external surfaces suggested the presence of cadmium red, a modern pigment whose commercial production started about in 1910. The yellow and brown tones were obtained by natural earth; in particular in the shepherd with bagpipe statue FORS identified raw sienna, while in the brownish hue the presence of the manganese signal in EDXRF spectra suggested the use of burnt sienna. On the external surface of another shepherd, chrome yellow was detected: even in this case it dates from the beginning of the XIXth century. Remains of a gilding were identified on the neckline of the red dress of the Virgin Mary (Fig. 4) while the removal of the opaque brown re-painting layer on the bagpipe of a shepherd highlighted the presence of a check pattern obtained by a tin leaf. Regarding the organic binders, the linseed oil was widely used while the protein component was detected only in correspondence of the gypsum ground layers. The glossy effect of the external surfaces is due to the presence of a terpenic paint.

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Fig. 1 – The Nativity group after restoration work.

Fig. 3 – Micro-fragment sampled from the St. Joseph blue jacket. Sample's cross section in visible and UV light are shown. In the stratigraphy is visible the sequence of the several retouching blue painting layers.

Fig. 2 – Virgin Mary statue: removal of the over-painted layer

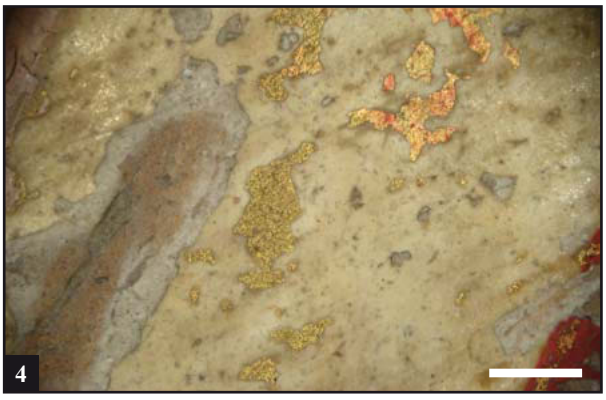

Fig. 4 – Portable optical microscope's high magnification images of few remains of a gilding on the necklace of Virgin Mary (bar=2mm)

MICRO-RAMAN ANALYSIS OF EARLY CHRISTIAN FRESCOES IN EGYPT

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ABSTRACT

The early Christian cemetery in Egypt is located at Kharga Oasis in the western desert. The cemetery consists of 263 mud-brick chapels dating back to the 4th century AD. In the present study, micro-Raman analysis was used to study micro samples from the paint layers of the chapels murals. Raman spectra were collected in the near infra red excitation line (785nm) of a diode laser source. The identified pigments were red ochre (hematite) with different tonalities, yellow ochre (goethite), green earth and carbon black from vegetable origin. A high quantity of TiO_2 anatase phase was found in the red pigment samples. The analyses showed the continuous presence of calcium carbonate (calcite polymorph) in the underlying layers accomplished with the absence of organic materials confirm the use of fresco technique.

Keywords: Christian Frescoes, Kharga Oasis, Egypt, Micro-Raman

INTRODUCTION

The early Christian necropolis of El-Bagawt is located about 3km from the centre of El-Kharga Oasis in the western desert of Egypt. Kharga Oasis is located to the west of the Nile valley, about 550 km to the South of Cairo. El-Bagawat is perhaps the oldest major Christian cemetery in the world; it consists of a vast expanse of domed mud brick mausoleums and underground galleries dating back to the 4th century AD, which were built over the site of an earlier Egyptian necropolis of pit graves. As a burial ground, El-Bagawat appears to have been in constant use until the 11th century, although the mud brick structures date only up to the 7th century [1, 2]. The architectural style of the 263 tomb-chapels varies from simple one-room structures to family mausoleums with ornate façades enhanced with faux columns and arches and domed roofs. The chapels were arranged in 'streets' and interconnecting narrow alleyways, making this one of the earliest (cities of the dead). Although many of the chapels were undecorated and consisted simply of a single chamber built over the tomb shaft, some were much more elaborate and contained plastered walls with painted biblical scenes in a strange mixture of styles while others have elements reminiscent of earlier Egyptian architecture. Two of the most outstanding and best preserved of the decorated chapels are named 'Chapel of the Exodus' and 'Chapel of Peace'. In recent decades, Raman spectroscopy showed several advantages in analysis of ancient painting materials. It has been successfully applied to study ancient Egyptian pigments and wall paintings [3,4]. This technique is a non-destructive because little sample preparation is required or no sampling in case of micro-Raman. The objectives in micro-Raman allow the laser radiation to be focused on a 1-3 μm spot typically in the visible region (in the infrared the spot size is 10 μm and over), what is particularly useful for the identification of specific components in heterogeneous mixtures [5]. In the present study, we report the results obtained from the first Raman analysis applied to examine paint layer samples collected from early Christian frescoes (Chapels No. 25&210 at El Bagwat necropolis in Egypt) (Fig. 1).

MATERIALS AND METHODS

Samples

The mural paintings at El-Bagwat cemetery show a serious state of preservation. The main deterioration forms observed were cracking, fading, biofilms and complete detachments of the paint layers. Twelve samples (detached fragments with approx. dimensions 1x1.5 to 2x3 cm) and few grains (milligrams) represent the chromatic palette at the selected chapels (red, yellow, green and black colors) were carefully chosen for analysis.

Analytical methods

Optical microscopy

Preliminary observations on the samples were performed using an Olympus SZ-40

stereomicroscope (10 and 20x objectives) equipped with an Olympus DP10 digital camera. Optical observations on the cross-sections were carried out using an Olympus BX60 in reflection mode (with optical magnifications 50× to 500×) equipped with a JVC KY-F1030 digital camera.

Raman microspectroscopy

Raman spectra were recorded using a Renishaw InVia Raman spectrometer in the near infra red excitation line (785 nm) of a diode laser source. The instrument is equipped with Peltier cooled charge coupled device (CCD 576x400 pixels). A Leica DMLM microscope with a XYZ motorized stage with 200 and 500 magnification objectives is equipped to Raman spectrometer which can provide a sample irradiation diameter of up to 1 µm. A polarized unit system is mounted onto the microscope which offers a clear view of the area under investigation, necessary for positioning the beam on individual pigment particles. The lower laser powers (up to 0.5 mW) were used to avoid inducing thermal changes to the mineralogy of the iron oxide minerals. Typical exposure time of the CCD was 20s per scan, while normally 5 up to 20 accumulations were co-added to produce the final spectrum in order to improve the signal-to-noise ratios.

ESEM-EDX

The microstructure and microanalysis of the studied samples were analyzed by environmental scanning electron microscope model Philips XL-30 ESEM. The X-ray microanalysis was carried out using an EDX detector (EDAX, Apollo SDD 10) with 20 Kv accelerating voltage and pressure of 3.0 Torr. EDX data acquisition was obtained through GENESIS 6.x software. Microanalysis of single pigment grains down to 1 µm, as well as of the matrix and the total average of the paint layer were performed.

RESULTS

Microscopic examinations

The visual observation of the rough plaster samples under stereomicroscope showed heterogeneity and stiff structure the. Two layers can be easily distinguished, the first one is the coarse layer '*arriccio*' and the second layer is the fine layer '*intonaco*'. The observations on similar samples from Coptic monuments in Egypt showed that large grains of Nile sands were used as filler in the lime-based plaster layers.

Micro-Raman Spectra

The microscopic unit attached to Raman instrument was helpful in recording spectra on individual grains in the paint layers. The Raman spectrum of red grains in the pinkish pigment sample (Fig. 2) represents typical bands of hematite (α-Fe_2O_3) at 228, 300, 416 and 616 cm^{-1}. The strong band at 416 cm^{-1} suggests that a well-crystallized hematite was used [6]. Black grains found within the pictorial layer were identified as carbon black. The band at 145 cm^{-1} is characteristic of titanium dioxide anatase phase which can be a contaminant in natural iron oxide deposits. A lighter tone of the red color was obtained by mixing hematite with portions of the lime-binder during painting. The Raman spectrum of yellow pigment sample shows bands at 394, 307 and 559 cm^{-1} are for goethite (α-FeOOH). The Raman spectrum recorded on the green pigment sample shows characteristic bands in the range 100–800 cm^{-1}, which are for green earth. The Raman spectrum recorded on the black pigment contains two characteristic broad bands for carbon black centered at 1344 and 1585 cm^{-1}. No Raman bands were found at 960 cm^{-1}, the wave number of the stretching of the phosphate ion $[PO_4]^{3-}$, so the presence of ivory black and bone black one may be excluded [7]. This indicates that the carbon used for the black pigment was obtained from a vegetable origin (e.g. charred plant matter, mostly wood). The Raman spectrum obtained on the underlying layer (Fig. 3) showed the presence of strong characteristic band of calcium carbonate (calcite) at 1089 cm^{-1}. The other band of carbonates is the medium one at 716 cm^{-1}. The continuous detection of calcium carbonates in all of the studied samples confirms the use of fresco technique.

ESEM-EDX

The environmental scanning electron microcopy coupled with EDX microanalysis detector was used as complementary technique to study the samples. That technique was helpful in providing information on the microstructure and chemical analysis of the samples. A close-up ESEM image obtained on intergrowth grains in the red pigment sample (Fig. 4) shows light grey crystals with slightly big size. The microanalysis of these crystals showed major elements of titanium (Ti) and iron (Fe) with elements of calcium (Ca), silicon (Si) and aluminum (Al).

CONCLUSIONS

In this study, micro-Raman spectroscopy was employed for the first time to examine samples collected from fresco paintings dating back to the

4th century at El-Bagawat cemetery at the western desert of Egypt. The combined examinations using Raman and ESEM–EDX on micro-samples allowed direct identification of the minerals contained in pigment and plaster samples. The identified pigments were red ochre (hematite), yellow ochre (goethite), green earth (specifically of glauconite) and carbon black (from a vegetable origin). The analysis showed that the preparation layer consists mainly of calcite which reveals fresco as painting technique in the cemetery. This study focused the light on some painting materials used in an important example of early Coptic paintings.

ACKNOWLEDGEMENTS

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Fig. 1 – View of Fresco paintings found in El-Bgawat cemetery

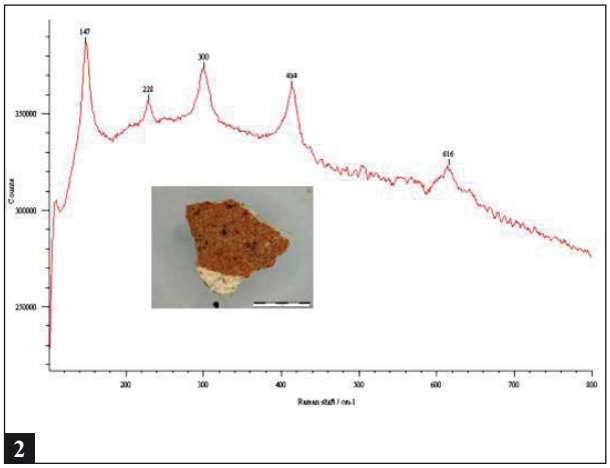

Fig. 2 – Micro-Raman spectrum of red grains in pinkish pigment sample (0.5 mW, 5 scans of 20s)

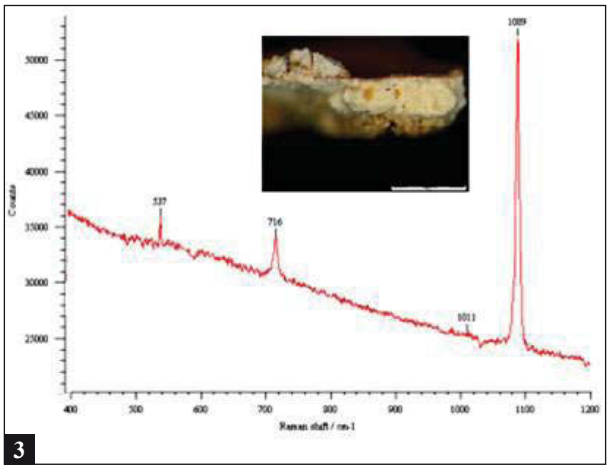

Fig. 3 – Micro-Raman spectrum of lime-plaster sample (1 mW, 10 scans of 20s)

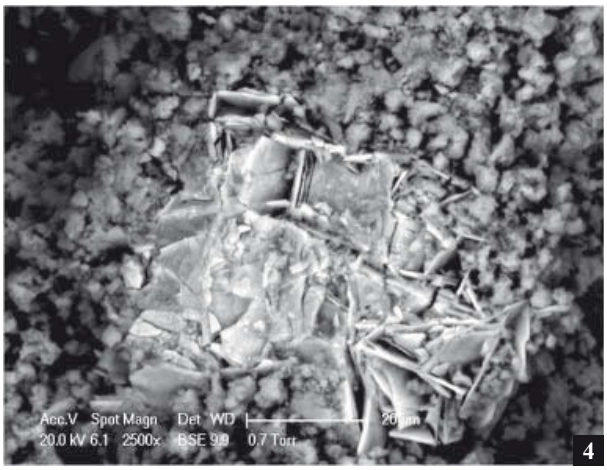

Fig. 4– ESEM image of TiO2 anatase phase in the red pigment sample (2500x, scale bar = 20µm)

THE GOLDEN LEGEND WALL-PAINTINGS CYCLE IN THE *ORATORIO DELL'ANNUNZIATA* IN FERRARA: RECOVERY OF A CULTURAL IDENTITY

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ABSTRACT

The theme of the True Cross, according to the Legenda Aurea by Jacopo da Varagine, represents an extensive task in the conservation process of the *Oratoria dell'Annunziata* in Ferrara, as it was neglected for too many years. Managing such a wide wall-painting cycle represents anything but a first step for the comprehension of its artistic techniques, as questions rapidly arise during its survey. What is the meaning of this work of art? Which community awareness symbolizes? How can it be explained in the cultural tradition of Ferrara in the Sixteenth century? These are some of the questions with which a so complex work of art was approached by searching a possible interpretation key. Indeed, this requirement testifies with evidence, as if any were needed, that art is a popular issue; not for specialist but a dialogue between the beholder experience and the practice of the artist and his own particular era that generated the wall-paintings cycle, according to a specific educational message.
In this sense, the work-of-art is not only described, but begings to be physically enconutered. A survey of the signs consequently get started, concerned by the shape, curious about its meaning. Tus, the aim of this paper is to make the analysis processes well illustrated, including the kind of research and debate that is necessary in conservation process, with technical information included in the text for a detailed report. The illustrations provide samples of techinical documentation and diagrams that are included in the full conservation project.

Keywords: two-point perspective, nano lime, ammonium carbonate, barium hydroxide.

INTRODUCTION

Located in an area of Ferrara so plentiful in artistic evidences of architectural importance, which have in the church of *Santa Maria in Vado* and in the *palazzo Schifanoia* examples of greater importance, the *Oratorio dell'Annunziata* is closely linked to the fortunes of the *Confraternita della Buona Morte* [1] that has governed its administration since the foundation. The brotherhood started accomplishing tasks autonomously taken, and then also formally delegated by the city government and by the ducal court.
In fact, it is possible to recognize in the stratification of the figurative episodes in the Oratory the growing role of the brotherhood in the society, not only for its miserable support role to the dying and sentenced to death, but also for the funeral service, so that it become the only institution authorized to undress corpses of garments and anything owned. Due to the link with the Confraterita, it is possible to support a venue for the *hospitale* at least by the Fourteenth century, as the association was constituted on 5 August 1366 [2]; at that period, should exist nothing but a small shelter for the dying, while the structures of comfort for those sentenced to death were located near the places of execution. With the increasing privileges and donations, including the legacies of the Marquis Niccolò III in 1441, the brotherhood established within the city walls a worship place, choosing to build an oratory, a small place of worship formed on a built area, in semi-public character, reserved to the use of the community and guests of the hospitale, and accessible to visitors only in special occasions. This choice permitted to achieve on the first floor, the worship place; while the underlying level, taking advantage of an identical covered surface, assumed the role of first asylum and shelter for those poor and indigent that only later would have been accepted into the *romitorio*. For this reason, the lower level was organized in different spaces; while the upper level was a single chamber, as now days. Thus, it is assumed that since the beginning of Fifteenth century the Oratory had reached the current dimension, but we have only few information about the figurative apparatus inside; the surveys carried out on the walls showed the presence of a plaster even more ancient than that of the *Resurrezione*, dated between the second decade and the fourth of the Fourteenth century. Consequently, it has to be

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the late Medieval plaster, partly frescoed and in part simply lime washed, lied inside on walls that, to the south, had five round-arched openings and three to the north. As the development in height is similar to the current dimension, these masonries were ended with eaves frame of "type A", according to the Righini classification, still visible on the northern front, and were characterized by a lime wash surface treatment. This chromatic season was replaced by a new figurative plan, to which belongs the Resurrection previously mentioned, spatially complemented by the construction of the lacunar wooden ceiling in 1495 [3]. The appearance of the chamber was rapidly transforming, due to the changing needs of the Brotherhood which, in this period, seemed to prefer the pompous apparatuses in religious services, progressively more extended to visitors then the restrained simplicity of the late medieval structure. The pictorial decoration of the Oratory walls dates to the second half of the Sixteenth century, 1547 to be precise, documenting the devotion of the Confraternity to the Holy Cross festivity, established 3rd May 1510, on the occasion of the arrival in Ferrara of the Cross relic. The current configuration is the consequence of the demolition of the timber floor (rebuilt in 1960 with reinforced concrete after the Second World War damages) that the Brotherhood decided to remove on 20th July 1612 in order to better serve the liturgical exercise of *Quaratore*; the squarings and the perspective architectures are instead ascribed to the intervention by Francesco Scala in 1693.

The pictorial cycle of the Stories and Exaltation of the Holy Cross represents an important witness of the work of a Mannerist Workshop practicing, on the half of the Sixteenth century, in buildings and *Delizie Estensi*. The masters and their apprentices accompanied with ephemeral apparatuses events in the Court life and the splendor of the liturgy in course of reform, according to a tendency to emphasize every aspect of civil life, due to the ever-closer union among civil commitment, religious life and music, the Oratory was the historic site of the *Accademia musicale della Morte*.

OPERATIONAL GOALS

The wall-paintings specimen

The decoration develops in eight panels the legend of the Holy Cross that largely comes from the Golden Legend, inside which there are two chapters dedicated to the history of the cross: the Invention of the Cross and the Exaltation of the Cross, from which are derived the episodes represented on the Oratory walls.

As a tale punctuated by photographic sequences, the cycle starts on to the right of the presbytery on the southern wall (fig. 1) -which is on the right of the wall where was placed the ancient altar- with the first episode referring to the Death of Adam. In the second panel are represented two episodes: in the foreground, the Queen of Sheba adores the tree of the cross; while, in the background, it is represented the felling of Adam tree for the construction of Solomon's Temple. The third fresco represents the Landfill or Burial of the wood of the Cross where, in the foreground, is illustrated the meeting of Solomon with the Queen of Sheba, while, in the background, the trunk which had to serve the construction of Solomon's Temple is·ready to be transformed in the cross Christ's martyrdom. The southern wall concludes with the fourth panel representing the Emperor Constantine, who adores the cross as a symbol of his victory.

The northern wall (fig. 2) opens with what is commonly referred to Christ and the followers of the Cross, in a very bad state of conservation that, after the damage of the Second World War, has been removed and integrated on canvas. The second panel illustrates the Baptism of Constantine by Pope Sylvester; while the third is the Invention of the Cross and, finally, the Miracle of the True Cross.

OUTCOMES

Among all the figurative features conserved in situ, before any other issue, the one at risk is the wall-paintings cycle that come to nowadays in very different conditions in relation to the characteristics of the environment and especially for the varnishes, powders and the candles smoke, which may have hidden the original freshness of colors, but especially the damages poorly repaired after the Second World War, and the most recent injuries of the 2012 earthquake. Therefore, it was decided to provide a detailed survey and an high resolution orthophoto mosaic for a better comprehension of the pictorial surface, both used for the formulation of a first mapping of the degradation morphologies, which will be supported by the next phase of laboratory investigation. It is clearly evident that, in some areas, the phenomenon of sulfation with its weathering action is appeared. This occurs for the presence of soluble salts in the masonry: these salts, in relation with the flood of water, or even only for high humidity, stressed by a wide fluctuations

in temperature, migrate on the painted surface causing the transformation of the carbonate calcium molecule into calcium sulfate, ie chalk.
To this end, thanks to the efficacy tested in the restoration of the Resurrection, the method of intervention will be based on the use of the barium hydroxide as sulphate removal [4] in addition to the traditional intervention with the ammonium carbonate, which through the interposition of an ashi tissue will strengthen the layer-to-layer detachments and delaminations of the dry finishing.
In order to fully understand the painting techniques and the used materials, it was prepared a diagnostic project consisting of ultraviolet and infrared photography, infrared reflectography, grazing light photography and chemical stratigraphic analyses of micro samples so as to investigate, centimetre by centimetre, the entire painted surface. Finally, this stage of knowledge was accompanied by a monitoring plan of fractures, even those opened after the earthquake on May 2012.

CONCLUSIONS

The study presented here, which is aimed to focus on the conservation of the wall-paintings cycle, deliberately separated by any attribution issues, constitutes an anticipation of the author's research on the Oratory for its restoration project, integrating the research on the wooden lacunar ceiling, object of a previous publication, on the occasion of the International Conference in Poland at Warsaw "Heritage Wood: research & conservation in the 21st century", titled the *Wooden lacunar ceiling of the* Oratorio della Buona Morte *in Ferrara: investigations on features and failures for conservation treatment*, in press.

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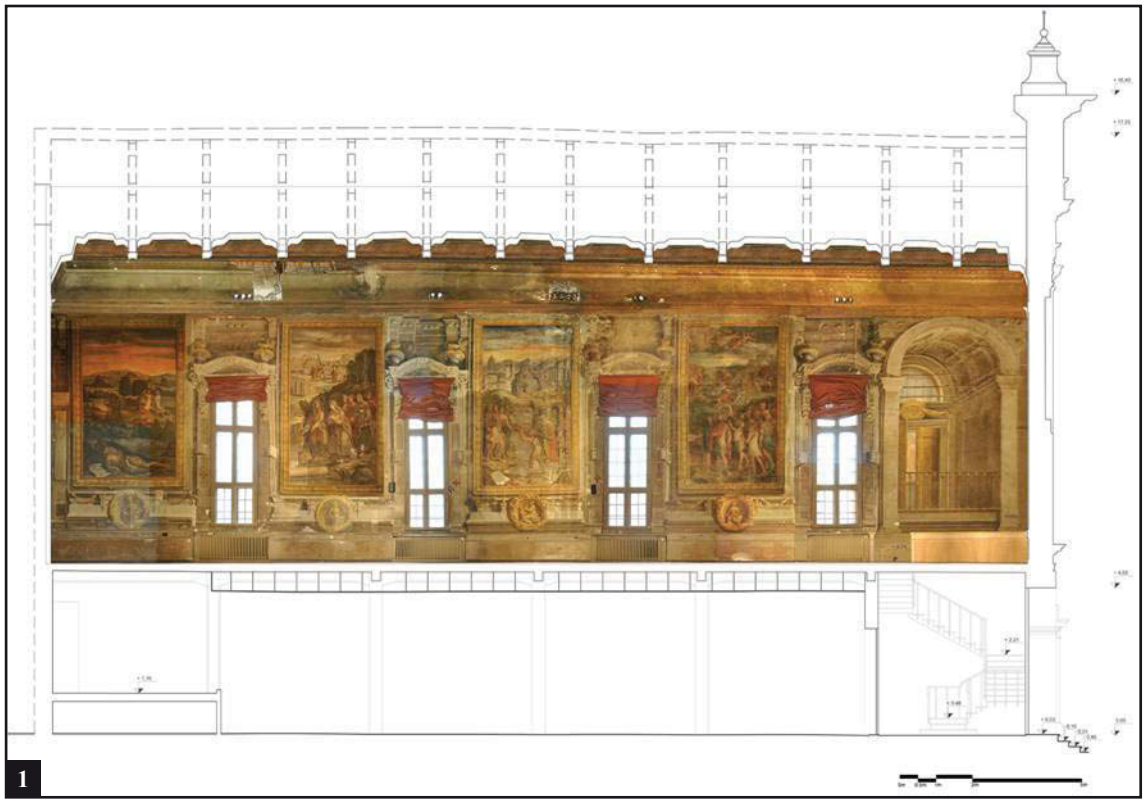

Fig. 1 – Ferrara, Oratorio dell'Annunziata, the southern wall-paintings.

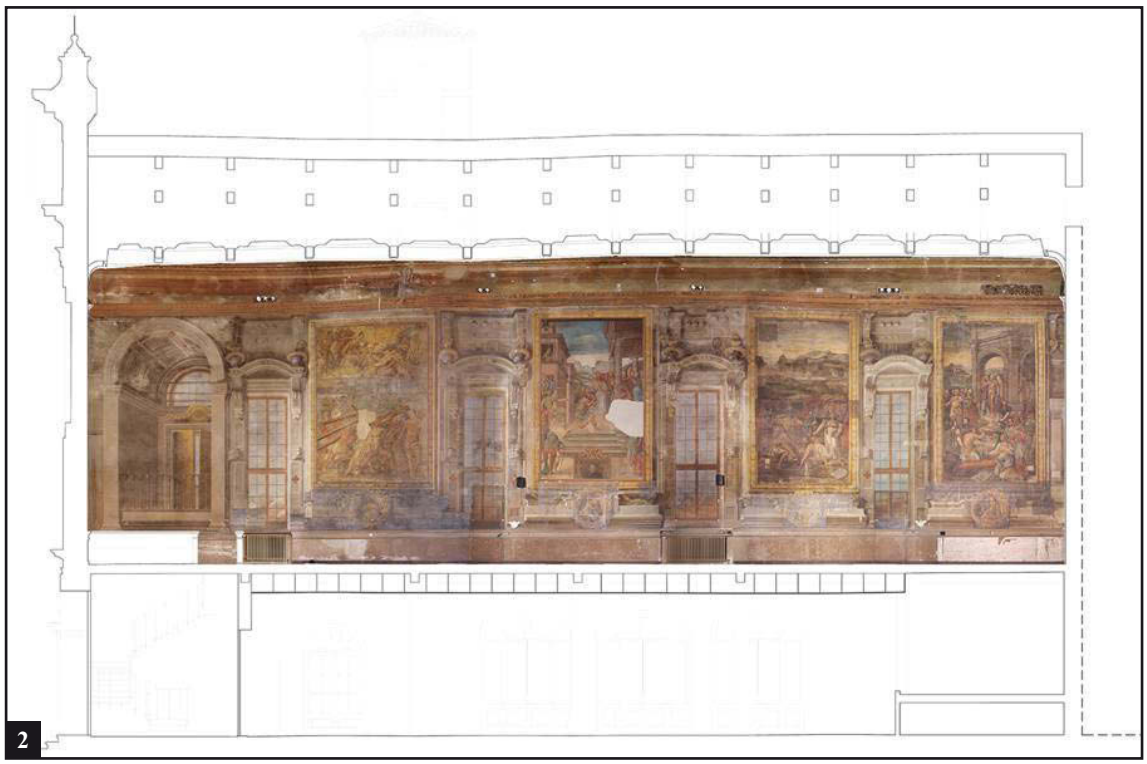

Fig. 2 – Ferrara, Oratorio dell'Annunziata, the northern wall-paintings.

SOME REMARKS ON FRACTAL ANLYSIS OF POLLOCK'S PAINTINGS

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ABSTRACT

A fractal analysis was performed on various paintings by Pollock in order to show some of the challenges that are involved in using this technique in the process of authentification. The reason for using fractal analysis is the fact that Pollock's paintings present a fractal dimension that increases over time and thus could prove valuable in the validation of the date of a specific painting. Based on a a modification of traditional Box Counting Method from the HarFA soft using Digital Image Processing with Mathlab the various fractal dimensions were obtained. Using different parameters we were able to show the variations that arise in the fractal analysis implying that this technique needs to be accompanied by other methods and is in need of standardization.

Keywords: Fractal Expresionist, fractal dimension, thresholding procedure, analysis, painting, Pollock, HarFA

INTRODUCTION

Many objects in nature display irregular shapes and discontinuous morphogenetic patterns in connection with their functional diversity and obtaining a rigorous or quantitative description of them using Euclidean geometry seems impossible. In recent years fractal anlysis has been revealed as a very useful tool for quantitaive description of irregular objects coming from different fields of science. Many works of art exhibit fractal geometry and a number of experimental data has showed the existence of fractal structures in archeological patterns. This information can be used to determine the building material in a perspective of study on degradation and restoration. In addition fractal analysis can be used to study the aging process of some works of art from the field of cultural heritage. In painting fractal analysis has been applied in order to study clasical and modern art. One of the most studied artists has been the famous american painter Jackson Pollock christened "Fractal Expresionist" by R.Taylor and coworkers due his "drip and splash" style of painting [1], [2]. The fractal dimension of his paintings increases from 1 in 1943 to 1.72 in 1952. Because the fractal dimension follows a distinct evolution in time, the fractal analysis could be a quantitative method to validate and date Pollock paintings. But the fractal analysis of Pollock'paintings is controversial yet and some researchers [3] argue that Pollock's drip-paintings cannot be usefully characterized as fractals and demonstrated that fractal criteria are not useful for authentication of these paintings. In this paper we used fractal analysis [4] for Pollock paintings in order to suggest that the succes of this procedure depends very much on the image preparation.

MATERIALS AND METHODS

To determine the fractal dimension a modification of traditional Box Counting Method from the HarFA soft was used. By this modification one obtains three fractal dimensions, which characterize properties of black plane DB, black-white border of black object DBW (and this information is the most interesting) and properties of white background DW. The fractal dimension is the slope of the straight line „Black&White". To use HarFA soft we prepared the black and white images of the paintings using the Digital Image Processing with Matlab. In Thresholding procedure a grey scale image is turned into a binary (black and white) image by first choosing a grey level T in the original image, and then turning every pixel black or white according to whether its grey value is greater than or less than T. The grey images of the colored paintings have been processed also in Matlab.

RESULTS

We analized one of the last Pollock's painting" Blue poles" from 1952. First we obtained a grey image of the colored painting Blue poles and then, using Thresholding procedure, we obtained the black and white image. The fractal dimension for T> 130, using HarFA soft, was DBW=1.8236 (Fig.1). For different values of T we found the values from the

Tab 1. These values are very well correlated with a correlation factor R^2=0.986 (Fig.2). Using T>130 we investigated the painting "Going West" from 1934-1935 and we found DBW=1.3088 and the "Untitled" from 1945 and we found D=1.7585. For "Convergence" from 1952, we obtained for T>130, DBW=1.8547. Afterwards we studied the "Number 18" Pollock's painting from Gugenheim in order to compare our method with D'Alessio [5] results on Pollock painting. For his black and white image we obtained using HarFA soft a fractal dimension DBW=1.8984. On the other hand, for "Number 18" using Threholding in Matlab for original colour painting (T>110), DBW=1.8510 was obtained.

CONCLUSIONS

The fractal geometry has begun to play an important role in the study of Pollack dripped and poured painting. If digital methods are going to be accepted in authentication, related robustness and stability studies must be performed; fractal analysis involves a great attention because it depends very much on the preparation of the images. For "Blue poles" the fractal dimension varies from 1.8295 to 1.7973 only due the magnitude of thresholding. Therefore this method needs to be accompanied by other methods like X-Ray difraction, FTIR and UV spectrometry. The fractal dimension of Pollock's painting increased in time, from the earlier work "Going West" (DBW=1.3088) to the last ones like "Convergence" (DBW=1.8547). Due the fact that the fractal dimension is a direct measure of the relative degree of complexity of the figure, the fractal dimension of an art work can be regarded as a preliminary indicator of complexity: lower fractal dimensions are a measure of low complexity, while a higher fractal dimensions demonstrate high complexity. To search nature of Pollock's contribution to modern art means to know how and why he painted fractals, if he knows about fractals before Mandelbrot or not, and so on.

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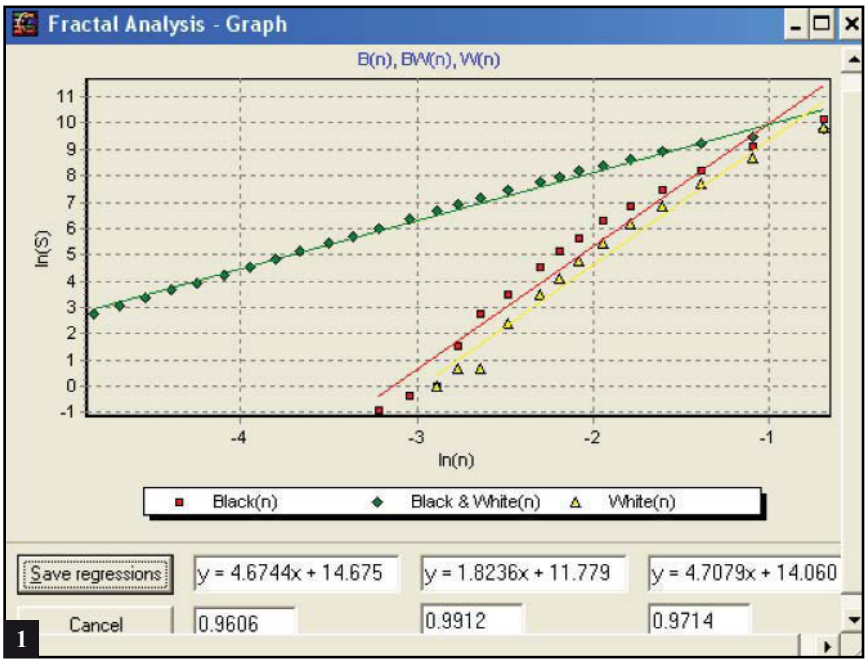

Fig. 1 – The HarFA graph for fractal dimension DBW=1.8236

No	Thresholding, T>	Fractal dimension
1	100	1.8295
2	105	1.8270
3	110	1.8236
4	115	1.8281
5	120	1.8167
6	125	1.8138
7	130	1.7973

Tab. 1 – Fractal dimension as a function of thresholding

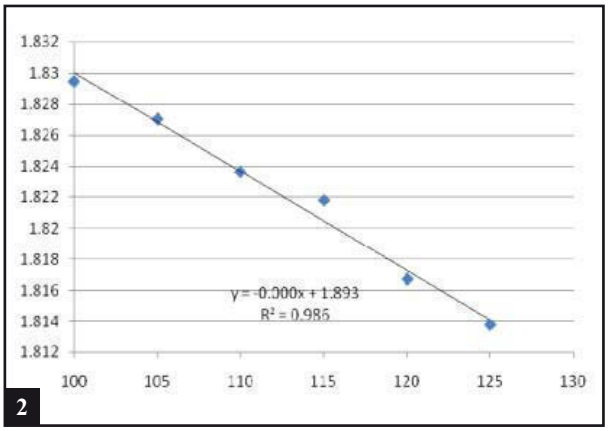

Fig. 2 – Correlation of fractal dimension with thresholding

ANTHROPOMORPHIC WOODEN RELIQUARIES FROM KNOWLEDGE TO RESTORATION

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ABSTRACT

Two wood anthropomorphic reliquaries, belonging to the Lipsanoteca of Epiphany Church in Trapani (Italy) were restored following the conservative restoration procedures based on an interdisciplinary approach. The hystoric-artistic contextualization, the constitutive materials and executive techniques were defined and physical-chemical-biological factors involved in degradation events were evaluated. The Saints relic (human bone or teeth), present in each reliquary, were analysed through visual investigation. After restoration, the manufacts showed their peculiarities and their extraordinary cultural value.

Keywords: Lipsoteca, Saints reliquae, Biodeterioration, Conservative restoration.

INTRODUCTION

The reliquaries are cases of different shape and material, usually precious, designed to preserve and exhibit relics. Initially, reliquaries were monumental altars that were built over the tombs enclosing the remains of martyrs, saints, Apostles. During the first millennium, the evolution of the relics cult determined the evolution of their containers. During the centuries, the reliquaries were assembled using different materials (gold, silver, wood, stone, etc), also reaching remarkable values and preciousness. Braun [1] classified these precious containers into categories and subcategories, as also reported by Vasco Rocca and Montevecchi in the Thesaurus Terminology of ecclesiastical furnishings (Central Institute for Cataloguing of the Ministry for Cultural and Environmental Heritage) [2]. A particular kind of reliquary, classified as anthropomorphic reliquary, originated in the ninth century and immediately spread, mainly reproduce part of the human body. In the Romanesque and Gothic periods anthropomorphic reliquaries represented the most common type [3]. In this work two wood reliquaries, dedicated to S. Devorino and S. Cosmo, have been studied by an interdisciplinary approach based on art history analysis, identification of matter and its transformation over time, evaluating the related chemical, physical and biological factors, able to induce the deterioration of these manufacts. Concerning the relics, S. Devorino and S. Cosmo contains respectively bone and theet that were carefully inspected only by visual analysis. The identification of executive technique, author or related school, completed the knowledges on these artifacts.

OPERATIONAL GOALS

Biodeteriogens identification

Microbial colonization: samples, from the surface of reliquaries, were collected by sterile swab or Nylon membranes (Amersham H^+) that were utilized to inoculate Nutrient Agar plates, incubated at 30 ° C for 24-36 hours. Identification of bacteria and fungi colonies was performed by molecular techniques based on rDNA molecular markes and sequences comparison [4].

Entomological colonization: *Rosume* samples, were analysed through Wild optical microscope (40X) and Scanning Electron Microscope (Leica – LEO 420).

Disinfestation of reliquaries

Since both reliquaries suffered a deep attack by xilophagy insects, they were treated by Permethrin and kept for 20 days in clean room (built by heat-sealed polyethylene) *ad hoc* assembled.

Cleanging steps

After dusting, the first lipophilic layer was removed by Ligroine (Petroleum ether) in free form, by cotton swabs. This solvent, non-polar and volatile, allowed the removal of the lipophilic coat without

interacting at all with the underlying layers.
The cleaning of the flesh-tone was performed by the mixture of organic solvent, Ligroine - Acetone (LA7-f_d 62), prepared refering to Wolbers test.
Gildings was cleaned by a Ligroine – Tween 20 mixture.
Decorated surfaces were cleaned by a mixture Ligroine – Acetone (LA5-f_d 72) or by Acetone- Ethanol solution, mixed in Klucel gel (hydroxypropyl cellulose), applied for few minuts and removed by Ligroine wet swabs.

Recreate the paint film harmony
The reintegration of weaknesses in the flesh, was performed by *Selezione cromatica* using varnish colors and dashed vertical line, connecting the color of the gaps with the surrounding area. The other reintegrated surfaces were chromatically reconstructed by the *Puntinato* paint technique.

Saints relics
San Devorino: metatarsal bone of the right foot, the relic was intact and good preserved.
San Cosmo: lower rigth second molar, the tooth was particularly worn on the occlusal surface and the cusps are no longer visible, that can be related to different factors such as nutrition, or any work activity with the aid of the teeth or, more likely, to the age. Referring to the Brothwel wear table (1981), the probable age of death is between 35 and 45 years.

RESULTS
In order to reveal and identify biodeteriogens involved in the degradation of wood structures, microbial and entomolycal monitoring was performed by optical (OM) and electron (SEM) microscopy, *in vitro* culture and molecular investigation [4-5]. The interdisciplinary approach applied during the different phases of the restoration of the reliquaries allowed to identify the constitutive wood materials, the pigments and binder, gilding layers, as well as revealing the forms of degradation, in particular those related to biological systems. Before restoration, several degradation events were identified as shoved in Fig.1 (S. Devorino) and in Fig. 2 (S.Cosmo). The evident deterioration of the wood substrates was induced by *Anobium punctatum* infestation, that caused the degradation of wood structure altering both the preparative and the painted layers, as showed in Fig.3 (S. Cosmo reliquary).
Onto the entire surface of both S. Devorino and S. Cosmo reliquaries, a homogeneous layer was revealed, as well as a general discoloration of the surface due to yellowing of coarse paint, applied probably in previous maintenance. A specific cleaning protocol was applied, considering the characteristics of painting layers, by using Ligroine, or Ligroine- Acetone mixtures.
The different steps of the restoration project performed for reliquaries can be summarized as follows: identification of wood specie, pest control, consolidation of the constitutive material and of the surface layers, appropriate cleaning, filling gaps, reintegrazion of painting layers, restoration of the painted and final coat.
The manufacts were realized by two woods species, Lime (*Tilia* L.) and Poplar (*Populus* L.).
The spread infestation of xylophage insect (*Anobium punctatum*) was revealed in both reliquaries, disinfested by Permetrine application and stored in a clean room for 20 days. Paraloid B72 (diluted in aceton, from 2% to 7%) was injected in the flicker insect holes; this grandient of concentration was needed to obtain a gradual penetration of the consolidant product.
In order to renew the adhesion between the wood-preparatory layers-paint film, small amounts of rabbit glue were applied by a brush and/or a syringe, and subsequently pressed by thermocautery, interposing between this and the paint layer a sheet of Japanese paper.
The painting reintegration was performed by two techniques *Puntinato* and *Selezione cromatica*, which guarantee the recovery of the correct reading, adapting perfectly to the three-dimensional shapes of the manufacts [6].

CONCLUSIONS
This restoration pointed out the great skill on carvings and the richness of the paintings that the Neapolitan school performed for the production of busts and, as showed in Fig.4, for St. Devorino bishop and martyr and St. Cosmo reliquaries.
The clever use of various methods for working with gold leaf, meccatura pigment (red lacquer) and the graffito technique, have made busts reliquaries as high artistic value manufacts.
Interestingly the interdisciplinary approach applied for the restoration allowed to perform a sustainable project and set up a manual for preventive conservation of these particular works of arts.

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Fig. 1 – S. Devorino wood bust, before restoration

Fig. 2 – S. Cosmo wood bust, before restoration

Fig. 3 – Section on S. Cosmo bust, showing different degradation events, and Graffito technique.

Fig. 4 – Anthropomorphic reliquaries aftere restoration; S. Devorino (left), S. Cosmo (right)

STRETCHING OF CURVILINEAR CANVAS OF RELIGIOUS PAINTINGS

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ABSTRACT

Religious art objects preserved in the form of curved canvas paintings present a very interesting subject for the research, both from technical and conservation points of view. The work concentrates on theoretical and experimental analysis of mechanically correct stretching of curvilinear canvas to avoid folding and buckling of paintings. It is shown that treating curvilinear canvas as a ruled surface might be a very promising solution. Reverse engineering can help to discover the ruled surface shape adequate to the individual curved painting.

Keywords: canvas, stretching, ruled surface, religious paintings

INTRODUCTION

In Baroque period, paintings on canvas reached enormous dimensions and became a decorative element closely connected with architecture. Sometimes canvas was even adapted to curved walls, curvature of bevels and even barrel vaults. Such an example is a giant vault decoration of the Hall of Mirrors in the Palace of Versailles, composed of the canvas cycle executed by Charles le Brun. In the XVIIIth century, various forms of curvilinear canvas, concave or convex, and of different radius of curvature were used. Curved paintings of religious themes played an important role in decoration of churches. One of the examples of such curvilinear painting is "Apostles discovering the empty tomb of Mary" by Camillo Procaccini from 1594, located behind the main altar of Basilica di Santa Maria Maggiore in Bergamo (Italy).

The concave shape of the canvas further emphasizes the theological dimension of the monumental vision – the supernatural character of the Assumption of Mary and the communion of gathered Apostles.

Another type of known curvilinear paintings are convex paintings placed on church pillars. In the St. Jacob church in Antwerp there are preserved two curvilinear paintings placed on the lateral pillars presenting St. Mary Help of Christians (Fig. 1) and St. Jacob Passion. Similar form has pair of canvas paintings exposed on the pillar in the Frauenkirche church in Nuremberg.

The presented research is to a large extent related to conservation works carried out in the Saint – Aubain cathedral church in Namur (Belgium), gathering a group of four large–size canvas paintings, presenting the scenes of the Christ's childhood by Mauritius Heinrich Loder. Two of them obtained an unusual form adapted to the shape of the apse walls. The canvas, being the object of conservation works is "Adoration of the Magi" with 3,70 m height and 4,50 m width. The painting is bowed in the horizontal plane and the sagitta of the arc of its stretcher frame is 37 cm [1].

The aim of the presented research was experimental and theoretical analysis of fundamentals of stretching of large curvilinear canvas to answer the conservators needs of rational shaping of stretchers for such religious paintings.

METHOD

It should be stressed here that the following analysis does not examine what are the adequate amounts of tensile forces to properly stretch the canvas. Only force directions are of our concern because this is a crucial point in stretcher frames design in the case of curvilinear paintings. Stretching forces can be more or less fitted during canvas fixing according to the needs if only an adequate stretcher structure is provided.

From simple geometrical considerations it is known that chord of an arc is shorter than the arc length. Thus pulling-out the arc ends diminishes its curvature and extends its chord. Hence, one may expect that any tension applied to the canvas in a direction other than that coinciding with tangent to the canvas surface will flatten the painting. In the case of flat canvases, any in-plane tensions have directions tangential to the canvas surface. Consequently, flat paintings can be stretched in any

in-plane direction. In the case of curved surfaces situation is much different. Tractions acting at surface boundaries can be tangent to the curved surface at points of their application but not at the inner points of that surface. This means that stretching the curvilinear canvas in general case has to flatten its surface. There is however one special type of curved surfaces for which one can find straight lines tangent to the surface at every inner point. These are ruled surfaces [3, 4].

A ruled surface *S* is generated by continuous motion of a straight line (*ruling*) along a base curve (*directrix*). This means that for each point of *S* one can draw at least one straight line on the surface. Ruled surfaces can be described by a parameterization:

$$S(u,v) = \mathbf{a}(u) + v\,\mathbf{r}(u) \quad (1)$$

where a(u) is the directrix, and r(u) is a unit vector providing direction of the ruling. Alternative representation is in the form [5]:

$$S(u,v) = (1 - v)\,\mathbf{a}(u) + v\,\mathbf{b}(u) \quad (2)$$

where S is a point on the surface, a(u) and b(u) are two directrix curves. Straight lines connecting points on directrix curves in this case define the ruled surface.

Searching for the optimal stretching directions in case of curvilinear canvas should begin with finding the closest approximation by ruled surfaces. Similar approach is applied in architecture for finding structural design for complex shells [6]. Fig.2 presents an example of two stitched, ruled surfaces with parameterization given by equation (2). Directrix curves are placed in the horizontal plane and are defined respectively as polynomials of order two and three with different coefficients for upper and lower curve.

In order to provide a basic verification of the proposed concept, experimental analysis of fundamentals of stretching of large curvilinear canvas was done with aid of a simple string model. The aim of the experiment was to confirm the above considerations and to visualize the deformations of the warp resulting from tensioning of the weft or in directions inclined to the weft. The string model (Fig. 3a) is composed of a stretcher frame and elastic strings stretched between upper and lower stretcher's beams. Therefore, the strings simulate the warp of the canvas. The upper and lower beams are curvilinear to assure convexity of the model "surface" in one direction. A lateral tensile force action was simulated by using an additional stretching string fixed to the vertical elements of the model. The analysis was a qualitative one and it had been repeated with various positions of the additional stretching string and with various relations of stiffness of the vertical and additional strings.

RESULTS

Experimental results are illustrated in Figures 3b–d. Figure 3b shows deformations of vertical strings resulting after an additional horizontal string and hence horizontal stretching force was applied at the model centre perpendicular to the vertical strings. The next two pictures show deformations due to stretching in the direction neither perpendicular nor parallel to the vertical strings – diagonal stretching (Fig. 3c) and arbitrary inclined stretching (Fig. 3d). Observed deformations clearly show that any stretching in directions departing from that of vertical strings deforms these strings and produces buckling in the inward direction. Applying tractions at two points of a canvas results in a tendency of straightening of the segment between these points and flattening of the painting surface. This tendency is favourable in case of flat paintings. I case of curvilinear paintings however this is undesirable because reduces a wilful curvature of the painting unless the tractions are applied along lines which are intentionally straight ones.

Straight lines can be drawn at every point of the curvilinear painting only if the painting surface is a ruled surface [3, 4,5]. Thus, one may conclude that probably all large curvilinear canvas had to be originally designed by the masters as the ruled surfaces, otherwise it would have not been possible to stretch them along straight-line segments. These straight-line segments coincide with surface rulings [3].

CONCLUSIONS

The research shows that stretching of curvilinear canvas substantially differs from that of flat ones. The correct canvas shape without out-of-surface deformations can be secured under two conditions:

- canvas must have a form of a ruled surface, and
- external tractions applied to the canvas should be co-linear with surface rulings.

In such a case the curvilinear canvas will be able to sustain its dead weight and traction loads like a membrane of no bending stiffness without out-of surface buckling and folding.

Based on the above conclusion it is expected that nowadays high accuracy 3D measurement methods

combined with reverse engineering calculations may allow us to discover the adequate ruled surface shape of the curvilinear painting prior to beginning of its conservation. Hence, the painting optimized stretcher shape and stretching directions would be correctly elaborated.

ACKNOWLEDGEMENTS

Authors wish to express their thanks to Mr. Jan Całka for his technical assistance in manufacturing of the string model. Presented work was partly supported by National Science Centre under Grant "Innovative measurement of deformations in large - size canvas paintings by remote optical methods and its application in documenting, designing and evaluation of technical conservation solutions" No.165419.

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Fig. 1 – Curvilinear canvas from St. Jacob's church in Antwerp.

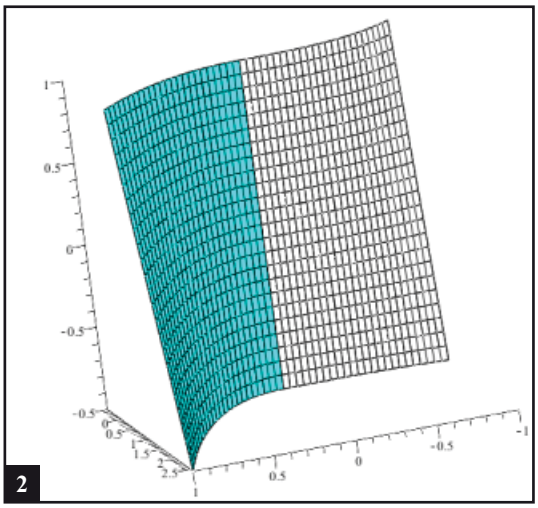

Fig. 2 – Two stitched, ruled surfaces with second and third-order polynomial directix

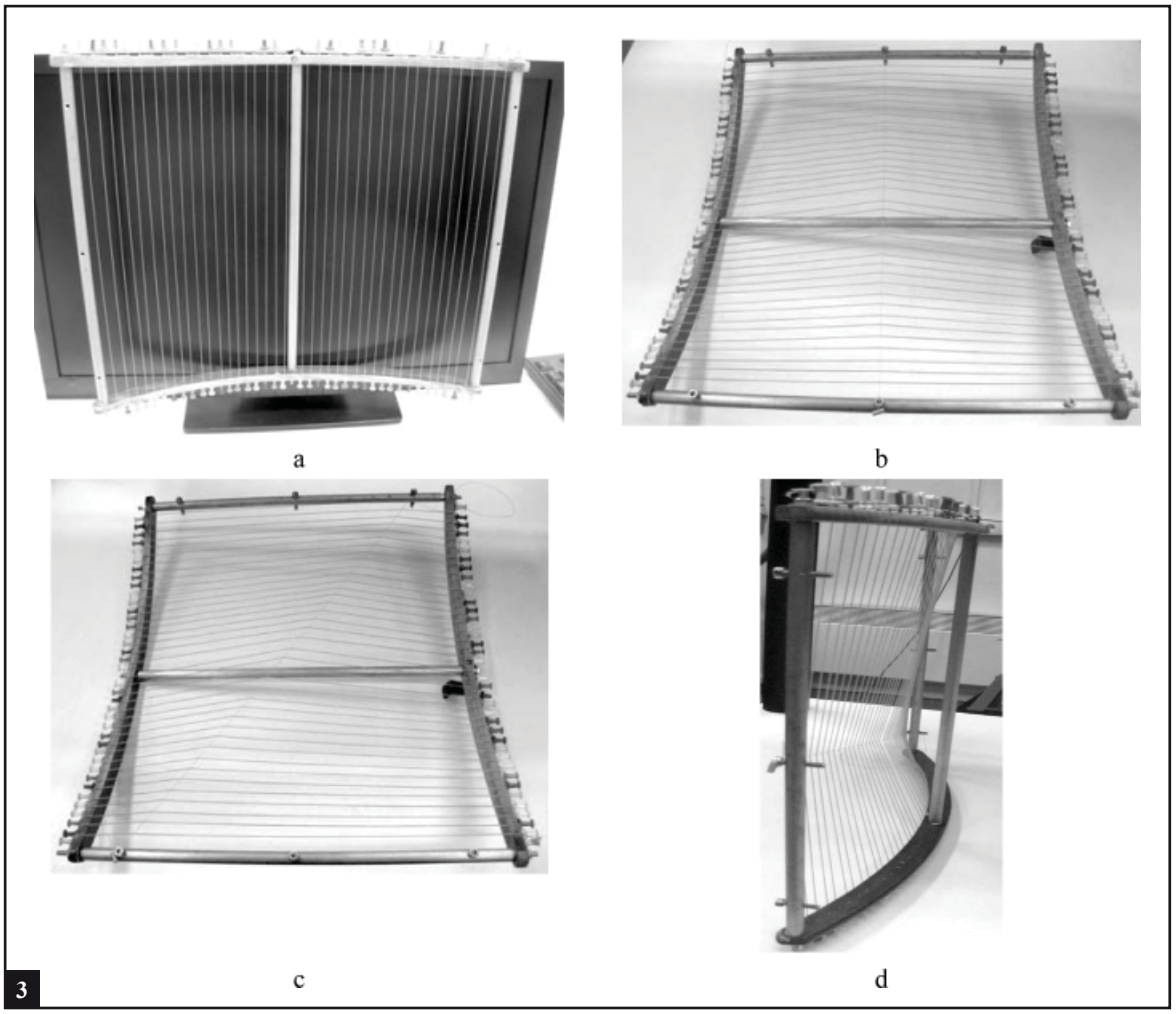

Fig. 3 – a) String model of a curvilinear canvas, b) model deformation – force applied through its center perpendicular to the strings, c) model deformation – force applied through its diagonal, d) model deformation – force applied at some arbitrary angle to the strings

THE TRIPTYCH OF THE HOLY SAVIOUR IN THE TIVOLI CATHEDRAL: DIAGNOSIS, CONSERVATION AND RELIGIOUS REQUIREMENTS

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ABSTRACT

The focus of this work is the Holy Saviour triptych, an important religious panel painting dated back to the 12th century, at present stored in the Tivoli's Cathedral (Rome). The triptych has a great historical and artistic value closely linked to its devotional significance.
In this study, original and additional materials were examined in order to provide a deeper understanding of the technique utilised and a greater awareness of how well preserved the object is, as well as an analysis of previous preservation and conservation interventions.
Due to the preciousness of the panel and to the great care used by the religious community in its conservation, the diagnostic analysis for the characterization of the painting materials and the wooden support was carried out by non-invasive methodologies. In particular, the following investigation was performed: video microscope acquisitions, infrared reflectography, false colour infrared photography, X-ray fluorescence spectroscopy.
The obtained results show the use of valuable pigments and materials like gold, vermilion, ultramarine blue. The study of wood anatomical characters allowed identifying chestnut wood in the Holy Saviour panel. This is an important result that supports the stylistic and technical relationship with another medieval panel.

Keywords: medieval triptych, panel painting, *Santissimo Salvatore Tivoli*, infrared reflectography, X-ray fluorescence spectroscopy, chestnut wood

INTRODUCTION

In the Cathedral of Tivoli (Rome) a precious wooden triptych, named *del Santissimo Salvatore* (the Holy Saviour), is conserved inside the thirth chapel on the left wall, protected by a special glass and an alarm system (Fig. 1). The triptych is composed of three panels that, if considered as a whole, may be classified as a *Deesis,* a byzantine iconography characterized by the figure of Christ between the Virgin and St. John the Baptist [1-2]. But the Triptych of Tivoli wanders off this traditional iconography: the two lateral panels, in fact, represent the Virgin (36,3x147,5 cm) and St. John the Evangelist (36x147 cm) with the same intercessor role. The image of the Holy Saviour in the central panel (75x160 cm), characterized by a golden background, shows the stylistic, technical and cultural expression of the Lateran *Acheropita*, so it can be considered a processional icon [3]. During the night of the 14 of August, in fact, the panel of the Holy Saviour and a panel from another church with the Madonna bent down three times one in front of the other on the occasion of the *Inchinata* procession in Tivoli. Nowadays a copy of the panel, covered by a rich silver cover that leaves visible only the face of Christ, is transported during the procession of the Assumption of the Virgin.
The scientific investigations on artwork with both an historical, artistic, demoetno anthropological and devotional value could provide a valid contribution to a better comprehension of their usage and of their significance for the peoples [4-6].
The analytical approach to a wooden artefact must be related to wood technology aspects, to execution technique, and to the historical artistic significance. Any intervention on such artefacts, from enhancement to study, from preservation to restoration, must consider several aspects: the botanical species of wood, the pigment nature, the stratification and binders, the deterioration processes, as well as the environment parameters like relative humidity and temperature [7-8]. In fact the idea

of work physicality as a value, has developed an interdisciplinary approach, with a stronger attention to diagnostic research. Such method has allowed a possible anamnesis and preserving interventions based on a scientific method which guides restorer's choices [9]. Diagnostic investigations provide often more information about an historical-artistic as well as philological study of the work of art [10].
The triptych 12th century dating has been traditionally based on stylistic characteristics, supported by the historical and artistical literature, so the non-invasive diagnostic analysis was performed to provide further information about the materials, the execution technique and therefore about the chronological aspects.
At last, it should be stressed that the choice of non-invasive methods of analysis was due to conservative requirements and to the necessity to avoid the paradox of damaging a work of art while monitoring its preservation state.

METHODS

The execution technique and the conservation conditions of the triptych were investigated by means of *in situ* non-invasive analysis: video microscope acquisitions, X-ray fluorescence spectroscopy (XRF), infrared reflectography and false colour infrared (IRC) photography.
The video microscope acquisitions were performed by a Keyence VH-5911 system equipped with a zoom objective from 25 to 175 magnifications, directly connected to a computer for the acquisition and processing of the images.
Infrared reflectography was obtained by a modified Nikon D100 camera by placing the Kodak Wratten gelatine filter n.89B. The IRC photographs were taken using a Nikon F3 camera with a Kodak Ektachrome Infrared film, by placing, the n.12 Kodak Wratten gelatine filter n.12 coupled for time by time with the following ones: n. CC20C, n. CC30M and n. CC50M. The lighting system was made up of 2x250 Philips Photolita lamps.
The XRF analysis was carried out by a portable instrument equipped with a 5-50kV tube and a Si-PIN detector (resolution 155 eV at 5.9 keV).
Wood support was examined with a digital microscope Dino Lite AM 413, on the back of the panels, in order to detect the anatomic characters necessary to identify the wood taxa.

RESULTS

The video microscope acquisitions are useful to study in detail the morphological characteristics of the surfaces. In total thirty points were acquired each at 4 magnifications (25x, 50x, 100x and 175x). The surface is clearly covered by a transparent layer that is probably constituted by the protective applied on the occasion of the last conservative intervention performed during the last three years of the 20th century and that generally dims the paintings (Fig. 2).
The IRC photography was performed on the two lateral panels, since they were less studied in respect to the Holy Saviour panel. In particular, the IRC photographs were obtained only from the scenes with the histories of the *Dormitio Virginis* and of the Preaching of Saint John the Evangelist, due the position of the artefact inside the theca and so to the positioning of the camera and of the lights. The main results from this technique concern the blue and the red areas that appear red and yellow respectively in IRC suggesting the presence of ultramarine blue and vermilion (Fig. 3). Some black parts have been observed in the Virgin garment and in the apostles' tunics that can be associated to repainting based on azurite. A similar result has been found on the panel with the Preaching sermon of Saint John.
The infrared reflectography allowed to reveal details of the drawing and to show some changes in the drawing of the hands and of the right foot of Christ.
The XRF analysis was performed on nineteen points, as described in the table 1. The presence of lead, calcium and strontium in almost all the examined points suggests the use of gypsum and lead white as setting layers. Blue colour was obtained by ultramarine blue; the presence of copper in some points is probably due to repainting. Vermilion is widely used for red and flesh colours sometimes mixed with red lead. The presence of arsenic in two points of the Christ's throne suggests the use of orpiment as priming of the painting.
The study of the anatomical characters of the wood allowed identifying chestnut. This kind of wood was used as a structural material for important building frames and artefacts of demo ethno anthropological interest, but it was found less frequently in artistic artefacts. The identification of the chestnut wood in the Tivoli's triptych is an important result that supports its stylistic and technical relationship with the panel of St. Angel in Pescheria, a chestnut panel dated back to the first quarter of the twelfth century

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[11]. During the Middle Age the use of wood panel paintings in the West was not as diffuse as the wall paintings. The most ancient wood panel paintings were the icons of the 5th-7th centuries. In Italy the *Archeropita*, created with walnut wood, probably dated to the 6th century, and the so called *Madonna della Clemenza*, made of cypress wood (8th century) are the oldest known icons [12]. The Sacred Icon of the Glicofilusa Virgin, stored in the Gregorian Monastery of Vena in Sicily, is made of a single chestnut panel (170x67x3cm) and it is dated back to the 6th century even if the ^{14}C dating postpones the cutting down of the original tree to some subsequent centuries, between the 11th and 13th [13].

CONCLUSIONS

In this paper some non-invasive analysis on the painted surface of the Holy Saviour triptych in Tivoli and a micro-invasive study of the wood support were performed. The analysis revealed the presence of pigments like vermilion, ultramarine blue, red lead, gold in the original painting and also lead white and orpiment in the priming. The wood support is made of chestnut a species rarely used for panel painting. This result supports the dating of the panel if compared with another panel painting (St. Angel in Pescheria) of the first quarter of the twelfth century.

The combined study of the historical background and of the material aspect of the works of art is fundamental to fully understand their present state, to evaluate the most appropriate conservative environment and to stimulate a wider deliberation before the conservative intervention.

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Fig. 1 – The Holy Saviour triptych inside the chapel.

Fig. 2 – A particular of the left eye of Christ, magnification 25x. The lines and the shadings are highly detailed.

Fig. 3 – IRC photograph of the Dormitio Virginis panel.

Point	Description	Ca	Mn	Fe	Cu	As	Sr	Sn	Au	Hg	Pb
Tiv.01	Blue of the pillow of Christ	27					71				27
Tiv.02	Blue gem of the Christ's throne	30					92				52
Tiv.03	Flesh of the Christ's hand									46	2883
Tiv.04	Red fold on the Christ's right sleeve (original)	24					83		506	1190	36
Tiv.05	Red paint on the Christ's chest (repainting)	39		38			49		887	250	32
Tiv.06	Red area of a square gem near to the point 2	135					80			6053	265
Tiv.07	Orange colour of a square gem near to the point 6	63					74			1538	1857
Tiv.08	Red of the Christ's throne, on the left	51		37	125	2446	215			42	159
Tiv.09	Red of the Christ's throne, on the right	33	43	117	65	5770	126			46	210
Tiv.10	Yellow of the Christ's throne			114			154		3342		27
Tiv.11	Green gem on the left of the throne						99			73	3239
Tiv.12	Red-orange on the Virgin garment	122		213	28		262			17	59
Tiv.13	Flesh tone on the Virgin hand			38			57				8482
Tiv.14	Red on the Virgin garment	95		42			236				198
Tiv.15	Red of the bed of the Virgin	29					149			4453	620
Tiv.16	Blue on the Virgin garment	37		23	151		109	142			6740
Tiv.17	Green on the garment of Saint John	58		271	45		170				1583
Tiv.18	Brown hair of one of the apostles	127	203	108	50		201			481	788
Tiv.19	Yellow background in the St John sermon panel						129		2721		123

Tab. 1 – Results of the XRF analysis expressed as cps (counts per seconds of the X-rays of each element)

ANALYTICAL, DIAGNOSTIC AND CONSOLIDATION AND WATER REPELENT TREATMENT OF THE BURGOS CATHEDRAL STONE

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ABSTRACT

The characterization and alteration study of the Burgos Catedral stone were performed. In addition, advantages and disavantages of differet consolidants and water repelent treatment applied on the stone have been discussed.
The stone is a limestone (bioesparitic). Density porosity, sorption-desorption, capilarity and permeability have been determined. Alterations in the stone surface have been studied and a cartography of alterations has been drawn. The stones from quarries and monuments have been treated with silicoorganic, acrilic resins and fine mortar ("jabelga"). The best results were obtained using "jabelga".

Keywords: stone, properties, alteration, consolidants

INTRODUCTION

Burgos Catedral is a Gothic-style Roman Catholic Cathedral located in Burgos, Spain. Its construction began in 1221 and the work continued off and on until 1567. It was built in French Gothic style although Renaissance style works were added in the 15th and 16th centuries [1]. The cathedral was declared a wold Heritage sites by Unesco on 1984. The building was constructed entirely of stone obtained from Hontoria de la Cantera quarries. Remarkable of this Cathedral is the white stone used. The formation of the quarry corresponds to a limestone of the cretaceous.

An accurate material characterization improves knowledge of the building`s material, increases understanding of its structural behaviour and facilites and development of sucessful intervention techniques. Treatment of consolidation and water repellent are frequently applied to the stoneworks at cultural heritages sites [2,3].

This study aimed, first physical and chemical characterization of the stone, second alterations developed in the stone, third, application of consolidation and water repellent treatment to the stone and to characterize the advantages and disavantages of different methods applied.

MATERIALS AND METHODS

Materials

Several samples were taken directly from the quarry and also 13 samples from different zones of the building (6 from the facade, 3 from the tower and 3 from the cimborrio) were facilitates.

Methods

Bulk density, porosity, resistance to compression, loss % of saturation in water resistance, water sorption and desorption, capilarity and permeability properties were determined. Alterations developed in the stone were also described. Silicoorganic and acriclic consolident and consolident and repellent inorganic fine lime mortars, "jabelga", were tested.

RESULTS

Chemical composition

The results suggested that the samples taken from quarry and the monument are highly-purity limestone (99.4% and 9,78%). The porcentages of sulfates and chlorides are somewhat higher in samples of the monuments 0.66% and 0.08% respectively, due to environmental contamination.

Mechanical and physical trials

There are not differences between the values of density and porosity of the monuments and the quarry stones. Sorption-desorption stone from quarry take in more quickly in the first ten minutes, reaching similar values with the stone of the monuments after one an hour submerged in water. These results are explained by the larger fraction of pores in the quarry stone. It has high speed of water sorption and low speed of water loss. The results obtained showed the presence of releases poros that facilitate the movement of water through stone.

Study of alterations showed on the surface of stone monument.

Patinas on the stone monument as a results of environmental contamination have been observed.

Cromatic, biogenic and bleaching patinas have been found. Different alterations have been observed on the rock surface of the monument. Black crust have a chemical, biological and mineralogical nature produced by the material transformation under the influence of exogenous compounds. It have also been observed: Pitting, detachments, efflorescence, disaggregations, surface deposits, descamaciones, alveolizaciones, arenization, cracking and vegetation. Cartography of aterations allow to distinguish four zones of alteration: a) White zone or washed stone, b) Greys areas or dry deposits, c) Black areas of wet deposits d) Green-yellow zones.

Consolidants and water repelents applied to the stone.

The stones improved its durability against thermal cycles when they receives a treatment of silicoorganic+water-repelent applying mist method. This treatment has a low quaranteed life and high cost per m^2.The consolidating acrylic has excellent behaviour when the application was done with inmersion and defficient when applied with nebulizer. This treatment is not recommended. The treatment with fine mortar had advantages of durability and behaviour at the time over the other consolidants and water repelent used in this work.

CONCLUSIONS

The stones from quarries and monument are highly purity limestone. The high retention of water in the open pores can cause freezing alteration and dissolution phenomena. The capilary rise of water and easy circulation is important in this stone.

Patinas, black crust, pitting, disaggregations, detachments, efflorescences, surface deposits, arenization, craking and vegetation have been observed in the monument and are responsibles of the stone alteration. The cartography of the alteration has established four areas. Different consolidants and water repelents have been tested on the stone in this work. The fine morter “jabelga” have shown advantages on the other products used.

ACKNOWLEDGEMENTS

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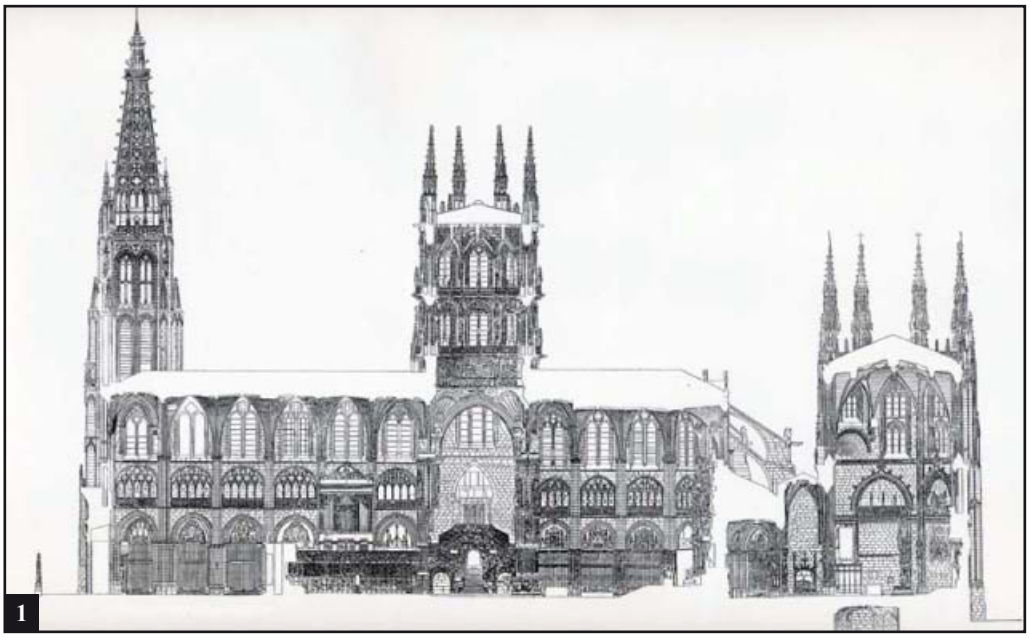

Fig. 1 – Longitudinal section of Burgos Cathedral

Fig. 2 – Stone treated with fine mortar

SCIENTIFIC STUDY OF THE GOTHIC-RENAISSANCE ALTARPIECE OF SANTIAGO CHURCH IN ÉCIJA (SPAIN)

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ABSTRACT

This work reports the characterization of inorganic and organic materials used for producing the polychromy of gothic-renaissance altarpiece of 16th century. The study was carried out in the cross sections prepared from small samples. Combined use of optical microscopy, micro-FTIR spectroscopy, SEM-EDX and XRD techniques has proved to be valuable for the characterization of compounds detected within artworks studied. Gypsum and animal glue on the support, casein and egg, lead oxide, gold and bole layers, iron oxides, red lake, cinnabar, white lead, cobalt smalt, azurite, tin-lead compounds were found.

Keywords: SEM-EDX, micro-FTIR spectroscopy, XRD, polychromy, support, binder

INTRODUCTION

By identifying pigments, binders and supports, we can reach back through time and develop a deeper understanding of the materials and techniques used by the painting masters. The first step in the traditional procedure is the preparation of cross-sections from the samples, and afterwards the application of conventional analytical techniques on, which include optical microscopy, micro-Fourier transform infrared (FTIR) spectroscopy, and energy dispersive X-rays spectroscopy coupled to scanning electron microscopy (SEM-EDX) [1-4].

The historical, physical and chemical study of a gothic-renaissance altarpiece in the southwest of Spain is carried out in this work. The temple inside is moorish style. It consists of three naves. The main altarpiece was carved in a transitional style between gothic and renaissance style by Alejo Fernandez Aleman in 16th century.

The Gospel Nave, on the left side of the altarpiece contains the paintings attributed to Pedro de Campaña, one of the masters of the sevilian painting in the 16th century. The decoration of this nave showed higher alteration degree due to environmental contamination.

The Epistle Nave, on the right side of the church contains another valuable altarpiece with polychrome sculpture and oil paintings.

The present investigation shows the successful application of the combined use of the following analytical techniques performed on cross sections of the representative samples: optical microscopy, micro-FTIR spectroscopy, scanning electron microscopy/energy dispersive X-ray analysis (SEM-EDX) and X-Ray diffraction (XRD).

The information provided by this study helps to a better description of the execution technique and corroborates a certain hypothesis about the authorship. Besides, the acknowledge of the materials used in the artwork manufacture will help to future interventions.

MATERIALS AND METHODS

Several samples from different paintings of both naves (Gospel and Epistle) as well as the altarpiece architecture have been studied.

The prepared cross-sections, were observed and photographed with an optical microscope Nikon OPTIHOT (x25, x50, x100 and x200). After preparing the cross-sections, a certain amount of powder samples was used for the XRD. FTIR spectra were recorded by a Nicolet 510 apparatus (Source: Globar, Detector: DTGS) in reflection mode, using a Nic-Plan optical microscope coupled confocally to the spectrometer.

RESULTS

Nave of Epistle

Sample 1. Lower side Virgin mantle (sculptural scene 'The Calvary')

It is noticeable the presence of a thick cementing layer (priming layer) on the wooden support. There are two white layers of preparation. It has several polychromy layers: a red layer of lead oxide. There is a gold leaf. A thin white layer has been extended over the gold leaf which presents Pb in its

composition. Finally a violet layer on the surface is made up by mixing blue and red. In the general microanalysis Pb and Cu have been reported. It contains blue and red inclusions. In punctual microanalysis on the red grains Fe is characterized whereas Cu is identified in the blue ones. Oily and proteic compounds are found so it could be attributed to whole egg used as glue.

Sample 2. Upper side architecture of the altarpiece.
It was found a zone with four layers. The two preparation layers were made up of a mixture of gypsum, dolomite and quartz and glued with protein, probably animal glue. Gold was applied over red bole layer (Si, Mg, Fe and Ca).

Sample 3. Central area Virgin mantle; La Asunción oil paint on wood.
Two layers of calcium sulphate appear on the support. This sample showed two polychrome layers: a white layer containing Pb and a red one with Pb, Hg and S. It was also found Cl attributed to an alteration product.

Sample 4. Dress from the relief "Virgin Asuncion" lower area.
A red layer of preparation (bole) and a gold leaf were found. There is a violet layer on the surface. It is made with a mixture of red and blue grains. The red pigment is obtained with hematite and the blue one is made with cobalt smalt.

Sample 5. Altarpiece architecture upper right side.
In this sample there are two thin red layers composed by cinnabar.

Nave of Gospel. Visitación oil on wood
The preparation is also extended in two layers in this artwork and made of gypsum and proteic compound.

Sample 1. Central area Virgin mantle.
Greenish blue containing Pb and Cu. Cerussite and azurite are characterized.

Sample 2. Sky.
A thin dark layer appeared on surface containing Pb, Ca, S and Cu what could be due to the formation of PbS.

Sample 3. Lower side. Santa Ana mantle.
The polychrome presents a green layer containing Pb, Ca and Cu. In some punctual analysis Sn has also been identified. Green colour is obtained with a mixture of azurite and tin-lead yellow with hydrocerussite and calcite. There is also a thin white layer containing Pb and Ca. A red upper layer contains S, Hg and Pb: a dark thin layer on the surface contains Ca and Pb and a certain amount of P, Si, Al, Cl and K.

Sample 6. Mantle of woman.
There is a greenish blue colour made up with a mixture of azurite and aluminosilicates glued with egg. On top of this layer a thin yellowish white layer obtained with lead-tin yellow and lead and calcium carbonates was found.

CONCLUSIONS

The study of both naves in the headboard altarpiece (Epistle and Gospel) has yielded valuable data with regards to the materials and execution technique. The thick stratum of preparation extended in two layers of gypsum with a proteic binder is a procedure by Pedro de Campaña (1503-1508) a Flemish painter in the Spanish Renaissance. Nevertheless, the presence of Ca and P in some analysis near the surface are indicative of the $Ca_3 (PO_4)_2$ which organizes casein micelles.

With regards to the polychrome, red, blue, violet and greenish blue are the most abundant pigments. Red boles as preparation layers of gold leaves were found. All golden layers are made of gold.

Red colours are obtained by a mixture of vermilion (HgS), and red lead (Pb_3O_4). A red lake is also added in some cases. Hematite is used mostly for the obtaining of violet colour: mixed with azurite in some cases or with smalt in other ones.

Green colour is obtained with a mixture of azurite and tin-lead yellow with hydrocerussite and calcite. These pigments and the kind of binders are indicative of original materials or at least not recent interventions.

With regards to the degradation products, the black PbS on surface in layers containing Hg, S and Pb pigments deserves a special mention.

ACKNOWLEDGEMENTS

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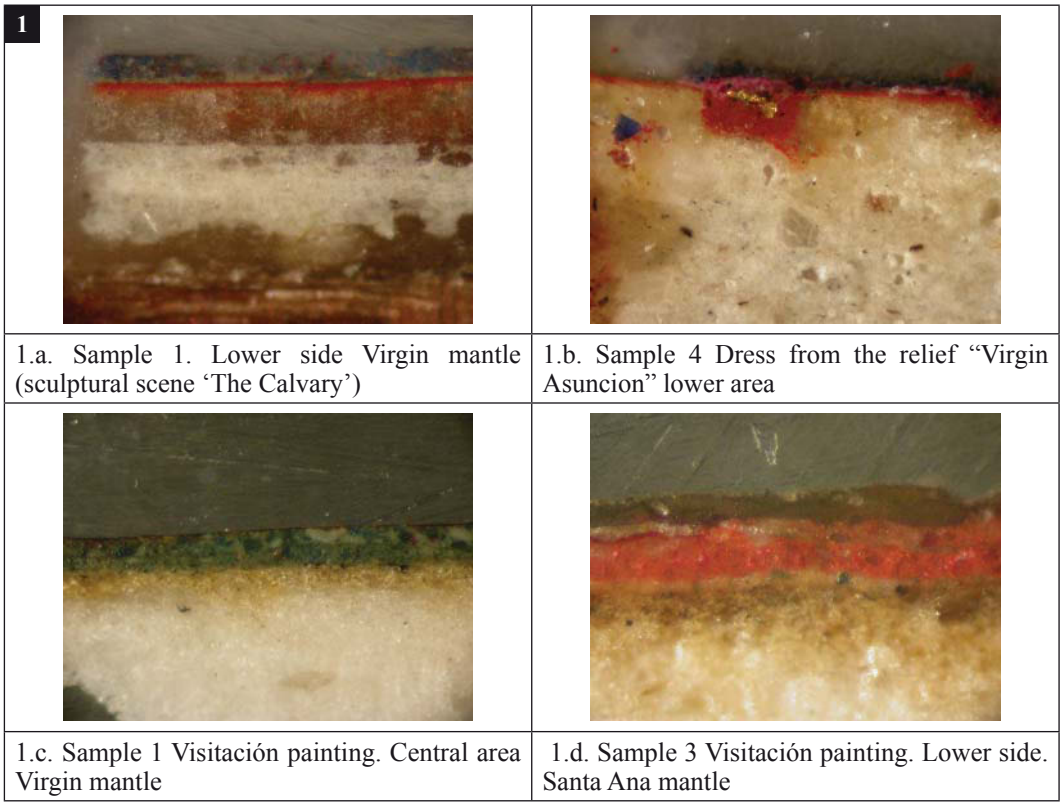

1.a. Sample 1. Lower side Virgin mantle (sculptural scene 'The Calvary')

1.b. Sample 4 Dress from the relief "Virgin Asuncion" lower area

1.c. Sample 1 Visitación painting. Central area Virgin mantle

1.d. Sample 3 Visitación painting. Lower side. Santa Ana mantle

Fig. 1 – Photomicrographs of cross-sections from different samples. 1.a and 1.b. Epistle and Gospel naves. 1.c and 1.d. Visitación painting on wood.

RADIOCARBON DATING AND GASCHROMATOGRAPHY WITH MASS SPECTROSCOPIC DETECTION ON THE RELIC OF S FRANCESCO' SACK FROM THE FRANCISCAN FRIARY OF MONTELLA

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ABSTRACT

A textile kept since AD 1224 in the Franciscan Friary of Folloni and in the main Church of Montella (AV) in Southern Italy has been analysed in order to bring a Franciscan legend to the test. The results of the radiocarbon dating and Gaschromatography with Mass spectroscopic detection are in accordance with the legned.

Keywords: Textile, S Francesco of Assisi, radiocarbon dating, GC-MS

INTRODUCTION

As the legend goes, S. Francesco arrived on a cold winter's day in AD 1222 at the city gate of the village of Montella. However, on the suspicion of being a leper he was denied access to the village, walked a short distance and slept unaffected by the snow under a tree in the nearby Folloni forest. Here the friary was subsequently founded. Two years later, during the winter of 1224/25, the brothers of the new friary were starving, because the friary was surrounded by wolves and the brothers unable to go out and seek food. They heard knocking on the door, and on the doorstep they found a sack ornate with French lilies and full of bread. S. Francesco was that winter visiting the court of the French king, and had allegedly sent an angel with bread for his brothers [1]. Fragments of the sack are now kept as a reliquary.

MATERIALS AND METHODS

Three samples of the textile were analysed. One was used for radiocarbon dating and stable isotope analysis at the AMS facility at Groningen in the Netherlands. Two were used for Chromatography − Mass Spectrometry (GC-MS).

RESULTS AND CONCLUSIONS

Results and conclusions will be presented in the talk.

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MONITORING OF THE SURFACE PATTERN OF ARTISTIC AND ARCHITECTURAL ARTEFACTS BY MEANS OF ULTRA CLOSE RANGE PHOTOGRAMMETRY

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ABSTRACT

In the present work two examples of application of ultra close range photogrammetry for on site assessing of the conservation status of surfaces of artistic and architectural interest are illustrated. The first case study regards the evaluation of cleaning treatments (chemical and physical) on the detached fresco from the intrados of the *Arco della Pesa* in Sansepolcro (AR), Italy. The second case study regards the effectiveness assessment of consolidant treatments applied on the facade of Santa Croce in Lecce realized with bioclastic limestone (Pietra di Lecce). The portability and the non-destructivity of such methodology (no-contact measurement method), propose this methodology to be used, in usual restoration works, for an easily and effective documentation of the surface pattern, for control and monitoring of wheatering processes and intervention treatments.

Keywords: Documentation, Surface monitoring, Pattern analysis.

INTRODUCTION

The documentation of artistic and architectural surfaces are usually performed by photographic surveys (photos and grazing light photos). These techniques only give 2D information and those related to the third dimension (depth or elevation) are lost. The depth or elevation are important features to assessing the state of conservation of the surfaces, in particular with respect to evaluate the effectiveness of restoration by monitoring of the surface pattern variations. 3D data can provide essential information for an early detection of any structural change, which is crucial to prevent irreversible damage. The laser scanner technique and photogrametry are candidate to give these important information.

The analysis of deformations of the wooden painting panels and canvas supports in relation to changes of environmental conditions (humidity and temperature) are already performed by a digital 3D surveying methods [1, 2]. The accuracy required for this surveying application is less than 1 mm; highest precisions (1 to 100 μm) are required for a proper investigation of surface changes due to conservation operations, such as cleaning treatments or consolidant operation. Recent works focused on the 3D tool based on the "shape-from-focus" technique [3] and ultra close range photogrammetry [4], both for assessing micro-morphological features during laser cleaning treatments of artworks.

The cleaning intervention on painted surface is one of the most important and sometimes controversial stages of the restoration, because it is a process that changes in irreversible way the surface. During the cleaning intervention, the restores have to decide, regarding to the patina (dirty, varnish, etc.), which are the optimal parameters of the cleaning process that allows the removal of undesired layers without damaging the underlying ones. On this topic the authors will discuss the use of ultra close range photogrammetry to assess the amount of patina removed during the cleaning treatment.

The second topic is an application of ultra close range photogrammetry to assess consolidant tretaments. It is evident that the type of product and its assessment are different if we consider wall paintings or stones. On wall paintings the effect of the treatment must be concentrate on the superficial layers, while on stones the applied product must also penetrate in deepth. In both case cases the surface texture must be evaluated to establish the effectiveness of the applied product, when it is no possible to use invasive tests, such as peeling test for example, the ultra close range photogrammetry allows an assessment of the surface morphology.

In this work an on site application is presented.

MATERIALS AND METHODS

The ultra close range photogrammetry is a non-destrucitve method useful for monitoring of surfaces after/during restoration activities, or to control the evolution of structural anomalies such as cracks, fissures and detachments of painted layer or small parts in unstable equilibrium.

The proposed method is based on the same principles of classic photogrammetry but it is applied to a different scale up to with a range of 30-20 cm. The size of acquired area can vary from 2 cm^2 to a maximum of 20 cm^2 with regard to the shooting distance and to the lens of the camera; so it is possible to investigate larger areas, without a mosaicking approach.

The system in Fig. 1 is a commercial products [5], composed by a motorized bar 260 mm long and a digital reflex camera (Canon 7D) equipped with calibrated Canon EFS 60 mm macro or 28 mm lens. After the selection of the camera parameters, a dedicted software allows to acquire the image of the area of interest with three shots, shifting the camera along the bar from left to right, symmetrically respect to the central shot.

The points cloud is generated via software through the acquired image (three images or more if it is necessary). On the obtained 3D model can be applied a texture that allows a better overview of the surface. The Digital Elevation Model (DEM) is generated selecting a reference plane through seeding points, and the metric information (i.e. the *xyz* data) can be extracted. The analysis of the surface morphology is performed by a dedicated routine in Matlab [6]. The best accuracy in the *xy* plane is about ±40 μm, and about ±30 μm in elevation, these performances have been obtained in laboratory with controlled light conditions.

RESULTS

Assessment of the effectiveness of consolidant treatments

In this case the photogrammetry in ultra close range configuration is used for assessing the effectiveness of some consolidant treatments applied on the facade of Santa Croce in Lecce realized with a bioclastic limestone (Pietra di Lecce. Several areas with similar state of conservation are selected to comparing the performance of some consolidant products (Ammonium Oxalate and Ammonium Phospate) with respect to non-treated areas. The variations of the surface morphology was monitored at different times after the initial treatments: t_1 is refer to 8th month,and t_2 is refer to 16th month. The patterns of the surfaces acquired by means of the photogrammetry at each monitoring step have been overlapped and the pattern differences elaborated. Some illustrative profiles are plotted in Fig. 2 for the non-treated area and in Fig. 3 for the area treated with Ammonium Oxalate.

Comparing the profiles at t_1 and at t_2 respect to the initial condiction (t_0) it is clear the loss of material form the surface of the non-tretated area (Fig. 2a). For area tretated with Ammonium Oxalate the differences are comparable with the precision error of the measurement (Fig. 3a).

Assessment of cleaning treatments

The ultra close range photogrammetry is used to evaluate the thickness of the patina (calcium oxalate) removed by some cleaning treatments from the painting layer of the detached fresco of the *Arco della Pesa* in Sansepolcro (AR), Italy. Several areas are chosen to compare three differents cleaning treatments (chemical, LQS laser, and SFR laser) and to evaluate the effectiveness of each one by means of the photogrammetry. Each area is divided in four sub-areas: the sub-area A is the reference area (non-treated area); B is the sub-area where the cleaning treatment was performed only one time; C is the sub-area where the cleaning treatment was performed two times; and on the sub-area D the cleaning treatment was performed three times.

For each treated area a single model is realized, and for each sub-area (A, B, C, and D), *xyz* coordinates of the surface have been exported. Five shots are needed to cover an area of 4x1 cm and three 3D sub-model were arranged forming a single model (Fig. 4a).

On Fig. 4b the thickness (Δz) of the removed material is shown as a function of the monitoring step (the error bar is equal to the root mean square). On the *x* axis, t_0 indicates the monitoring at the refence (before the treatment), while t_1, t_2, and t_3 are the monitoring after one, two, and three steps of cleaning treatment, respectively.

CONCLUSIONS

The ultra close range photogrammetry method and it is possible applications to monitoring surfaces of interest for the Cultural Heritage have been illustrated. The method allows thorough three images, acquired by a commercial camera, to obtain metric information on the surface under

investigation. The advantages due to the simplicity, the portability and to the non-invasivity (no-contact measurement method) propose this methodology to be used, in usual restoration works, for an easily and effective documentation of the surface pattern, for control and monitoring of wheatering processes and intervention treatments.

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Fig. 1 – Micro-photogrammetry system (by Menci Software Srl, Arezzo, Italy).

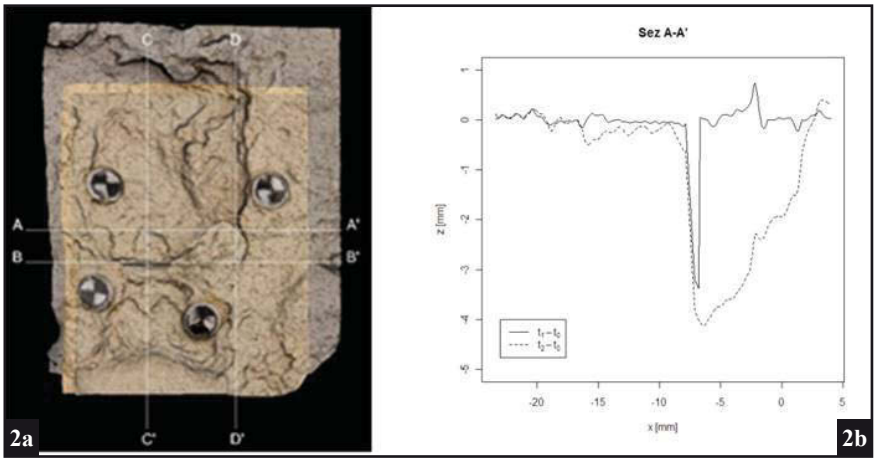

Fig. 2 – (a) The reference area selected for the monitoring; (b) Comparison of the elevation profile along the section AA' at different steps of monitoring respect to the initial condiction (t0).

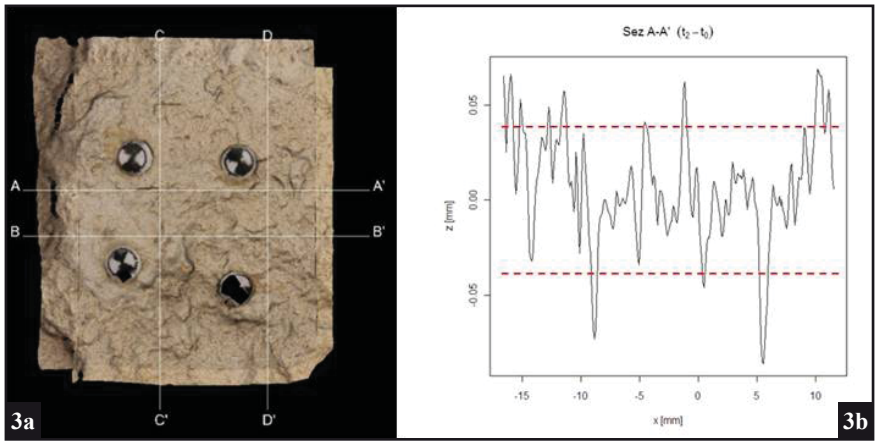

Fig. 3 – (a) The area treated with Ammonium Oxalate selected for the monitoring; (b) Comparison of the elevation profile along the section AA' at different steps of monitoring respect to the initial condiction (t0).

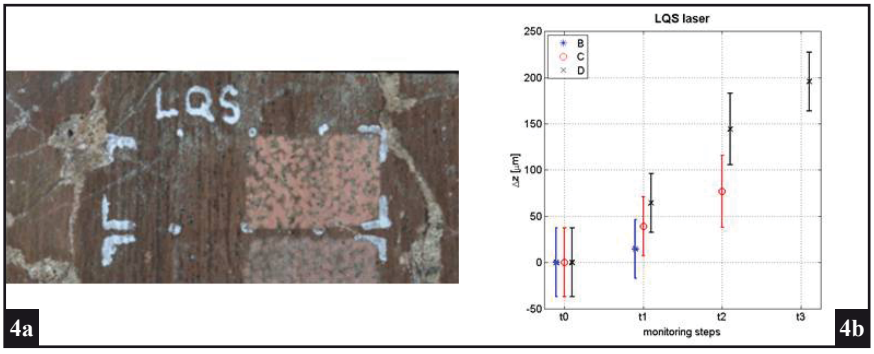

Fig. 4 – Example of an arrangement of three 3D sub-models for LQS laser working area to obtain a single model.

RESEARCH ADVANCES ABOUT PAINTINGS ON COFFERED CEILINGS IN THE NORTH OF PORTUGAL

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ABSTRACT

Paintings on coffered ceilings are a set of compartments in a ceiling with images inside that can be decorative or figurative. Mostly in the Portuguese Baroque style some churches and chapels have paintings on coffered ceilings, typically of rectangular or square format.
The paintings on coffered ceilings usually focus in sacrum-religious aspects, relating the lives of Jesus or Mary. Generally, the themes are connected to a particular place or church, describing the life of a Saint.
The investigation provides a better understanding of the paintings on coffered ceilings, typologies, themes, conservation diagnostic and points out aspects which ought to be taken into consideration for their technical and material characteristics.
It is through analytical methodologies that the conservator clarifies techniques and materials in works of art and makes the right conservation diagnostic in order to achieve the best possible methodologies for intervention.

Keywords: paintings, coffered ceilings, materials, conservation

INTRODUCTION

This form of artwork spread from North to South of Portugal since the first quarter of the XVII century to as late as the beginning of the XIX century. Through historical religious representations, these were developed in cycles, aiming towards catechizing and also seeking a decrease in the illiteracy that marked this period. (Fig. 1)
The use of paintings on coffered ceilings begins in the classical origins, Ancient Greece and Rome, but earned particular interest in the creativity and originality of the techniques and materials characterized by the Portuguese style.
Both the concepts and forms of the Greco-Roman Art were based on rationalism, harmony and proportion. Coffered ceilings were used for the first time by the Etruscan civilization while searching for the right balance between symmetry and harmony. The first ones were made of stone without the use of decoration or painting. [1]
Afterwards, the Renaissance Art came as a period of rediscovery and revaluation of the cultural classical values. These elements reflect the Greco-Roman Art, both in architecture, as in painting and sculpture which is common in the Baroque Art, although with a different structure.

OPERATIONAL GOALS AND METHODS

The main purpose of this research is to clarify issues related to the paintings on coffered ceilings from several perspectives, such as historical places, themes, forms, materials and techniques, and their relation to conservation.
To achieve this it was necessary to do an exhaustive research due to the large number of coffered ceilings, and a database was developed with locations, themes, shapes, types of ceilings, materials and techniques of execution.
Then, we selected the most interesting paintings for tests and scientific analysis. The work methodology was based on the visual observation of the paintings, on the information gathered from the available documentation on the subject, and also on the results obtained from several scientific analyses, namely infrared phtography, ultraviolet fluorescence photography, energy dispersive X-ray fluorescence spectrometry (EDXRF), cross-section examination of samples collected from the paintings using optical microscopy. Microchemical and staining tests were also performed for the identification of pigments and binders as well as Fourier transform infrared microspectrocopy (micro-FTIR) analyses). EDXRF analyses and photography techniques using ultraviolet and infrared lights were done only in some paintings to characterize pigments, varnish

types and preparatory underdrawing, because of the difficulty to access to the paintings, displayed on the churches' ceilings at 5-9 meters high. The microchemical tests and spectroscopic analyses were relevant as they brought new information of techniques and materials employed in this artistic style.

By identifying the causes of conservation problems, we improve the ways for the maintenance of coffered paintings and also the techniques of conservation and restoration.

RESULTS

Paintings themes: decorative or figurative

For better comprehension the themes of this type of paintings it is important to understand the relationship between the paintings and the church or chapel, and also other conditions like the context of artistic creation, their location or the monument's typology.

With this, we outlined a duality of themes or, in other words, typologies, of coffered ceilings in the North of Portugal: Decorative and Figurative. However, in some ceilings it is possible to see a combination of these two typologies.

To understand the distribution of the coffered ceilings in Portugal, we made an exhaustive inventory which then led to a map with all the locations and identifications of the main themes in Portugal. (Fig. 3)

Regarding the decorative typology, we found sacristies' ceilings and naves of churches with floral style and ornaments, from North to South of the country.

The paintings in coffered ceilings with floral ornaments, volutes and turns are less common. The ceiling of the *St. António of Capuchos* Convent's sacristy in the city of Guimarães is an excellent example of this typology. This division has a coffered ceiling with phytomorphic decorations in shades of white, green and gold. It is decorated with fine lines of reddish painted plant forms on a white background. The marbled frames contrast with the white background of the paintings. In some ceilings, these elements are combined with sacred themes, usually portraits of apostles and saints or catholic symbols, as seen in the ceiling of the *St. Apolinário Church's* sacristy, in *Urros*, *Torre de Moncorvo*.

Another example of the decorative typology can be seen in the main Church of *Arcos de Valdevez*, in *Viana do Castelo*. The ornamental paintings are on the coffered ceiling in the side-chapel of the *Virgin of Our Lady of Sorrows*. We found wooden original paintings hidden under these easel paintings. (Fig. 2)

Regarding the figurative typology, we noticed the existence of paintings with representation of images that can be grouped into four distinct categories according their themes: 1) figurative paintings with only one Saint or figure; 2) paintings of historical episodes; 3) themes of either symbolical or allegorical paintings; 4) paintings of profane themes.

The first theme (figurative paintings with only one Saint or figure) is the most popular and it was usually used in the sacristies or naves of Churches. The paintings are mainly half-body portraits and rarely full-body representations. The style of the compositions is simple, without motion, due to its static characteristics'. This figures, generally saints or Apostles, are represented accompanied by their representative element. Hence, these images with attributes are a consistent communication of Faith and Devotion. Either behind the figures or in their hands we can see objects that help identifying them. The distribution of the figures usually depends on images present in the iconographic scheme of the ceiling. The first paintings are the most important, usually representations of Virgin or Christ. We can find apostles or other Saints in the back of the paintings.

The second theme (paintings of historical episodes) is normally arranged by cycles mainly in the nave's of the churches' ceilings because they allow a better distribution of the scenes. The most common themes are the story of the life of Christ, scenes from the Bible and the lives of Saints composing hagiographic narratives.

The ceiling of the Salvador Convent's nave, in *Braga*, consists of forty paintings in the late mannerist style [2], picturing the lives of Christ and St. John The Baptist, and may well be one of the first ones ever made in the country. (Fig. 1)

The third theme (themes of either symbolical or allegorical paintings) is not often used in paintings on coffered ceilings especially when isolated, in other words, in only one painting. Regarding the symbolical theme it can be divided into three types: isolated, with phytomorphic motives and symbolical with narrative pictures. The ceiling of the nave in the Church of Custóias is an example of an isolated symbolical theme.

The fourth theme (paintings of profane themes) regards all the paintings that represent historical

figures, popular motives or other forms, usually in domestic or civil buildings. Coffered ceilings were also used on palaces in the eighteenth century. For instance, the Ducal Palace of Vila Viçosa includes two spaces: the Dukes Room and the Virtues Room, representing the glorification and the exaltation of the nobility.

Materials and techniques of paintings on coffered ceilings

The paintings on coffered ceilings have different support materials: wood, canvas and stone. The most common material used for both the support of the coffered paintings as for the structures is wood. The internal structure of the ceilings is usually made of metal beams supported by stone foundations.

The materials and techniques used in coffered ceilings paintings may vary depending on the client, the artist, the model used and also the types of materials most abundant in the region. There is still a lot to study and many doubts to be clarified.

The brushstroke technique should be understood according to the purpose of the paintings, because, in addition to the decorative function, it has a strong means to catechizing. We found that it is common to use a base, *imprimitura*, in many ceilings in order to assist the composition.

The under drawing, the scientific characteristics of pigments and varnishes, some restorations or even initial composition changes are other aspects have been explored in this research. (Fig. 2)

CONCLUSIONS

The database was fundamental for the investigation. This Database is the result of an exhaustive research about paintings of coffered ceilings in North of Portugal providing a better organization of many topics and consequently allowing paintings to be categorized, for example: themes, materials and techniques.

The paintings on coffered ceilings are based on specific characteristic themes of easel paintings, however differing slightly in some forms and models.

The typology of paintings on coffered ceilings in North of Portugal can be Decorative or Figurative. However, there are multiple themes inside these categories.

Regarding materials and techniques, several cases of study show that the presence of an initial pictorial layer similar to preparation, *imprimitura*, is crucial in this type of paintings because it allowed artists to give an overall tone.

Only by knowing the characteristic of techniques and materials is it possible for conservation science to evolve and find appropriate forms of treatment according to criteria of compatibility and stability.

ACKNOWLEDGEMENTS

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Fig. 1 – The paintings on coffered ceilings in the Salvador Convent's nave, in Braga.
Foto: Luis Ribeiro/QREN

Fig. 2 – The painting on coffered ceiling in the Church of Arcos de Valdevez – side-chapel of Our Lady of Sorrows, Viana do Castelo. The original painting on wood is under canvas picture.
Foto: Rita Rodrigues.

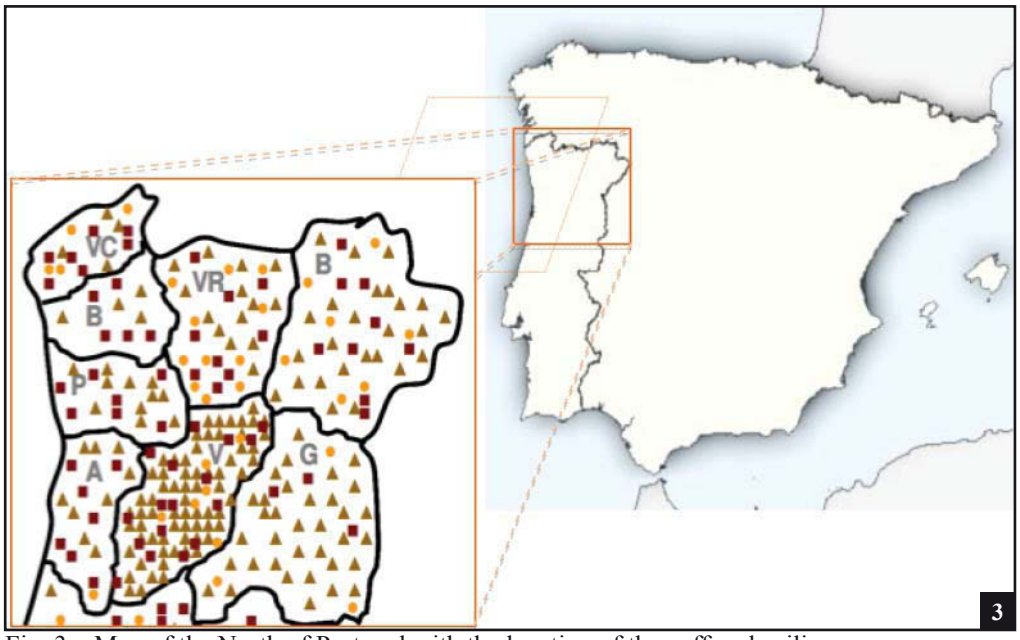

Fig. 3 – Map of the North of Portugal with the location of the coffered ceilings
Figurative Paintings ▲ Decorative Paintings ■ Combination of both themes ● Letters – Districts

MEGALITHIC BURIAL MONUMENTS IN THE BASQUE COUNTRY. A PROPOSAL OF ANALYSIS, DIAGNOSIS AND INTERVENTION

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ABSTRACT

The megalithic burial monuments located in nature sites are one of the most vulnerable of Basque cultural heritage. A series of uncontrolled natural and mostly human actions have propelled this worrying situation. This together with the historical, social and religious incalculable value of this Prehistoric legacy attracted the attention of several institutions of the Basque Country resulting in the design of a comprehensive protocol of analysis, diagnosis and intervention. For over ten years the implementation of this protocol has led to the study, conservation and restoration of almost thirty monuments in the province of Biscay, the Basque Country. Nowadays they are completely recognizable and integrated into megalithic routes.

Keywords: Megalithism, Dolmens, Authenticity, Conservation

INTRODUCTION

One of the most significant expressions of recent Prehistory in the Basque Country (Northern Spain) is the Neolithic and Chalcolithic megalithic legacy consisted of mainly religious monuments like dolmens, burial mounds, cromlechs and other lithic structures.

Among the Neolithic funeral rites, the religious-symbolic concept has a meaningful position that gains importance as an essential system of social organization of their builders. These monuments, for the first time in our History, transform into receptacles filled with a specific meaning that shows the physical fact of emotional and cultural processes turning into emblematic symbols for the community that built them.

Dolmens have a rectangular or polygonal funeral chamber, vertically made up of a series of flagstones and covered with a horizontal slab. The chamber is surrounded and, thus, protected with a mound of stones and/or earth that provides the whole with stability. Dolmens, usually reused over many generations, are located in outstanding places for being seen in the distance as a symbol of a community of dead people and as an indicator for the alive.

The main characteristics of these monuments are their location in nature sites and their simple construction with numerous elements: stones, blocks and flagstones of different size arranged following easy construction systems [1].

At present their conservation state is far from ideal and reveals a high level of risk and vulnerability (Fig. 1). The main reasons of this alarming situation can be the following: the archaeological excavation itself when has no post-intervention project; the intensive and mechanized forest and farming exploitation; the uncontrolled growth of invasive vegetation that camouflages or covers the monument; the use of its lithic elements for building medium height walls, shacks,…; the construction of tracks, paths, forest routes,…; despoliation (treasure hunt); vandalism; and atmospheric conditions.

Given the circumstances, in 2001 we began the design and development of a system of analysis, diagnosis and intervention that aims to recover and properly value megalithic monuments.

OPERATIONAL GOALS

Our proposal of analysis, diagnosis and intervention takes into account intervention criteria originated from current international policies on Cultural Heritage protection [2, 3, 4, 5, 6, 7].

This protocol focuses on innovative aspects among which outstands the concept of authenticity or wholeness as the point of veracity of the monument [8]. This concept allows for the conservation of most of the historic materials, ensures the matching with the original designs (colour, tone, texture, shape and scale) and avoids any addition that could prevail over the original appearance of the

monument preserving its real potential.
Other important aspects to consider are the diachronic value of the monument or sum up of changes that result from its historical evolution and the superseding of the concept of minimal intervention. Regarding the latter, bearing in mind that the main goal is the idea and understanding of heritage as record of a very important part of our past the intervention works need to be dynamic and should guarantee the stability of the monument against atmospheric, natural and human conditions.
In last instance, we have to point out an ethical principle towards the builders of megaliths that can be described as a total protection of their religious constructions prevailing over weakly justified archaeological interventions without an interpretation planning.
Recovering and properly valuing the megalithic heritage of the Basque province of Biscay is the final goal of the protocol arisen from these criteria.

RESULTS

The elaborated proposal relies on a scientific and comprehensive plan for ascribing value to megalithic burial monuments. Some intervention actions include:

- Analysis of the conservation state, diagnosis and classification of natural and human damaging agents.
- Selection of potential post-intervention uses of the monument.
- Assessment of the level of risk and vulnerability and execution of control measures [9].
- Design and implementation of argued analogical reconstruction proceedings on external and internal lithic structures.
- Decision about the final arrangement of the monument to make it stable and opened to the visit of tourists.
- Elaboration of a conservation protocol [10].
- Study and placing of exposition and protection systems.
- Development of a museum-like status planning that comprises different types of path closures, global and partial observation points, plotting of internal routes and systems of signposting and information within the monument and its access points [11].
- Interpretation and cultural promotion: introduction of the monument in cultural routes together with other monuments and places of interest that suggest synchronic and diachronic interpretations.

The implementation of this intervention protocol in the geographical area of Biscay has resulted in the design of three megalithic routes including twenty seven monuments now perfectly recognizable (Fig. 2).

CONCLUSIONS

This protocol has been proven effective as well as crucial for properly valuing these monuments as material evidence of human, economical, social and over all, religious practice.
At present this protocol is being performed in a fourth route that will complete a 30 km. network of megalithic routes in the West of Biscay.

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Fig. 1 – La Cabaña IV dolmen before the works of conservation and restoration. Haizko megalithic route. Karrantza, Biscay

Fig. 2 – La Cabaña IV dolmen after the works of conservation and restoration. Haizko megalithic route. Karrantza, Biscay

GILT-TELLER - A MULTIMEDIA TOOL FOR THE STUDY AND MONITORING OF GILDED WOODCARVED DECORATION IN PORTUGUESE CHURCHES

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ABSTRACT

The presentation focuses on an innovative bilingual multimedia tool designed within a research project funded by the Portuguese Foundation for Science and Technology (FCT) and aiming to disseminate the scientific results of this project to both the larger public and specialized one. The interdisciplinary multi-scale research of the gilding materials and techniques in ecclesiastic Portuguese woodcarved decoration ("talha dourada") covering a range of time from c.1500 to c.1800 proposed by this project will be available online through a dedicated website and database including the most representative altarpieces and polychrome sculptures studied within the project. The tool, designed with the help of a company from Coimbra (Take the Wind), illustrates the different components of the project and its outcomes in the form of text, images and video contents on case studies. For the first time in the history of the ecclesiastic Heritage, this multimedia tool will bring together knowledge from three different scientific areas, all related wit the topic of the project: Art History (with a component of Technical Art History), Conservation and Heritage Science.

Keywords: multimedia, tool, gilding materials and techniques, Portuguese woodcarved decoration

INTRODUCTION

The Gilt-Teller project (www.gilt-teller.pt) is a 3 year research project funded by FCT (Portuguese Foundation for Science and Technology) dealing with historical, technical and analytical study of gilding materials and techniques [1] in the gilded woodcarved decoration ("talha dourada") from Portuguese churches during 3 centuries (ca. 1500-1800).

"Talha dourada" is a singular type of gilded decoration on wooden support developed in Iberian Peninsula and that in Portugal knew its outermost expresson during the Baroque époque. This decorative phenomenon has been adopted and spread together with other artistic techniques such as "azulejos", in the form of a complete work of art and a national mark for this country, expressing also the religious faith and a catechetical message [2-4]. Although subjected to intensive historical research, "talha dourada" decorations all over the Portuguese territory were not systematically investigated from the material and technical points of view and many churches and museums house today altarpieces, retables and other wooden and gilded decorations, never studied. Thus, the Gilt-Teller research was meant to fill this lacuna and launch a pilot-project on the territory [5]. Due to the limited amount of time versus the huge amount of altarpieces and other woodcarving typologies of artefacts (ecclesiastic furniture, sculptures etc.) spread allover Portugal, the project focused on some geographic areas (Lisbon and surroundings, Santarém, Portalegre, Guarda, Viseu, Miranda, Algarve) and on three typologies of objects: main altarpieces from churches and chapels; lateral and collateral altarpieces from churches and chapels, polychrome sculptures with gilded decoration. The main criteria considered for selecting the altarpieces and sculptures were: *historical and artistic values* , pointing out the esthetical and cultural relevance of the case studies in close relationship with: presence of historical documentation (work contracts and other documents from the same époque), presence or not (better if not) of past interventions, their conservation state, prediction of future treatments (sampling campaign organized before the start of restoration intervention).

Within this study the fifth task is focused on the design of an innovative multimedia bilingual (Portuguese/English) tool in the form of a website supporting a database of open access. The website was created in the form of a virtual trip into gilding materials and techniques, illustrating the historical, artistic and scientific background of the studies performed during the project.

Conceived as an interactive map of Portugal (Fig. 1) on which several points were marked to indicate the location of important altarpieces and polychrome sculptures studied in the project, the tool shows the complexity of "talha dourada" from three perspectives: *the historical and stylistic one* (the classification of the altarpieces being done based on the historical-stylistic attribution), *the conservation one* (each object taken into study was provided with technical sheets resuming its conservation state and other technical data), and *the scientific perspective*

from various scales of characterization (from Macro to Nano) [6-7].
Traditional analytical techniques (optical microscopy, spectroscopy, difractometry) together with innovative tools, such as time-of-flight mass spectrometry (MALDI-TOF-MS), immunological assays (ELISA, IFM), fluorescent dyes, atomic force microscopy (AFM) and micro-computerized tomography (μ-CT) were used to study the gilding materials and techniques of more than 30 altarpices and sculptures all over Portugal and the scientific results obtained were elaborated in the form of an analytical database.
This task involves several members of the working group (the PI as responsible) and the consultants from abroad and Portugal. Their work and interaction provide also a model for interdisciplinarity and multidisciplinarity in the field of conservation and heritage science.
The Gilt-Teller tool has several functions: database structure, comprising various typologies of documents (texts, static images, graphs, movies etc.) with hypertext facilities; easy and friendly-accessible, available online and also on a magnetic support (DVD) in the form of a movie explaining how to access and search the information; experimental and virtual instrument, allowing real-time multi-level interaction with the fruiters/ public; capability to be transferred and integrated in an alternative, unconventional system of training (e-learning); capability to be applied and up-dated to/with similar case studies or research topics (technological transfer), allowing also comparative studies; capability to apply it for monitoring the preservation state of the studied artifacts (gilded surfaces and composites) and to evaluate in time the effects of restoration treatments; capability to offer the basis for the creation of an international network/forum for research and knowledge/know-how transfer.

OPERATIONAL GOALS

The applications of the GILT-Teller are various and incorporate an Outreach dimension that conservation field can adopt for better dissemination of its activities, covering a wide range of end-users from the general public to the students in conservation of ecclesiastic heritage.
The tool was designed as a milestone from the research activities of the project but at the same time its functions makes it available as an innovative instrument for didactic activities in e-learning systems in the fields of Art History, Conservation and Heritage Science and also as a mean to draw the attention of the wide public on this particular typologies of heritage and their problematics. The database content, although limited for now to several case-studies, can offer the background for further comparative studies on gilding materials and techniques in Europe (and not only, if we consider that Portuguese Baroque Art was spread on five continents during the Portuguese expansion) and can be subject to updgrading the information with other case-studies from the Portuguese territory, for the moment not included in the study. As the database contains sheets with reports on the conservation state of the investigated altarpieces/ sculptures, it can also be useful in monitoring campaings of their state in time.

RESULTS

Based on the collaboration with Take the Wind Lda from Coimbra, a layout of the online bilingual (Portuguese and English) tool and database was built up and compiled partially. Texts and images were provided by the involved members of the project in order to create a series of pdf documents that describe the project, its objectives, participants, milestones and the typologies (styles of "talha" or sculptures) of studied artworks.
The structure of the tool (Figure 1, layout of the Home page and example of the case study) is based on a ***Vertical Menu*** with types/styles of "talha dourada" and a ***Horizontal Menu***, at the bottom of the Home page, where general and specific information on the activities and components of the project are provided. In this last Menu, there are some parts to be yet completed: *Historical reconstructions, Additional materials, Glossary* (work in progress).
The first column of the Horizontal Menu contains *General information* on the project, its *components* and participating *institutions*, *Publications* and *Dissemination actions* (participation to conferences,workshops etc.) and the *Historical background* of the project.
The second column contains more technical data, on *Recipes and treatises on gilding, Historical reconstructions of gilded structures* (composites), *Gilding materials, Gilding techniques* and *Additional Materials*. In this last part collaborations with specialists from Italy, Germany and Spain, consultants int the project, will provide additional information on gilding techniques from these countries.
The third column contains only one specification, *Glossary*, but its content will be complex and innovative, illustrating through texts and static/ dynamic images the terminology related with all three components of the project: History, Conservation and Science.
The forth column includes the short description,

from an historical perspectives, of the main styles of talha (*Renascentist, Maneirist, Baroque, Rococó, Neoclassical*) and the *Polychrome sculpture* typology of objects.
The database was organized in technical sheets structuring the main information obtained from the research activities undertaken during the first three tasks of the project. We briefly illustrate here this structure for a case study, the ***Main Altarpiece of the Church of Sorrow in Lisbon*** (Figures 2-4). The first document contains *general* data about the altarpiece including a general view on it (image). The following data sheets are organized according the main categories of information provided by the analytical methodology of study: *Samples*, *Layers* of gilded structures from each sample, *Materials* of gilding, *Techniques* of gilding. This part can be considered a first level of access, for general public, as contains texts and images that everyone can basically read and understand. The second level is recommended for specialists and students in conservation field as it contains more detailed data about the conservation state of the objects, the samples and their analysis. In fact this second part points out the analytical techniques applied on each sample for each case-study, giving the full record of the analytical parameters and results obtained. Each sample is identified using an acronym derived from the acronym of the object/case-study (e.g. for our case-study: PT-AM-NSPLx = Portugal - Altar Mor - Nossa Senhora da Pena Lisboa).

CONCLUSIONS

Although the content of the bilingual Gilt-teller tool described here has to be still completed, the layout and first case –study included in the online database show the potential and functions of this tool for research, didatic and dissemination purposes. The Gilt-teller multimedia content facilitates the easy acess to the available information to general and specialized public.
The innovation that this tool and database bring into the field of Cultural Heritage research is the cross-bridging of three components of the project: History, Conservation and Science both at the level of how the information is structured and presented (using technical sheet with data on the history of the studied objects, the gilding materials and techniques, their conservation state etc.) and as far as the terminology is concerned (to be still organized in the form of a bilingual multimedia Glossary).

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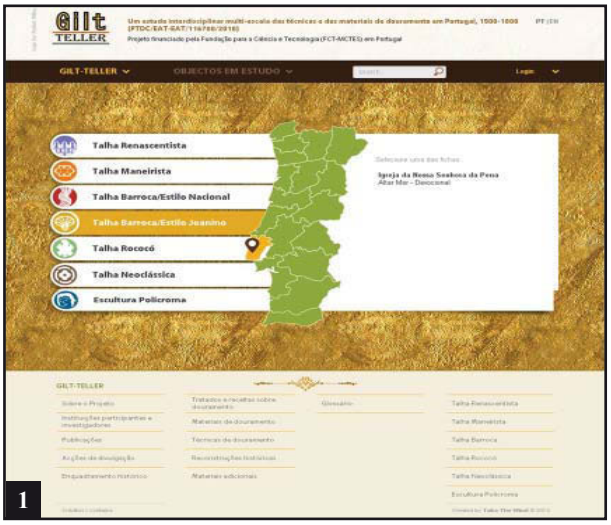

Fig. 1 – Portuguese Homepage of the website and online database with a case-study pointed on the map.

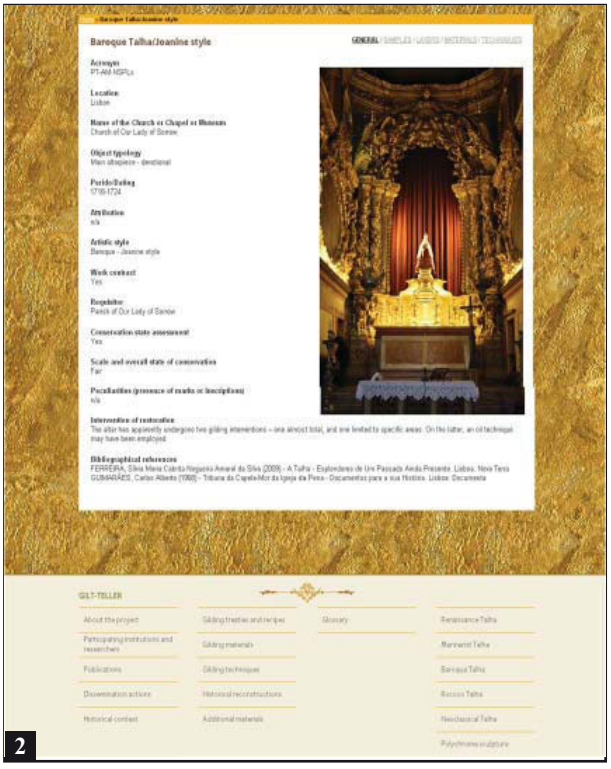

Fig. 2– Detail of the general data sheet of the altarpiece (English version) and of the Menu (upper right side) showing the components of the database for this case-study (only for the first nivel of acess)

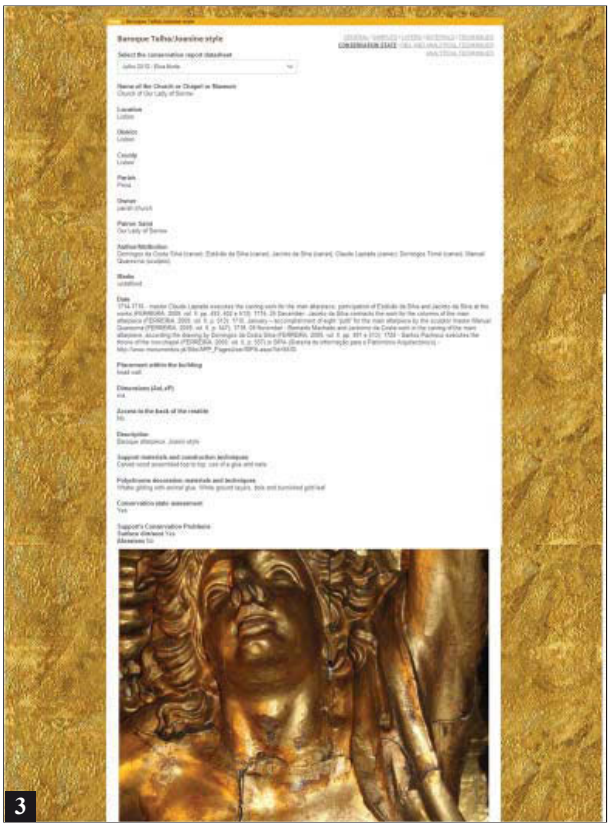

Fig. 3– Detail of the data sheet with the description of the conservation state of the altarpiece (English version)

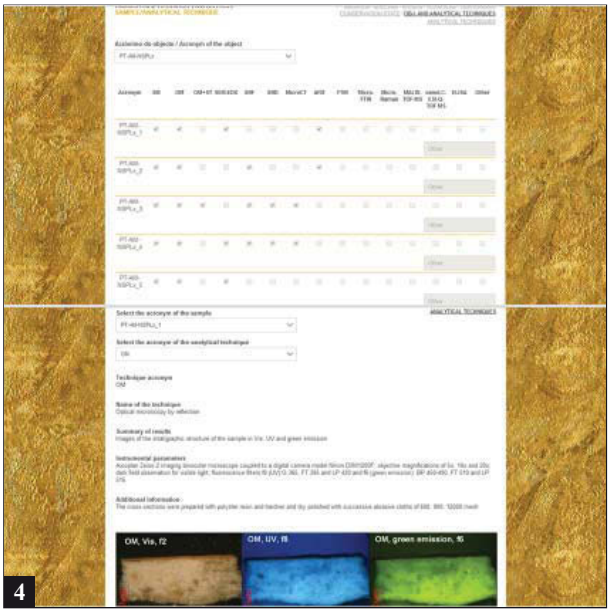

Fig. 4– Data sheets with analytical techniques by samples and description of results from each technique (English version) – example of the data from optical microscopy (OM) observation

MORE THAN GOLD – AN INTERDISCIPLINARY, COMPLEMENTARY STUDY OF GILDING MATERIALS AND TECHNIQUES IN BAROQUE ALTARPIECES FROM PORTUGAL

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ABSTRACT

The poster deals with an interdisciplinary and multi-technique study of gilding materials and techniques in several altarpieces from Portugal during the Baroque époque (known as National Baroque "talha dourada") developed within a research project funded by the Portuguese Foundation for Science and Technology (PTDC/EAT-EAT/116700/2010; 2012-2015).
The National Baroque "talha dourada" in Portugal was generally identified as the Baroque expression of art during the reign of king Pedro II and it is characterized by different ornamental motives such as: acanthus leaves, bunches of grapes, ears of grain, phoenixes, volutes, half-bodies and boy-like figures, usually employed for columns decoration. The "national style" altarpiece was widely accepted throughout the country, from the larger, most relevant cities, to the smaller, more isolated towns of inland Portugal.
Different microscopic techniques (stereomicroscopy, optical microscopy and scanning electron microscopy) together with X-ray diffraction, micro-CT, micro-FTIR and micro-Raman spectroscopy were used to characterize the stratigraphic structure and gilding techniques of around 50 samples taken from 7 eucharistic and devotional altarpieces in the areas of Lisbon and Santarém. The multi-technique and multi-layer approach was aimed to answer to several issues related with gilding materials and techniques, such as: differentiation between *gesso grosso* and *gesso matte* in the structure and composition of the ground layers; differentiation between ground, bole layers and metal leaf and their elemental characterization; identification and mapping of inorganic and/or organic phases in the whole composite.
The study pretends to be also a comparative research between the gilding materials and techniques used in altarpieces from the same historical period but in different geographical areas, not very far one from another, the chosen altarpieces being from main churches such as Cathedral of Santarém and Our Lady of Sorrow in Lisbon but also from several villages and a small city (Cascais) around this two main Portuguese cities. Preliminary results show the characteristics of the layers in the gilded composites specific to watergilding technique and the use of gold leaf but also of the imitation of its appearance using silver leaf and a varnish (commonly known as shellac). In some cases polychromy can be found, especially in the representation of ornamental antropomorphic (e.g. angels, Christ from the reliquary scene of Ressurection) or vegetal motives. Polychrome layers belonging to over-painting interventions were also found in few samples.

Keywords: gilding materials and techniques, Portuguese altarpieces, Baroque époque, interdisciplinary study

INTRODUCTION

Within the Gilt-Teller (www.gilt-teller.pt), a research project funded by FCT (Portuguese Foundation for Science and Technology), an interdisciplinary team is studying from three different perspectives (historically, technically and analytically) the gilding materials and techniques [1] in the gilded woodcarved decoration ("talha dourada") from Portuguese churches during three centuries (ca. 1500-1800) [2].
The art known as "talha dourada", of a great scenographical component reinforced by the dogmas instituted after the Trento Council (1545-1563), was a privileged art, transversal to different stylistic époques not only in Portugal but also in all the countries of Portuguese expansion and influence [3]. The most florishing expression of this art occurred during the Baroque époque, namely between XVIIth and XVIIIth century. Portuguese Baroque talha can be attributed to two different stylistic moments: one that generally corresponds to the reign of Pedro II (designated as "national style"), and another that is usually associated to the

reign of his son, João V – hence its designation of "Joanin style" [4].
The "national style" altarpiece was widely accepted throughout the country, from the larger, most relevant cities, to the smaller, more isolated towns of inland Portugal. In these churches the altarpiece is projected as an individual entity, a closed-up and powerful space. It makes use of spiral-like columns, that tend to prolong themselves way into the top of the retable. At the centre, a void space with premeditated dimensions is created, in order to place the eucharistic throne, usually in the shape of a pyramid.
A classical stratigraphical structure of gilding on wood [5] in watergilding technique was made of the following components: a sizing animal glue layer (added with some garlic pieces, mixture named "alhada" in the XVIIIth century) applied still hot by brush, to impermeabilize the support; a white preparation, made of gesso and in some cases with addition of chalk, frequently *gesso grosso* overlapped by *gesso fino*, bound with animal glue, in a total of 1 to 5 layers each; a bole reddish colored layer, made of argillous materials or mixed with ochres, traditionally named *Armenian bole*, bound by animal glue and applied by very soft brushes (known as *pituá*) in 3 to 5 layers; good quality gold leaves (*ouro de lei*), that could be made of pure gold or alloyed with silver and/or copper, applied over the bole with very diluted animal glue solution (*água de cola*); final polishing of the gilded leaf with agate burnishers; polychromy obtained by overlapping layers of tempera color where the drawings were left visible (using a sharp tool, *esgrafito*), showing vegetal, zoomorphic or geometric motives made with the point of a fine brush [6-8]. In the more hidden carved areas of the retables or sculptures the gilding could also be done using a *mordant*, being a more immediate and less expensive method than the *water gilding*.
The research pretends to be also a comparative study between the gilding materials and techniques used in altarpieces from the same historical period but in different geographical areas, not very far one from another. Four main altarpieces (one from the church of Our Lady of Purification in Bucelas, Loures - PT-AM-NSPLx; one from Our Lady of Victory in the Cidadela Palace, Cascais - PT-AM-PCC; one from the parish church of Tancos, Santarém - PT-AM-Ta and another from the parish church of Salvaterra dos Magos, Santarém – PT-AM-Sal) and three lateral altarpieces (lateral altarpiece from Our Lady of Sorrow in Lisbon - PT-AL-NSPLx, right lateral altarpiece of Our Lady of Glory - PT-AL-NSCSt and left altarpiece of Our Lady of Conception - PT-AL-SGSt, both in the Cathedral of Santarém) were taken into study (Figure 1). The lack of work contracts providing information on gilding materials and techniques justified the necessity to undertake a close observation of the retables during sampling and to perform a complex analytical investigation on the taken samples.

MATERIALS AND METHODS

Different microscopic techniques (stereomicroscopy, optical microscopy and scanning electron microscopy) together with X-ray diffraction, micro-computerized tomography (micro-CT), microFTIR and microRaman spectroscopy were used to characterize the stratigraphic structure and gilding techniques of around 50 samples taken from 7 eucharistic and devotional altarpieces in the area of Lisbon and Santarém.
The microscopic observation under visible light was complemented with UV fluorescence on cross-sections and with a specific stain for proteins (Sypro Ruby) useful to map and identify the presence of animal glues in the different layers of the gilded composites [9]. The SEM and micro-CT imaging [10] contributed to the characterization of the layers morphology and peculiarities of technique (such as the difference between *gesso grosso* and *gesso fine* in the ground layers), while the energy dispersive X-ray spectrometric elemental analysis (EDX) mapped the constitutive elements for each layer and identified the karat values for the leaves. Inorganic (inert charges, pigments) and organic (binders and varnishes) phases were identified using XRD, microFTIR and microRaman techniques[10].

RESULTS

The multi-technique and multi-layer approach was aimed to answer to several issues related with gilding materials and techniques, such as: differentiation between *gesso grosso* and *gesso matte* in the structure and composition of the ground layers; differentiation between ground, bole layers and metal leaf and their elemental characterization; identification and mapping of inorganic and/or organic phases in the whole composite; etc.
As the Figure 2 shows, there is a certain similarity in the structure, appearance and composition of gilding layers for all the altarpieces. The stratigraphy is generally made of *gesso grosso/gesso fine* layers (gypsum/anhydrite) of ground (variable thickness, from 200 um to ca. 600 um) (Figure 3), red or yellow ochre bole layers (with variable thickness, from 20 um to few um) and the metal leaf, just few micron thickness. Chalk was identified in few samples in mixture with gypsum (PT-AM-BULx_7 and 8; PT-AM-PCC_2). The bole layers are mainly made of *iron oxides* and *clay minerals* (XRD and SEM-EDX

identified kaolinite, quartz and muscovite in layers of yellow ochre). The presence of organic materials (such as wax or vegetal resins) as protective coating was identified in case of some altarpieces (PT-AL-NSPLx, PT-AM-Ta, PT-AM-PCC), for the others their absence confirming cleaning or other restoration interventions.

In some samples (e.g.: PT-AM-BULx_3, PT-AM-PCC_6), two phases of gilding were identified, the upper layers being probably from later interventions of re-gilding (the leaf being of poorer quality than in the lower layers of gilding). Generally the gold leaf was identify to be an alloy of Au with Ag and Cu (from 21 to 23 karats purity); in case of PT-AL-NSPLx silver leaf with a shellac varnish (identified by a typical color of fluorescence and micro-FTIR analysis, Figure 4) on the top was found. These results are consistent with other studies performed on gold leaf from Portuguese retables [7-8].

Polychrome layers were also detected in some samples in correspondence of incarnations or other colored areas (e.g.: "marmoreado" technique) and in few cases (e.g. PT-AM-PCC) their presence testify some intervention using recent pigments (such as barite and zinc white), lead white (identified as cerrusite by microRaman in samples PT-AL-NSCSt_2 and PT-AL-SGSt_4) and calcite (e.g.: white layers in samples PT-AL-SGSt_4).

CONCLUSIONS

Preliminary results show the characteristics of the layers in the gilded composites specific to watergilding technique (ground layers of variable thickness, bole layers of different colours - red or yellow ochres, and the thin leaf) and the use of gold leaf (made of Au alloyed with Cu and Ag; 21, 22 and 23 karats) but also of the imitation of its appearance using silver leaf (as pure Ag or as alloy of Ag with Cu) and a varnish with an orange color of fluorescence (commonly known as shellac). In some cases polychromy can be found, especially in the representation of ornamental antropomorphic (e.g. angels, Christ from the reliquary scene of Ressurection) or vegetal motives. Polychrome layers belonging to more recent over-painting or re-polychromy interventions were also found in few samples.

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Fig. 1 – The 7 studied altarpieces

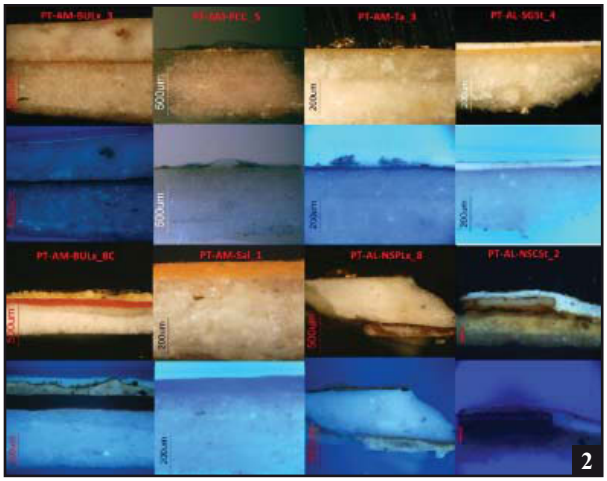

Fig. 2 – Examples of the stratigraphy of the gilding layers in the 7 altarpieces, observed by optical microscopy in Vis and UV light

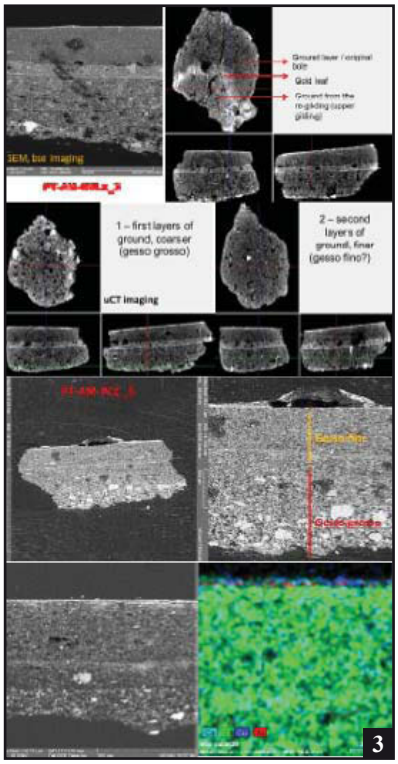

Fig. 3 – The gesso grosso/gesso fine technique in the ground layers using microCT and SEM-EDX imaging, samples PT-AM-BULx_3 and PT-AM-PCC_5

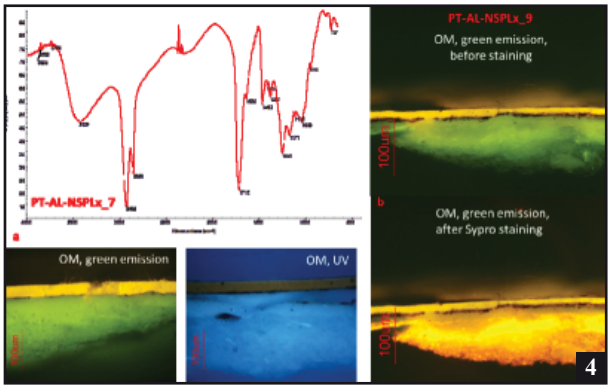

Fig. 4 – Two examples of the organic materials identified and mapped in the stratigraphic layers: a) shellac varnish for silver leaf protection in samples from PT-AL-NSPLx identified by microFTIR and OM fluorescence; b) Sypro staining for mapping animal glue in the grund layers of sample PT-AL-NSPLx_9

IDENTIFICATION OF INORGANIC ARTISTS' PIGMENTS BY SURFACE ENHANCED RAMAN SPECTROSCOPY

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ABSTRACT

This work demonstrates the systematic effect of surface-enhanced Raman scattering for micrometers size cinnabar crystallites. Colloidal Ag nanoparticles and Au-coated Ge/Si-nanostructures have been used for SERS-active substrates preparetion. Obtained results can be considered as the extension of traditional surface enhanced Raman spectroscopy towards bigger inorganic probes.

Keywords: SERS, Ge/Si-nanostructures, cinnabar, inorganic pigments

INTRODUCTION

The main challenge of cultural heritage study is the art materials identification without affecting artwork's aesthetic and artistic value. For many reasons, art materials identification is not a trivial task for analytical study. Modern high-sensitive atomic and molecular spectroscopic techniques provide objective information about the material under the investigation. However, for their successful application in daily practice of cultural heritage study it is necessary to solve a number of tasks, such as the research process optimization, improving sensitivity etc.

Raman spectroscopy is one of the most effective techniques of substances identification owing to the facts that the frequency set of the Raman spectrum is determined by the structure of the substance under investigation. However, Raman scattering has very low yield and therefore it needs large amount of material to be examined. Additionally, since Raman scattering is rather weak it is readily masked by uncontrollable intrinsic fluorescence of the analysed probe. That is why Raman spectroscopy has a very limited application in the cultural heritage study.

The intensity of Raman scattering can be essentially increased if the atom or molecule is placed near a metal nanobody where generation of surface plasmons offers superior enhancement of light--materr interaction resulting in increasing of Raman scattering by 10^4 – 10^6 times [1] and in certain cases by 10^{14} times [2]. This effect is called Surface enhanced Raman scattering (SERS). Recently, a number of papers have reported successful application of SERS to identify organic art materials [3-5]. However, there is some challenge to apply this technique for inorganic pigments study mainly because of the relatively large particle size of these pigments.

In this paper several approaches to the SERS realisation for inorganic microcrystals are presenred. We demonstrate systematic enhancement of Raman scattering on the example of relative large (2-2.5 μm) cinnabar crystallites which is known as most popular red pigment of the ancient artists.

MATERIALS AND METHODS

Two types of substrates were used for the experiments. The first of them was the gel-film of Ag nanoparticles on the glass. The silver sol has been prepared via silver nitrate reduction with sodium citrate [6]. Silver nanoparticles are mostly nearly spherical and have the average diameter approximately 50 nm while a few of them being rod-shaped (Fig. 1a). The optical density spectrum features typical extinction maximum near 400 nm with a noticeable optical density in the red edge (Fig. 1b). This red extinction band results either from a small portion of bigger nanoparticles or from nanoparticle aggregates.

The second one were Au-coated Ge/Si-nanostructured that have been grown by chemical vapor deposition with using Dichlorosilane and Germane as reactive gases in a Hydrogen atmosphere at total vapor pressure 0.1 Torr [7]. Au deposition was performed in vacuum with in situ monitoring using scanning electron microscopy. In the result of self-assembled process the germanium pyramids with a square base has been formed on the

silicon surface (Fig. 2a). The reflection spectrum (Fig. 2b) is characterized with maximum on 550 nm that assign to the Local Surface Plasmon. The topology of metal surface was completely defined by the Si-Ge topology.

The pigments suspensions that were prepared using ultrasonic disperser had been deposited on the SERS-active substrates and dried at the room temperature in the horizontal position. The suspensions in the same manner were also deposited on the reference metal-free substrates.

In our previous works [8] it has been shown that semiconductor Si/Ge-nanostructures can be successfully applied as the templates for the SERS-active substrates. They have suitable topography for SERS needs which represents itself the three-dimensional arrays of germanium islands on the silicon substrate. Moreover, the Si/Ge-based SERS-active substrates can be reused many times.

Cinnabar microsized crystals were used like the model samples. Cinnabar is the alpha-modification of mercury sulfide (α-HgS). It has the trigonal elemental cell and consists of HgS helical spirals that are arranged around the *c*-axis [9].

The Raman measurements of cinnabar were performed in the backscattering configuration at the room temperature. The He-Ne laser (632,8 nm) has been used for Raman spectra excitation. The registration system consists of a spectrograph with a diffraction grating 1200 lines/mm (Solar TII S3901) and a cooled CCD matrix (Princeton instruments).

RESULTS

The bands at 254, 286 and 344 cm^{-1} are occur in the Raman spectra (Fig. 3). The frequency band at 254 cm^{-1} corresponds to secondary vibration of A_1, and the bands at 286 cm^{-1} and 344 cm^{-1} correspond to the E(TO) transverse vibrations [10,11] .

In SERS spectra the selectively increasing of the intensity of the bands mentioned above has been obtained. Moreover, the longitudinal stripes E(LO) oscillations on 294 cm^{-1} (as a shoulder of the band 286 cm^{-1}) and 353 cm^{-1} (as a shoulder of the band 344 cm^{-1}) appeared in the spectra as well as second order bands $A_3 + A_3$ and $M_2 + M_2$ on 493, and 498 cm^{-1}, respectively.

The enhancement of several bands in the Raman spectra was 14-16 times. However, according to our calculations for silver spherical particles [12], the more distance between point-like probe and metal surface increase, the less enhancement could be observe. Maximal distance where the enhancement can be observed is not more that 30-50 nm in dependence on the orientation of the dipole moment of the analyte. Since, the average size of cinnabar particles is 2 μm, only small portion of crystallites' volume could give the contribute to SERS signal while normal Raman signal comes from the whole volume of every crystallite. So, taking into account all this facts we estimate average local enhancement to be $8–9 \cdot 10^5$ times.

CONCLUSIONS

These results show that surface enhanced Raman spectroscopy can be successfully used for inorganic art pigments identification. Because of high enhancement factors, the samples required for SERS could be microscopic in size, of the order of a few powder grains or crystallites, which can be safely taken from delicate pieces leaving no visible damage on the objects.

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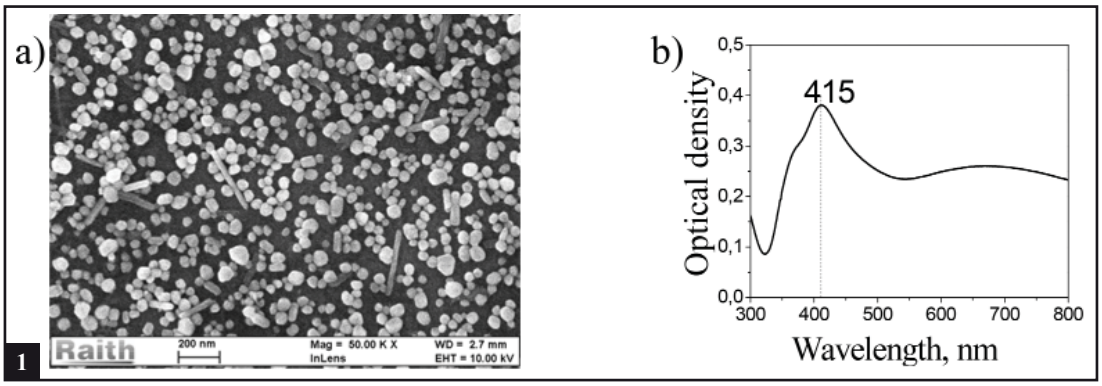

Fig. 1 – TEM-image of silver nanoparticles in the sol (a) and the optical density spectrum of silver nanoparticles in the film (b)

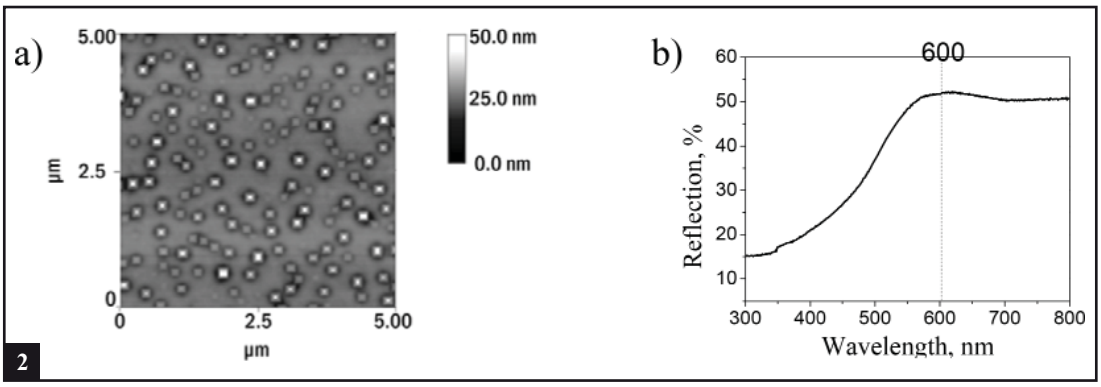

Fig. 2 – AFM-image of Au-coated Si/Ge-nanostructure (a) and its reflection spectrum (b)

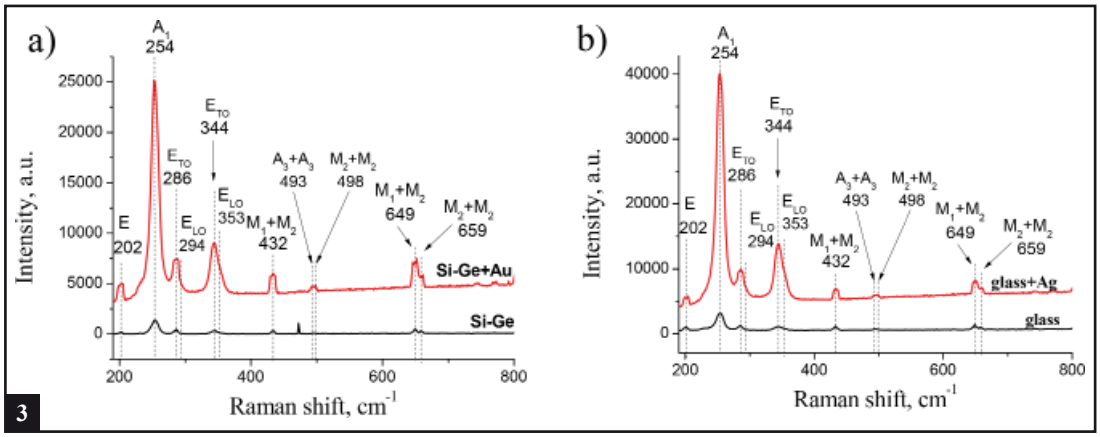

Fig. 3 – Raman spectra of cinnabar on the top of (a) Si/Ge-nanostructures and (b) gel-film of Ag nanoparticles

ARTWORKS ASCRIPTION BY ATOMIC SPECTROSCOPIC TECHNIQUES

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ABSTRACT

A layer-by-layer technique of laser induced breakdown spectroscopy (LIBS) as well as an alternative method of sample preparation for quantitative elemental composition analyses with inductively coupled plasma optical emission spectroscopy (ICP-OES) are proposed for art pigments identification.

Keywords: stratigraphic structure, micro-chemical analysis, art pigment identification, LIBS, ICP-OES, laser ablation

INTRODUCTION

Detailed structural characterization and identification of key chemical constituents can uncover important information of the historical and artistic significance of artworks. Obviously, their authenticity can be questioned if the pigments or binders used are not in agreement with the work's chronological placement.

It should be noted that works of art have a complex stratigraphic structure. They consist of a large number of components that differ from each other by their physical and chemical properties. And to make the conclusions about what materials are found in each of the structural elements, we should determine the distribution of chemical elements into the bulk of the sample.

Laser induced breakdown spectroscopy (LIBS) is a rapid elemental analysis technique, which is applicable *in situ,* don't require any sample preparation and give the opportunity to carry out multi-elemental composition study. Moreover, it is possible to realize layer-by-layer analysis of chemical composition of the artwork with the help of this technique.

The quantitative data about elemental composition can greatly facilitate the art materials identification. To obtain this information from the LIBS results the calibration-free theory and the complicated calculation should be apply. By the way, inductively coupled plasma optical emission spectroscopy (ICP-OES) is the powerful technique for quantitative measurements of elemental composition without any complicated calculation.

The tradition way of sample preparation is based on the method of "wet" chemical digestion. Since artworks fragments consist of a large number of components with different dissolve ability, the sediments can be formed in the analyte solution, and the accuracy of the quantitative measurements will decrease. Thus, the laser ablation in water can be a good solution for the sample preparation in the ICP-OES analysis of the materials having low solubility in acids.

MATERIALS AND METHODS

Layer-by-layer LIBS analysis

Classical LIBS experimental setup consists of the laser, the optical system for laser beam focusing and signals collecting, and a spectrometer. To realize layer-by-layer LIBS technique we need to use the special laser operation modes that could provide the minimum thickness of the ablation. Emission spectra should be recorded after each laser pulse. The main challenge in this case was to increase signal/noise ratio, because plasma amount after single laser pulse was too small to obtain informative emission spectra.

We used double-pulse Nd:YAG laser (1064 nm) and wide-aperture detector with an inlet 1:4,4. As has been shown [1], in the case of double laser pulses, the first pulse ejects the plasma into a comparatively dense air medium at a temperature of 300 K, while the plasma produced by the second pulse develops in the cloud of vapors heated to a higher temperature. As a result, a much larger portion of the energy of the second pulse is supplied to the specimen surface than in the case of the one pulse at atmospheric pressure. Moreover, the time of the light emission increases and the background intensity decreases.

The technique has been tested and optimized at

the analysis of the model samples with layered structure and known elemental compositions. So, they consisted of a canvas, the ground on the base of titanium white (TiO_2) and two painted layers. For example, the first painted layer was cadmium yellow (CdS), and the second one was chrome green (Cr_2O_3).

Double-pulse Nd:YAG laser (1064 nm) was used in the following operation mode: the energy of each double-pulse was 0,04...0,05 J, the duration was 10 ns , the time interval between two–pulse was 7 ms and the pulse repetition frequency was 10 Hz. To reduce the laser pulses penetration depth the laser beam has been defocused.

Laser ablation as a sample preparetion technique for ICP-OES

Laser ablation as an alternative method of sample preparation for quantitative elemental composition analyses with ICP-OES is based on the idea of obtaining colloidal solutions of nanosized particles by laser ablation of solid samples in deionized water [2,3].

The effectiveness of this approach was evaluated by quantitative studying of the model samples of hardly soluble art pigments, such as ultramarine dark ($Na_7Al_6Si_6O_{24}S_3$) and cinnabar (HgS). Sample preparation was carried out by a procedure of "wet" mineralization as well as laser sampling in water.

The pigments had been immersed in a 15 ml beaker filled with de-ionized water. The laser beam had been focused in a spot onto the painted layer surface. The Nd:YAG laser (1064 nm) was used in the following operation mode: power density was 10^{10} W/cm^2, frequency was 10 Hz, the delay between pulses was 8 ms and the energy of each pulse was 50 mJ. After 30 laser shots the laser beem had been moved to a new position on the painted layer surface and the laser sampling went on. Time of exposition was 2 minutes. The particles ablated from the sample surface had uniformly distribution in the water forming a suspension. According to AFM-data the average particle size is 600-800 nm and don't exceed 1.6 µm. So, obtained analyte solutions satisfy the ICP-OES requirements [4].

RESULTS

Layer-by-layer LIBS analysis

Ten double-pulse shots had been made at the one point of the sample. The size of the ablation spot after one-shot action was 1-1.2 mm in deep and 900 mm in a diameter. Emission spectra had been recorded after every laser pulse. As the laser radiation penetrates into the depth of the painting new spectral lines may be observed, which gives the opportunity to define the layered structure and analyze the chemical composition of each layer.

As one can see from the Fig. 1, only chrome spectral lines are present in the first ablation layer. As the laser radiation penetrates into the sample depth the intensity of these lines decrease and the cadmium spectral lines begin to appear in the fourth ablation layer. There is a weak cadmium line in the seventh ablation layer and lines of titanium appear. And the spectral lines of Ti are major lines in the ninth ablation layer.

The technique had been successfully applied for the ascription a number of canvas painting and icons [5-8]. In the Fig.2 the recent results obtained during the process of the "Appearance of the Holy Mother to St. Nicolas" (XVII cent.) icon ascription are presented. Obtained spectra allow us to make conclusion about stratigraphic structure of the icon. The wood base had been covered with the chalk gesso, and then yellow-glazed silver leaf was deposited. Yellow ochre had been used like a yellow pigment. In the same manner the analysis has been carried out in the others points of the icon surface. So, the entire palette of used pigments has been defined. Cinnabar, azurite, umbers and burnt bone were identified.

Therefore, there are some cases when this *in situ* technique should be considered just as a preliminary stage for further researches.

Laser ablation as a sample preparetion technique for ICP-OES

Obtained quantitative results (Fig. 3) show us that the using of the laser ablation preserves the chemical elements stoichiometric ratio of the substances under investigation and can be used for the precision quantitative measurements of the elemental composition in cultural heritage objects. In addition, laser sampling is compatible with the using of international multi-element standard samples used in routine ICP-OES analysis and allows us to avoid the using of concentrated acids.

This approach had been applied in combination with layer-by-layer LIBS technique [9]. On the base of comparing quantitative data of ICP-OES analysis with the stoichiometric ratios calculated for art pigments that had been identified with LIBS in each painted layer the mixing recipes of colorful pastes can be obtained. Using of photosensitive

semiconductor detector in ICP experiments results in lower detectability limit in all spectral range and wider nomenclature of elements under determinations.

CONCLUSIONS

The provided techniques demonstrate the reliable results and can be applied for the cultural heritage study, both separately and in combination with each other.

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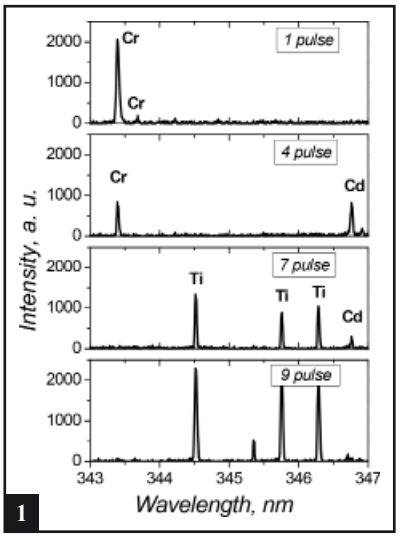

Fig. 1 – Emission spectra of model sample

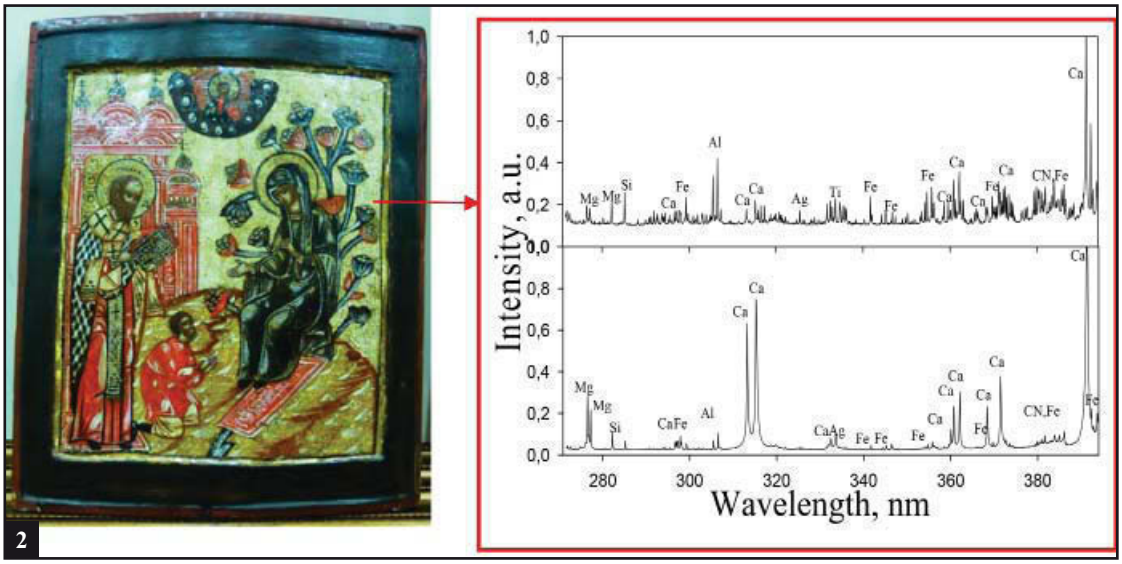

Fig. 2 – The "Appearance of the Holy Mother to St. Nicolas" icon and emission spectra of the background in the spectral range 270-390 nm

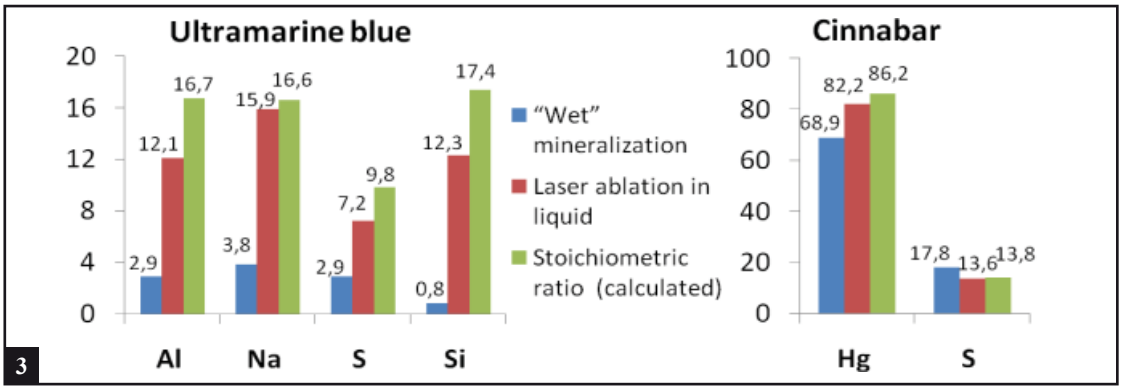

Fig. 3 – Quantitative results of elemental composition study of Ultramarine blue and Vermilion

NON-DESTRUCTIVE TESTING FOR THE ASSESSMENT OF STONE DECAY IN RELIGIOUS HERITAGE: CHURCHES OF SAN ROQUE (SEVILLE) AND NUESTRA SEÑORA DE LA ANTIGUA (TORREALHAQUIME, CADIZ)

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ABSTRACT

Measuring ultrasonic velocity provides information of the state of conservation of the stone. Two types of stone from two religious heritage monuments were assessed with a non-destructive and portable technique, ultrasound velocity.

Keywords: US, heritage conservation, non-destructive testing

INTRODUCTION

Natural stone is commonly used in architectural heritage. Although stone is often considered to be a durable material, it is affected by air pollution, weather and climate change. Every type of stone shows a different ultrasonic velocity depending on its inner structure. A decrease in velocity indicates weathering. Moreover, below a certain threshold, incipient failure is indicated. Therefore, linking decay processes to changes in ultrasonic velocity measurements helps to assess the state of preservation and can be used to protect cultural heritage.

MATERIALS AND METHODS

This study focused on the deterioration evaluation of the columns of two important churchs:

- San Roque (from 1760), in Seville.
- Nuestra Señora de la Antigua (from 1755), in TorreAlhaquime (Cádiz).

The evaluation is based on the deterioration map made by visual inspection and ultrasonic velocity measurements at 5 different levels on the chapitells (Fig. 1) in the case of Nuestra Señora de la Antigua and in the basement of the columns of San Roque (Fig. 2).

Deterioration maps were determined in each level for all columns of both churchs.

The equipment used for the measurements is a Krautkrämer BP V model, with an operating frequency of 50 KHz, and cylindric testers.

RESULTS

San Roque Church

The deterioration maps showed that the most serious deterioration was located in one of the six columns. Thus, it is required to prepare conservation schemes to reduce deterioration and to reinforce the structure of the church.

Nuestra Señora de la Antigua Church

The deterioration maps (Fig. 3) showed that the most serious deterioration was present in columns of the right side of the church probably due to no similar load strength in both sides.

CONCLUSIONS

The results of these kinds of studies are important from a technical point of view to assure the stability and long-term conservation of the religious heritage and will further serve to establish scientific conservation systems of stone cultural heritages in the future.

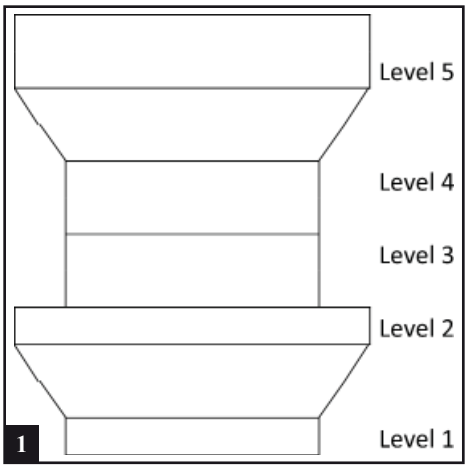

Fig. 1 – Scheme of the pillars of the Church Nuestra Señora de la Antigua and levels in which ultrasound transmission has been measured

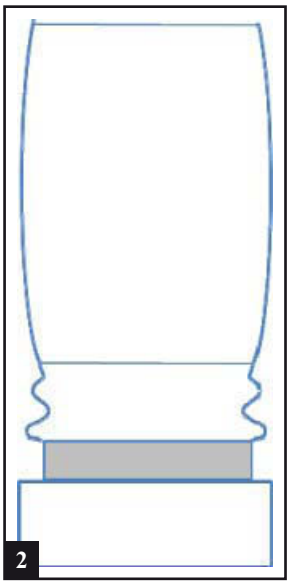

Fig. 2 – Scheme of the pillars of the Church San Roque and area (in grey) in which ultrasound transmission has been measured

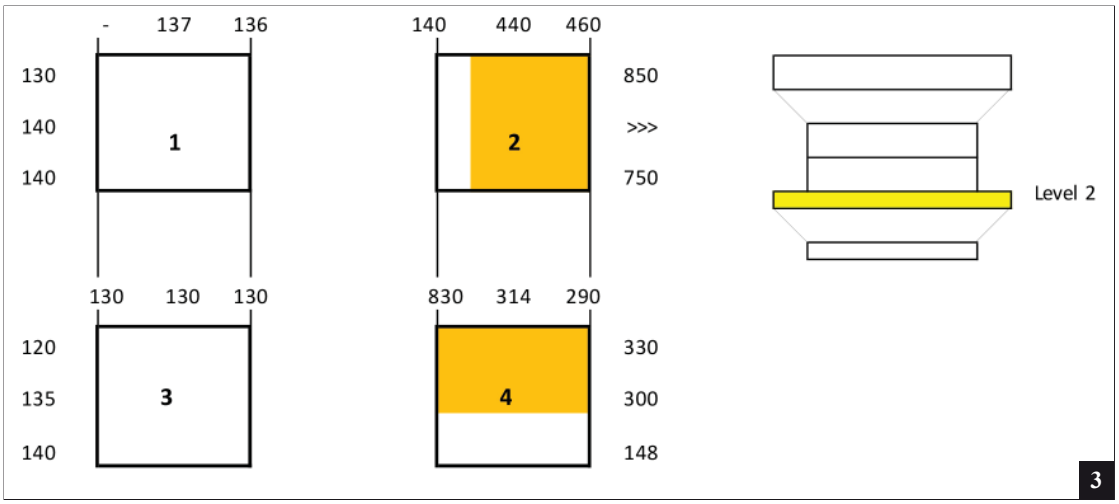

Fig. 3 – Ultrasonic transmission times obtained in the columns of the Church Nuestra Señora de la Antigua (level 2)

METAL CROWNS AND EX VOTO OBJECTS APPLIED TO CANVAS PAINTINGS: PROBLEMS OF CONSERVATION AND POTENTIAL SOLUTIONS

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ABSTRACT

In this study the attention is focused on the conservation of paintings on canvas embellished with metal elements. Currently, from literature it is possible to recover a few information concerning the conservation / restoration strategies, from both historic–artistic and technical–scientific points of view. Even more limited are the information about a suitable technique to remove the metallic elements from canvas, without causing any damage.
In this work a potential approach is performed on the painting representing "Our Lady of Sorrow" by unknown author and dating back to the XVIII century (from Diocesan Museum, Palermo). Two metal elements characterized this paint, the crown on the Virgin's head and the dagger on her chest.
Different aspects: the representation of the Virgin Mary as a Queen, the practice of coronation in art, the images of Mary's crowned, are dealt. The analyses of several documents from photographic archives of both Soprintendenza Beni Culturali and Historic Diocesan Archive, in Palermo, revealed that in the past, this type of embellishment was quite diffuse. Unfortunately, a reduced number of these paintings are actually disposable due to wars, robberies and depredations.
Here a prototype of "Our Lady of Sorrow" has been created, in order to hypothesize and test a potential methodology to stabilize the metal elements on canvas according to the principles of minimum intervention and reversibility.

Keywords: Painting on canvas, Metal applications, Conservation intervention, Counter frame

INTRODUCTION

The practice of crowning the paintings of the Virgin Mary, particularly venerated by Christians, dates back to over four centuries. Saint Alfonso Maria De Liguori (1787) summarized the theological and doctrinal thought of Mary's regality in his book " Le Glorie di Maria" (Mary's Glories) where he stated: "*poiché la Vergine Maria fu esaltata a essere madre del Re, ben a ragione la santa Chiesa l'onora e vuole che sia onorata da tutti con il titolo glorioso di Regina.*"("*as the Virgin Mary was praised for being the mother of the King, for this reason the Holy Church worships and wants her to be honored by everybody with the glorious title of Queen"*). Moreover, "*Se il Figlio è Re ("If the Son is a King)* – De Liguori went on – *la Madre, giustamente, deve essere chiamata e considerata Regina*" (*So obviously his Mother must be called and considered Queen")* therefore, if Jesus is King of the Universe, Mary is Queen. The attribution of the title of queen to Mary became the Church's task and on October 11th 1954, when the Pope Pius XII established the liturgical feast of Mary the Queen [1, 2].
The idea of a new form of veneration of the Holy Mary was born from the Christian piety and art: *apporre materialmente sul suo capo una preziosissima corona* [3] (*to put on her head a very precious crown).*
The application of crowns to an image changed the meaning of the work itself, because the "*Madonna*" changes into "*Mary the Queen*". This tendency to embellish Mary's images became a spontaneous coronation [4].
The theme of the coronation of the Virgin spread in Sicily in the XIV century, thanks to several foreign influences due to commercial contacts. The first who gave stability and holy solemnity to this ritual was the capuchin Friar Girolamo Paolucci De Calboli from Forlì, known as the "*Apostle of Our Lady*".

After his death, the coronations became a canonical ritual encouraged by the ecclesiastical Council of Saint Peter in Vatican. From that time, every years one or two images were crowned in Italy and after about eighty year even abroad. The necessary requisites to obtain the coronation were the antiquity, the great veneration and the established fame of miracles. In Sicily, there are about 46 images of the Virgin officially crowned by the Vatican Council, as reported in the book "*Madonne coronate in Italia e nel Mondo*" by Paolo Bonci. The cult of Our Lady is one of the most important in Sicilian culture and tradition; in fact in this region there is the highest number of sanctuaries [3, 5].

This trend also included the application of different metal ornaments as gifts of popular devotion (eg. *ex voto*), often without considering their constitutive material. In relationship with the weight of these objects, the effects on support (textile, wooden, stone) can be different. Particularly for painting on canvas, the presence of these elements can cause rips, tears, cuts and deformations.

In the past this kind of artifact underwent on several restoration procedures, sometime changing the artistic profile of the manufact, including the removal of these metal elements without considering alternative solutions. In this study we report a conservative approach, without altering the original painting, by which the metal applications (crowns and ornaments) were kept "*in situ*" trying to reduce their weight on the canvas.

MATERIALS AND METHODS

We have created a PVC counter frame put inside the thickness of the original wooden frame. PVC is inert material, unaltered by humidity, temperature or biodeteriogens. Some textile strips have been placed on the PVC counter frame; strips that can be placed in both horizontally or vertically position. In particular, synthetic textile strips, Dacron, have been positioned few millimetres from the original structure. The aim is to download on this counter frame the anchor bolts of the metal elements (crown and dagger), in order to unburden the original support.

In order to identify the surface tension caused by the metal elements (crown and dagger), if did not exceed the maximum material resistance, a scientific analysis has been carried out by "COMSOL Multiphysics" software. The model was a two – dimensional ellipse, the corresponding weights of the crown and the dagger were schematized with the loads applied to the two fixing points of the objects to the canvas; the value is equal to half of the total weight. Moreover, since the crown did not adhere to the canvas, but was inclined slightly forward, we considered the resulting moment of the weight force.

The linen was considered as a homogeneous, isotropic material with an elastic linear behavior. The "discretization" of the structure by finite elements (mesh) was made up with two – dimensional triangular elements with three joints of "plate" type.

RESULTS

The proposed solution was applied to *Our Lady of Sorrow* (Fig. 1) oil on canvas, XVIII century (Diocesan Museum, Palermo, Italy), in order to carry out a restoration on the original support without removing the metal elements, making them lighter. The result showed that the most stressed areas were the points of anchoring of the crown (Fig. 2). On these points there was a maximum tension at $8.7065 \cdot 10^{-5}$ GPa and, making a comparison between the obtained numerical values and those of linen resistance, we were able to deduce that the highest tension was inferior to the resistance of linen by about five units of measurement.

From this result, we have deduced that the deterioration of the canvas was not caused by the weight of the crown and dagger, but considering the aging of linen we decided to support the weight of metal elements. We have created a model that would reproduce the characteristics of the original work of art (Fig. 3). The aim was to create a removable counter frame inside the thickness of the original wooden.

For this reason, PVC was chosen because it is stable, inert and long – lasting, and the counter frame follows the oval structure of the painting. In order to reproduce correctly the form, two PVC slats with quadrangular section have been, attached by two springs inserted into PVC rectangles, applied to the slats with flat – head screws. These rectangles have been used to distance the springs from the original counter frame so as to avoid contact between metal and wood. The aid of the springs also permits us to remove the counter frame and put it back more easily.

On the PVC counter frame some strips of synthetic textile have been applied. Dacron has been chosen because it is very resistant and inert (it is used in sailing manufacts), has a high resilience and is

resistant to physical and chemical agents, unlike all other natural fibres. These strips can be applied in different ways on the canvas; can be stuck or stitched if necessary; the metal elements were anchored on these strips.
Finally a strip of Teflon is applied to the internal thickness of the PVC counter frame, to avoid the contact between the metal screws and the wooden frame and to guarantee greater inertia (Fig.4).

CONCLUSIONS

In this study we set up a conservation model applying to a works of art exposed in the Diocesan Museum in Palermo, Sicily, characterized by the presence of metal decorative elements (Fig.1).
We suggest a potential solution to the problems concerning the conservation (or removal) of metal elements from canvas painting support, during the restoration procedure. The guideline was the maintenance of these elements to guarantee the complete conservation, the respect of iconography and historic value of the applications themselves. So we suggest to lighten the tensions caused by the metal elements (the crown and the dagger) on the textile support, guaranteeing however the conservation of these elements on the manufact.
This proposal offers an example of methodology to follow in order to hand down the iconography of the paintings respecting its historic and aesthetic value.

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Fig. 1 – Unknown author, Our Lady of Sorrow, oil on canvas, XVIII century, Diocesan Museum, Palermo, Italy

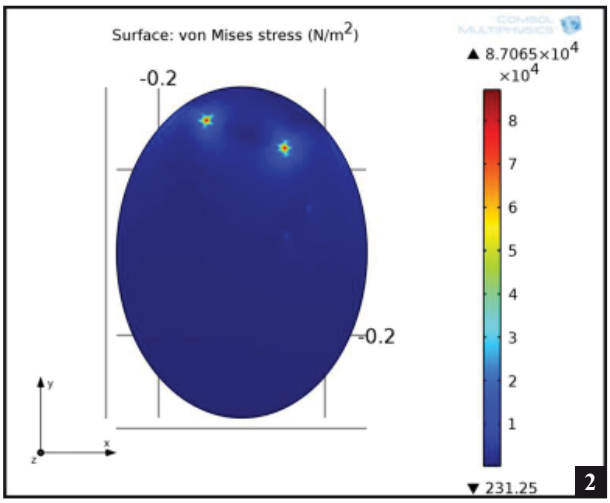

Fig. 2 – Plotting of tensions on the surface of the two – dimensional solid

Fig. 3 – Model with metal elements

Fig. 4 – The PVC counter frame with Dacron strips

New materials for the conservation and restoration

NEW MATERIALS AND METHODS USED IN THE CONSERVATION OF THE XVIITH CENTURY CURVILINEAR CANVAS PAINTING "ADORATION OF THE MAGI" FROM THE SAINT AUBAIN CATHEDRAL CHURCH IN NAMUR (BELGIUM)

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ABSTRACT

Paper discusses a concept and conservation methodology of the XVIIIth century curvilinear canvas painting "Adoration of the Magi" from the Saint – Aubain Cathedral church in Namur (Belgium). Atypical form of the painting bowed in the horizontal plane, adapted to the apse wall and its enormous size (3.70 x 4.50 m) required using some innovative technologies and materials. The basic premise of the conservation process was a detailed analysis of the canvas shape and its preservation on each step of the conservation works. The concept required construction of two curved platforms: concave and convex. The new system of the canvas overturning was also designed. An innovating method of strengthening of the canvas vertical direction during lining process by using Kevlar fibres was applied. In consequence required strengthening and modification of the stretching frame is the next discussed issue.

Keywords: curvilinear, large-size canvas painting, lining, stretching, Kevlar fibres

INTRODUCTION

The principle of the individual approach to the each piece of art has a particular importance when we face to conservation of an atypical object. In this case not only new conservation proposals but also technical solutions and materials must be often developed. Such an example is conservation of curvilinear canvas painting "Adoration of the Magi" from the Saint – Aubain Cathedral church in Namur. The painting belongs to the group of four large-size canvas, presenting the scenes of the Christ's childhood, exposed in the cathedral presbytery.

The author of this opus is Mauritius Heinrich Loder, who was born in 1728 in Germany and died in 1793 in the province of Namur. The cycle of the paintings was planned as a decorative element closely connected with the architecture, thus two of them obtained an unusual form adapted to the shape of the apse walls. The canvas "Adoration of the Magi" is bowed in the horizontal plane. Dimension of the painting is 3,70 m height and 4,50 m width. The weight of the painting, including the frame is about 300 kg. Inspection revealed a special construction of the stretcher frame.

The upper and lower stretcher beams were bent by making perpendicular cuts on the outer bar side to a depth of approximately 3-5 cm. The beams were stiffened with suitably shaped flat iron bars. The deflection of the stretcher frame is 37 cm.

The painting was in a very poor condition and required complex conservation works. The main conservation problem was a serious deformation of the canvas support resulting from the incorrect stretching. The canvas was badly distorted and fragile, while the painting layer showed numerous damages and cracks. The original composition of the painting was almost invisible.

MATERIALS AND METHODS

Conservation Project Logistics

The concept of the conservation was preservation of the curvilinear canvas form on each step of the conservation works. In the initial phase of work the painting was measured by means of laser scanning. Over 4500000 points with angular resolution of 0.0157rad and accuracy of 0.3mm in the radial direction were acquired by a laser scanner 3D Surphaser 25HSX. Results of the scanning allowed to find profiles of canvas surface and to asses dimensions and curvature of the stretcher frame. The measurements were necessary for the design and manufacturing of curvilinear work tables used for further conservation works [1].

Two separate wooden tables were built: concave and convex. The restoration process required

access to the face and back side of the painting, so during the conservation treatment the canvas had to be overturned several times. Usually for the over-size canvas painting a roller may be used [2], however the canvas support of the Loder's painting was too fragile to be rolled. For this reason another system of canvas rotation had to be developed. An innovative idea was to overturn the painting suspended on a metal bar (Fig. 1). In order to provide sufficient stiffness of the bar (length of 4 m) it was constructed from steel, telescope-like tubes. The bar was positioned above two work tables by ropes fixed to the roof structure. The ropes were introduced through the chapel vault by the existing holes in the ancient decorative elements. The canvas fixed by the shorter side to the metal bar was raised up from the one table and slowly placed on the other one each time it was necessary to change the accessible side of the painting. The rotation system was furthermore equipped with a hook weight, so the weight of the painting was controlled on each step of the conservation works.

RESULTS

Technical works: cleaning of the support, straightening and consolidation, removing of the dust and brown varnish, filing of the priming and paint losses

In July 2013, the painting situated on the high of 5,5 m above the church floor was taken down from the wall. Then the frame was taken out and the painting was transported to the lateral chapel, where it was placed on the convex platform. The support was cleaned through the chess-board method ~~(Fig,2)~~ (Fig.2) using water steam. Humidification of small areas only, eliminated contraction of the entire canvas surface. During this operation deformations of the linen fabric were almost entirely eliminated.

The next step of the work, was laborious local repairs of the canvas support and consolidation of the painting layers. Then the painting was turned on the other platform. Layers of the dust and brown varnish were removed. After cleaning the original colors, some details and finally the signature of the artist were discovered. In the following step, losses in paint and priming were filled with elastic ground.

Lining operation – string stretching

The painting was placed face down and stretched on the convex platform by using auxiliary sleeves. During lining process an innovative method of canvas strengthening in the vertical direction was applied. Before lining operation the experimental investigation of stretching induced deformation of such a curvilinear canvas was done with aid of a simple string model [3]. The conclusion was that stretching forces should coincide with canvas straight-line segments, which coincide with surface rulings [4].

The canvas support was straightened by using Kevlar fibers stretched in the vertical direction. The fibers were sewed parallel in the nonwoven stripes, which were later fixed between original support and lining canvas. Then the painting was relined on a new polyester canvas using diffused solution of the synthetic resin Beva 371 [5]. For lining we used not only traditional irons but also metal rollers of our own design, heated with warm water.

After lining the surface was cooled by metal plates and cold gel compress. The final stage of the work was retouching. The areas of losses of the painting layer were integrated with local color and missing elements of the composition were reconstructed. Finally the painting surface was covered with dammar varnish.

Stretching system

Research shows that the Loder's painting requires a new stretcher construction. Our current studies aim at preserving the original stretcher frame and modifying them to obtain proper vertical tension.

CONCLUSIONS

Conservation project of the non-planar canvas painting "Adoration of the Magi" from the Saint - Aubain Cathedral church in Namur allowed to develop conservation methodology for the whole group of curvilinear canvas paintings.

The most important advantages of the presented procedure are:

- preservation of the original canvas curvature on each step of the conservation works,
- elimination of the painting rolling (another system of the canvas overturning was proposed),
- reinforcement and stretching first of all the vertical canvas direction,
- preservation of the original stretcher frame as an example of historical construction,
- modification of the stretcher system out of the original stretcher frame.

ACKNOWLEDGEMENTS

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Fig. 1 – System of canvas overturning.

Fig. 2 – Painting placed face down on the convex platform during cleaning operation through the chess-board method.

MONITORING AND SCHEDULED MAINTENANCE

THE IMPORTANCE OF INTERDISCIPLINARITY FOR MONITORING HISTORICAL MONUMENTS - THE CASE STUDY OF PROBOTA MONASTERY, SUCEAVA, ROMANIA

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ABSTRACT

Historical monuments are carriers of the spiritual, cultural and political messages from the past. This has become more evident for the humanity who began to consider them as common patrimony, growing more interested in knowing, acknowledging and preserving them as testimonies for the future generations. Seven of the UNESCO monuments from Suceava County have been enlisted as World Heritage properties in 1993 (Arbore, Humor, Moldovița, Pătrăuți, Probota, Saint John the New in Suceava and Voronet monasteries), while Sucevita monastery was added in 2010 as an extension to the group. A multidisciplinary and international team was involved in the restoration and conservation of the Saint Nicholas church of Probota monastery, which was restored within a project implemented by UNESCO in cooperation with the Romanian Ministry of Culture and the support of the Archbishopric of Suceava and Rădăuti, and funded by the Japanese Trust Fund. After ceasing of restoration program the conservation state of these monuments were periodically verified. The interdisciplinary complexity of the monitoring activity of the Probota monastery is presented in this paper.

Keywords: UNESCO monuments, monitoring, interdisciplinary

INTRODUCTION

The *Saint Nicholas* church of Probota monastery is the second church built by Petru Rares. The first one dates from 1391 (1398), while this one was built in 1530 [1] and painted between 1532 – 1534/1535. The ruins of another church were found in 1973 near the local river, these belonging to the Old Probota, and the archeological investigations [2] showed that there were two churches built in the same location. The nowadays Probota was conceived as the princely burial place, a decision strongly opposed by the Putna monastic community at that time [3]. The monument, as we know it today, suffered, as did many of the monuments, a series of interventions. Till 1996, its maintenance was targeted mainly on the: architectural elements, mural paintings, Treasury House (*Clisiarnița*) and walls, and not always the performed interventions contributed to the safekeeping of the monumental complex.

In 1996, a complex project, implemented by UNESCO in cooperation with the Romanian Ministry of Culture and the support of the Archbishopric of Suceava and Rădăuti, was funded by Japanese Trust Fund. It implied, first of all, the mensuration of the complex investigations regarding all the elements of the monastic complex, including the living area outside the wall of the Monastery. Furthermore, interventions were carried out on all the objectives: ruins, Treasury, walls and towers, church (architecture and painting, and mobile assets and furniture), living area, sidewalks, etc. The team implied in this activity was a multidisciplinary one: restorers, historians, chemists, biologists, archeologists etc. [2]

The interventions lasted till 2001, and the aspect of the Monastery changed considerably. The interventions were focused to the outdoor and indoor mural paintings, to protect and highlight these precious mural decorations enlisted in the World Heritage. This work brief about the monitoring activity developed after the ceasing of the restoration interventions in 2001, for the *Saint Nicholas* church of Probota monastery, a unique UNESCO monument.

METHODOLOGY

When it comes to historical monuments, interdisciplinary study is of major importance, as the complexity of the heritage assets to be monitored and the numerous factors that may affect them are highly challenging. The monitoring team from Suceava County is formed basically from restorers of mural and wood paintings. However, the Department for Monitoring UNESCO Monuments from Suceava County, which is part of the Regional Restoration Laboratory of Bucovina Museum, may and are working in collaboration with other specialists

(biologists, chemists, physicists, historians, restorers of other specializations etc.) depending on the complexity of the issues involved. Besides the importance of interdisciplinary collaboration for diagnosis, there must also be a continuative cooperation with specialists in the conservation. A periodic monitoring of the state of conservation of all the components of the monument is compulsory, as an outdoor historic monument cannot be isolated from the environmental factors. When problems occur, they are signaled to the responsibles. Quick and proper interventions are desirable, so that large scale interventions could be avoided, as the latest imply large financial issues which usually contribute to the delay of the interventions.

One of the first steps in monitoring historical monuments refers to documentation. The monitoring responsibles should possess not only the basic historical data about the monumental complex and the surrounding area relevant for its state of conservation and original aspect, but also the proper knowledge about all the past problems, interventions and environmental changes to which it has been subdued.

The monitoring inspections are made at least twice a year, once during the warm season and once during the cold one. The investigation relies mainly on visual assessment of the state of conservation of the monument in general, and of the mural painting in particular. When needed and possible, the on-site observations are followed by laboratory investigations and microclimate monitoring. The observations are recorded in written form and with the help of professional cameras – a very useful tool in comparing the state of conservation between two inspections and the evolution of the state of conservation in time. Based on the information recorded on-site, periodical reports are being elaborated; these are sent to all the institutions involved in the management of these monuments. Together with the assessment of the state of conservation, a list of recommendation on maintenance and needed interventions is attached. These reports should constitute a baseline for a Management plan that is to be drawn by the newly established [4] Organizational Committee for UNESCO monuments from Suceava County [5].

RESULTS

Not as susceptible as the animated natural heritage, the built heritage has its specific "chronicle diseases". It is harder to trace their origins, as most of the time the causes are multiple. However one of them, the damp, has usually the major role in degradation of historical monuments. Direct observations and investigations of *St. Nicholas* church of Probota monastery have made possible to establish the areas that are most exposed to damp. As expected, the northern wall is the most affected by permanent high levels of humidity. Both interior and exterior surfaces are subjected to the colonization of micro- and/or macroorganisms, which often cause biological decay. The interior paintings is covered with a pinkish veil (Fig. 1a), which is more evident in the burial chamber and near the *Iconostasis*; the biological investigations revealing the presence of micromycetes commonly present in the airflora. Excepting the pigmentation of the surface of the mural painting, the decay does not seem to affect the conservation of the support or pigments. However, the problem needs a more detailed investigation. The presence of the mold is clear sign of damp retaining into the walls, due to the rising dump, the lack of proper ventilation and to the north exposure. This is a case that needs proper interventions as soon as possible.

On the exterior northern walls, the biological decay is due mainly to the presence of the black crusts, mosses and lichens such as *Caloplaca* sp., *Verrucaria* sp., *Lecanora* sp. (Fig. 1b-d), that can be observed on the bench and plinth which together work like a buffer zone for the *frescoes*, which are not affected by biological decay. Permanent damp in the warm season that leads to biological development, while in the cold season contribute to the physical-mechanical decay of the stone material. High humidity and low temperatures cause the freezing of water contained in the masonry plaster and the jointing mortar, ultimately leading to the crumbling and loss of joint mortar, fragments of plaster and even stone elements. Stone which is more resistant to damp and biological decay, is also affected, because of the continuity of the phenomenon.

The southern mural surfaces are mostly affected by abrupt changes of temperature and humidity, leading to deliquesce and recrystallization of salts. The impact is more obvious on the interior mural painting from the burial chamber, where a wide surface is affected by the loss adherence and cohesiveness (Fig. 2) of the paint layer. These kinds of degradations are usually caused by variable microclimate parameters along with high levels of humidity and salts, biological effect being also

present (Fig. 3). In the case of the burial chamber of *St. Nicholas* church of Probota monastery, the salts have been established to be nitrates (NO_3^+).

CONCLUSIONS

Permanent and periodic monitoring of all kind of heritage along with physical, chemical and biological investigations are tools that can be successfully used in preventive conservation. It is easier to prevent certain phenomena, instead of dealing with the problem through restoration interventions. For example, the biological decay which is a highly recurrent phenomenon can be prevented through a proper ventilation of the interior spaces and a periodic biocide treatment for the areas that are known to be exposed to biological decay. In the case of rising damp, the problem requires more complex interventions, for some of the causes are related to underground waters and unequal terrain settling near the church, causing malfunctions of the rain water collection and drainage systems. Still, it can also be dealt with through proper structural interventions. Both phenomena may be observed on the one and the same surface, making it difficult to differentiate between the two. Generally one of the main indicators of biological attack in visual investigation is the tendency of the biofilm to spare copper based pigments and gilded details. Still, the presence of biological agent does not exclude salts and vice – versa. At the same time, researches carried out on the monuments in the north of Moldavia, have shown that some sulfur oxidizing bacteria of the *Thiobacillus* type, due to their metabolic activity, contribute to the creation of the calcium sulfate [6]. Biological decay as well as recrystallization of different kind of salts can ultimately lead to loss of mural paintings and even decay of masonry.

As professional and complex as it may be, the restoration of built heritage cannot and should not be seen as a final point in conservation, as it does not solve the problem of the environmental factors that influence the state of conservation of this kind of heritage. Constant observation, in time notification and proper intervention are activities that can prolong the existence of these monuments.

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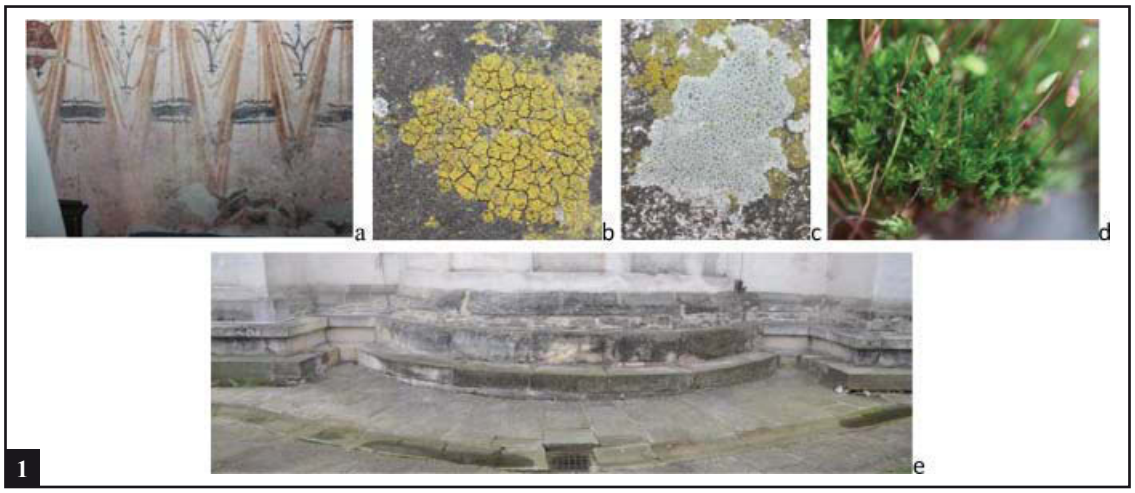

Fig. 1 – Different kind of biological organisms that colonize the northern façade, both in interior or exterior, such as the fungal colonization with a pinkish veil aspect on the interior of the northern wall - Nave, near the Iconostasis (a), lichens (b, c), mosses (d) and black crusts (e) developed on the bench and plinth.

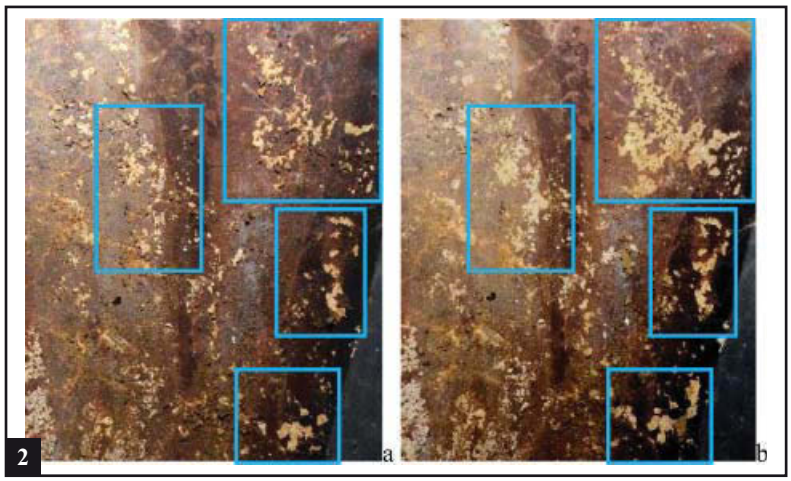

Fig. 2 – Aspect changes in time, 2011 (a) and 2013 (b), of the Southern wall, St. Pimen, due to microclimate variations, high levels of humidity and salts, conditions that led to the loss of cohesiveness and adherence of the painted layer. This phenomena was noted on all the characters from the first register (Saints standing) on the southern wall and on some areas on the western and eastern walls (in the southern half of the chamber), reaching 2 m in height.

Fig. 3 – White traces that may indicate a biological decay as well as salt efflorescence, observed on the western wall of the burial chamber.

MICROCLIMATIC MONITORING OF THE SANTA CROCE MUSEUM IN FLORENCE: ENVIRONMENTAL RISK ASSESSMENT AND PREVENTIVE CONSERVATION STRATEGY

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ABSTRACT

In 2009 a microclimatic study of the Santa Croce museum was carried out within a national project aimed at investigating the main environmental risks related to the conservation of the works of art preserved in the museum, in particular the oils on wooden boards (*Deposition from the Cross* by Francesco Salviati, *Descent of Christ into Limbo* by Agnolo Bronzino), a fresco by Taddeo Gaddi (*Tree of Life* and *Last Supper*) and the famous Crucifix by Cimabue, all located in room VI of the museum. One of the main goals of this study was to identify preventive conservation actions to be integrated in the future management plan of the museum. The monitoring pointed out that the general microclimatic conditions were not properly suitable for conservation purposes, mainly due to the management of the museum. This result associated to the risk related to a possibile future overflow of the Arno river (similarly to that occurred in 1966 that destroyed most of the Cimabue's Crucifix) led the Opera di Santa Croce to develop an emergency plan that included the movement of the works of art in safer locations within the Santa Croce complex. In spring 2014 another microclimatic monitoring is going to be performed in the new selected locations to evaluate the suitability of the conservation conditions.

Keywords: microclimate, conservation of works of art, environmental management

INTRODUCTION

Within a national project aimed at developing a sustainable conservation strategy for the works of art preserved in the Santa Croce museum, the Opera di Santa Croce commissioned the CNR-ISAC to do a microclimatic study in order to investigate the main environmental risks and thus identify suitable mitigation actions for the improvement of the conservation conditions.

It is well known that the use of a building may have a great influence on the environmental conditions and consequently on the risk of damage of the works of art preserved. As in other museums, the most important factors that have to be taken into account are related to the management: the opening/ closing of the doors, the cleaning, the heating and lighting systems and the presence of people (visitors and public during conferences and concerts). Therefore, the microclimatic conditions inside the Santa Croce museum were monitored in order to evaluate the impact of the mentioned perturbing factors, including the influence of the external climate. For the risk assessment of the works of art, in particular of the wood paintings preserved in room VI - *Deposition from the Cross* by Francesco Salviati, *Descent of Christ into Limbo* by Agnolo Bronzino and the famous Crucifix by Cimabue - (Fig. 1), the fluctuations of the environmental parameters were investigated in the medium-long term, daily variations (24 h) and sudden changes (from some minutes to 2-3 hours). This careful analysis was necessary because wood is extremely sensitive to the thermo-hygrometric variations; moreover, the paint layer has different thermo-hygrometric behavior respect to the underneath wooden substrate. In addition, the flood risk due to a possibile future overflow of the Arno river, similarly to that occurred in 1966 that severly damaged the Cimabue's Crucifix causing the loss of the majority of its paint layer, led the Opera di Santa Croce to develop an emergency plan that included the movement of these masterpieces in safer locations, i.e. in other rooms of the Santa Croce complex: the Sacristy, the bookshop (undergoing to a change in destination), the Medici Chapel and the entrance hall of the Novitiate. Hence, another microclimatic monitoring is going to start in spring 2014 to evaluate if the environmental conditions in these new locations are suitable in relation to conservation issues and, if necessary, to identify possibile future actions to be included in the conservation strategy.

METHODOLOGY OF ANALYSIS

The main thermo-hygrometric parameters (air and surface temperatures - T, relative humidity - RH and specific humidity - SH) were investigated in the whole museum, composed by 6 rooms (from I to VI). Air and surface temperatures were measured using platinum thermoresistances (Pt 100, accuracy ± 0.2 °C) while relative humidity was measured by means of capacitive sensors (accuracy ± 2% RH). These parameters were sampled automatically in many locations of the museum for two years, as indicated in Fig. 1, and in different points of the surface of the oils on wooden boards, in order to evaluate the thermo-hygrometric gradients occurring between front/back surfaces of the paintings. At the same time, air temperature, humidity and surface temperatures were also investigated during 4 manual campaigns, each one lasting 3 days in different seasons. The air T and RH measurements were taken with the same fast-response psychrometer, in order to monitor spatial gradients, to identify patterns of air masses with different thermo-hygrometric characteristic, to investigate heat and moisture exchanges between the atmosphere and the walls and/or the surfaces of the works of art [1]. During these manual campaigns surface temperature of the paintings was measured by means of a radiometer (accuracy ± 1°C) in order to evaluate differences between the high/low levels of the paintings. Moreover, thermographic images of the roof and the walls of room VI were also carried out using a FLIR B400 Thermal Camera with microbolometer sensor (accuracy ± 2°C). In fact, the artificial and natural lighting may have an important impact on the internal environmental equilibrium, causing stress to the surfaces and enhancing airborne particle deposition processes.

RESULTS

The results showed important thermo-hygrometric excursions mostly in the rooms from I to V. In fact, as indicated in table 1 the maximum daily variations were $\Delta T = 7°C$, $\Delta RH \sim 50\%$ in winter. The highly variable conditions inside the museum during the opening time put in evidence the necessity of modifying the management of the museum in order to stabilize the environmental parameters and thus to guarantee more suitable conservation conditions. Daily simple operations like the cleaning of the rooms caused abrupt indoor variations. An example is shown in Fig. 2: during the cleaning of the rooms from I to V the variations of the indoor air temperature and relative humidity were respectively 3°C and 20% in 30 minutes, to be compared to the yearly ones of 7 °C and 30%. Even the incorrect menagement of the heating system affected the internal thermal conditions of the museum causing daily excursion up to 2,5 °C. The microclimatic study has also pointed out the effect of the amount of heat and vapour released by people during particular events like conferences, normally taking place in room VI. In fact during those events an increase of the temperature up to 4°C and of the vapour content up to 1g/kg was recorded in 2 hours. The main effects on the works of art preserved in the museum are thermo-hygrometric stress and gradients between high/low levels and front/back surfaces especially for the paintings on wooden panels, which may result in dimensional variations, leading to irreversible damage, such as cracks and detachment of the paint layer. The radiometric measurements on the surfaces of the paintings showed important thermal gradients because of the direct impact of the lighting system. The thermographic analyses showed, finally, the influence of the solar radiation penetrating from the windows and the heating of the ceiling not totally insulated, which altered the natural environmental equilibrium.

CONCLUSIONS

The results of the microclimatic monitoring of the Santa Croce museum showed that the management strategy was not properly suitable for the conservation of the works of art preserved. In particular, the opening of the doors during the cleaning, the visit time and before/after particular events let the inflow of external air masses with different thermo-hygrometric characteristics, that cause the formation of temporal and spatial gradients. At the same time, the presence of many people during conferences and concerts in room VI caused the temporary variation of the main thermo-hygrometric parameters, with consequent risk of damage, in particular for the wood paintings. Finally, a better management of the lighting and heating systems is strongly recommended. In particular, the artificial lights having a direct impact on the wood paintings should be changed, as well as the heating eelements (radiators and fan coils) placed along the wall of all the rooms.

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	Spring	Summer	Autumn	Winter
Maximum daily thermal variation	3-4°C	2-3°C	6°C	**7°C**
Maximum daily variation of RH	25%	30%	20%	**49%**

Tab. 1 – Maximum daily variations in rooms from I to V.

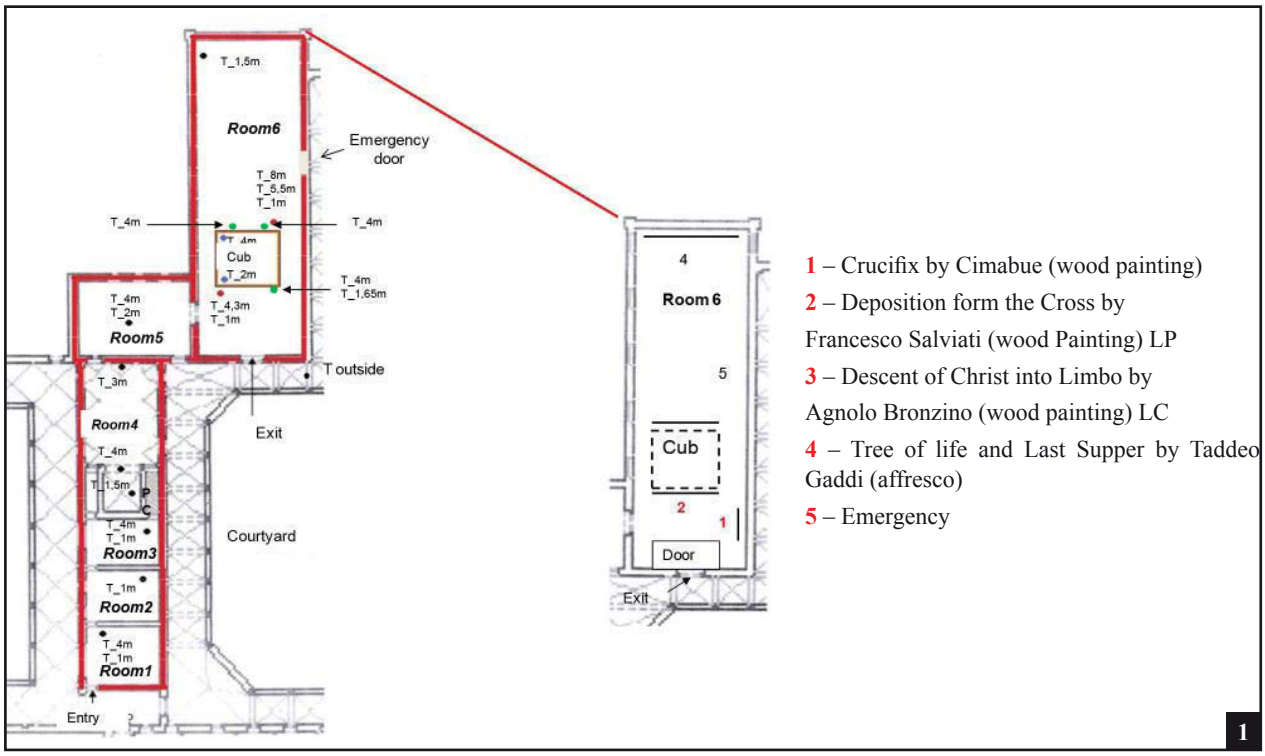

Fig. 1 – Positions of the sensors (rooms I-VI) and location of wood paintings in room VI

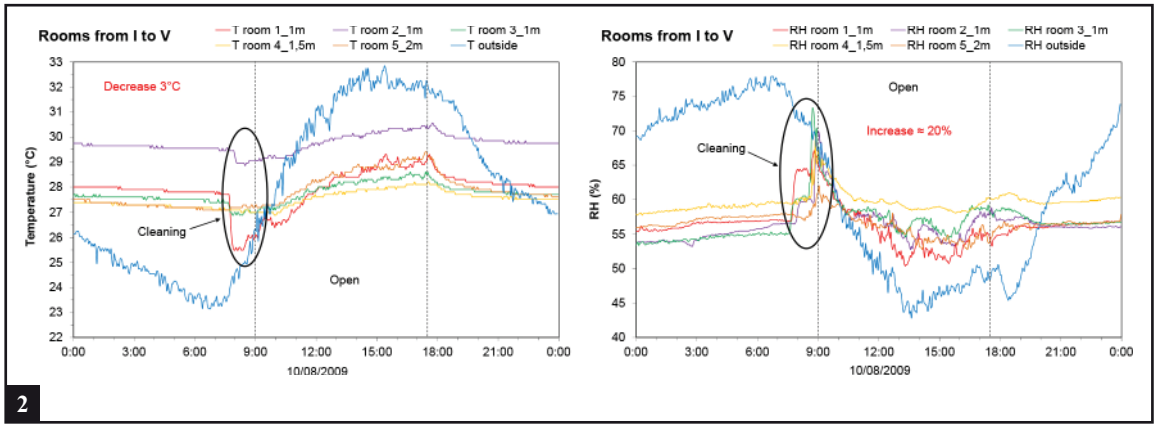

Fig. 2 – Variations of the indoor air temperature and relative humidity (respectively 3°C and 20% in 30 minutes) during the cleaning of the rooms from I to V.

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TOPICS A: THE SOCIO-SPIRITUAL VALUES OF THE RELIGIOUS ART

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