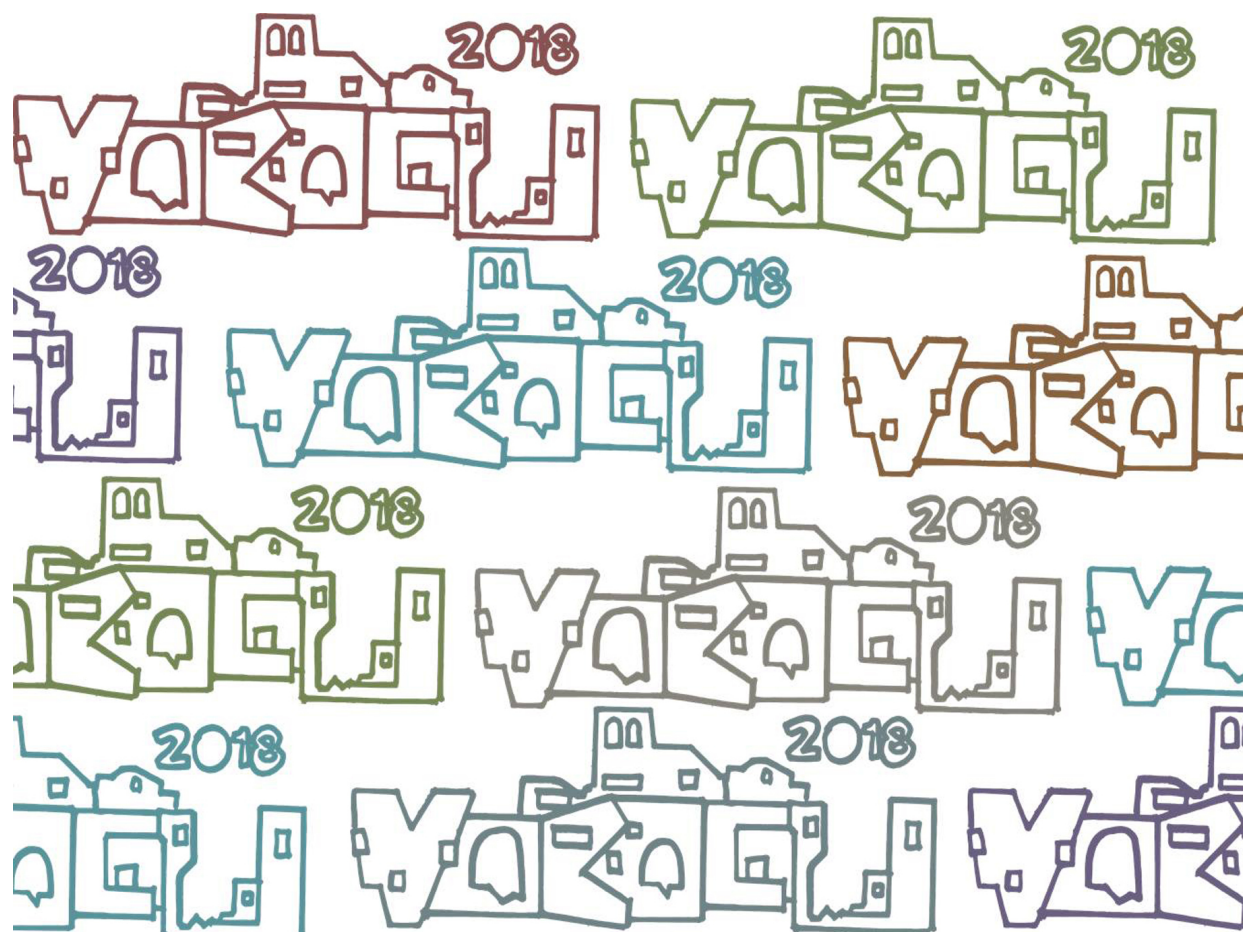


Dialogues in Cultural Heritage



**Book of Abstracts of the VI International Conference YOCOCU
Matera 22-26 May 2018**

**Andrea Macchia
Nicola Masini
Mauro F. La Russa
Fernanda Prestileo**

Editors

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Edited by

Andrea Macchia

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Preface

YOCOCU has become in the last decade a networking and meeting platform where senior and young researchers, professionals and students, all animated by the common goal to preserve and promote cultural heritage, share their experiences, show and discuss their investigation methods, offer their input in research in the different fields of cultural heritage, from the conservation to management.

The 2018 YOCOCU conference at Matera (Italy) has been conceived as a forum to promote dialogues and partnerships between scientists, conservators and managers, on one hand, and civic and community non-governmental organizations, on the other.

All parties act as interlocutors and sources of information and advice as *pares inter pares*, as partners for heritage since both are interested in new ways to improve the conservation and management of movable, immovable and intangible cultural heritage.

In YOCOCU 2018 this meeting platform will welcome citizens to encourage new dynamics between these contributors to ignite the experience and the creativity in each of these groups for the benefit of cultural heritage management and conservation.

In YOCOCU 2018, cultural heritage professionals and researchers (architects, restorers, conservation scientists, archaeologists....) and the citizens (association, municipality, heritage groups....) will present their projects, accomplished research, future activities or challenges; all together will consult, debate, establish new decision-making strategies and trace new future priorities; professionals, on their side, will learn the aims and objectives of civic groups and establish conservation strategies that may keep the integrity of cultural heritage as a first priority.

This Book of short papers is the result of a will and effort aimed at creating a bridge between Research and the Conservation of cultural heritage, in continuity with previous conferences, inclosing the last one held in Madrid in 2016.

The Book is divided in five sections, Museum, Heritage Science, Cultural Heritage management, archaeological sciences and architectural/built heritage, in their turn divided in paragraphs which better define methods, approaches and aims: (i.e. from microclimate monitoring of Museums to Cultural Heritage valorization, from archaeometry to Public Archaeology, Reuse of Industrial heritage and monuments ..).

The short papers (2 to 5 pages) deal with most of the issues that characterize the debate of scientists and conservators for two decades among which: i) the most reliable strategies and methods of safeguarding, maintenance and preservation of cultural heritage sites, including monuments and archaeological areas; ii) the effectiveness and compatibility of remedial treatments; iii) the best way to use and integrate in situ investigations and laboratory tests to study and evaluate the decay processes of heritage material; iv) the museums as inclusive places to share knowledge, culture and heritage which is the focus of the Opening of the Conference

In conclusion, the Book is the result of the will of YOCOCU, CNR and the other partners which contributed to the organization of the conference to create an effective alliance between research and conservation in order to increase the interest, understanding of the public in cultural heritage problems.

Such alliance will take place in an emblematic town, Matera, that just half century ago was considered a national disgrace for the poverty, "the shame of Italy", and next year will be the European Capital of Culture.

Matera, 22.05.2018

Andrea Macchia, Nicola Masini, Mauro F. La Russa, Fernanda Prestileo

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5.1.6

THE WHITE MARBLE OF THE CLOISTER OF THE REAL COLLEGE-SEMINAR OF CORPUS CHRISTI IN VALENCIA (SPAIN): ARCHIVAL RESEARCHES FOR THE IDENTIFICATION OF ITS PROVENANCE AND DIAGNOSTIC STUDIES FOR UNDERSTANDING ITS DECAY

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Abstract – White marble and Ribarroja stone are the stone materials employed for the columns, the balustrade and the façades of the cloister of the Real Colegio Seminario of Corpus Christi in Valencia (1586-1611) also called Colegio del Patriarca. The state of conservation of the marble elements of the balustrade is more critical than that of the columns. The lack of data concerning the type and provenance of the marble from both the balustrade and the columns and its chemical-physical characteristics, has probably been the cause of wrong interpretations and wrong choices adopted in the restoration works executed in the 1980s. The data reported in this paper are the preliminary results of an interdisciplinary study based on the analysis of the archival sources and on the diagnostic investigations performed on the constituent materials. The gathered data allowed us to define the provenance of the marble (Carrara, Italy) and to establish the main causes of decay of the elements of the cloister.

Key Words – Colegio del Patriarca, Carrara marble, restoration works, diagnostic campaign.

I. INTRODUCTION

During the sixteenth and seventeenth centuries, within the commercial exchanges between Italy and Spain, trades of high value stone materials together with craftsmen and specialized building techniques were promoted. This created the basis for the realization of artifacts with high value, in which materials and construction techniques gave rise to original results due to the involvement of both local and foreign materials and craftsmen. Spain and Italy, their heritage and historical relationships, are witness of the coexistence of materials and execution techniques imported from distant territories, thanks to the exchanges across

the Mediterranean. The history and geography of these relationships, especially for the architectural heritage, have not always been deeply investigated, and indeed they often represent an unknown factor. The present case study constitutes an opportunity in this sense that might open to many areas of knowledge, from the political and commercial history of the seventeenth century up to the personal and family relationships of Saint Juan de Ribera (Seville 1532-Valencia 1611), founder of the College-Seminar of Corpus Christi in Valencia (Fig. 1).



Figure 1. View of the cloister

The sources consulted during the research have led to the identification of a system of economic and cultural exchanges that suggest, at least in broad terms, founded interpretations of an episode of interaction between different cultures and coexistence of local and Italian materials. The founder of the *Collegio*, Patriarch *in partibus* of Antioch, Archbishop and Viceroy of Valencia, had close family and political relations with Naples, Rome and Genoa, as well as with the Spanish

Crown. For this reason, for the construction of his Seminar, he gathered contributions from the best local masters and he could exploits also Italian architects and materials [1].

The cloister is considered the most successful Renaissance work of the city of Valencia [2]. It is composed by a double gallery of arches, one located on the lower level and the other one on the upper floor laying directly on white marble columns, respectively in Doric and Ionic order. The white marble of the balustrade on the upper floor shows a decay more severe than that of the columns, which is particularly worse on the sides of the balusters facing toward the southern and western directions. The edited sources and the archival researches report a rich documentation concerning the transport of columns, bases and capitals in *marmol genovés* ("Genoese marble", name indicating only the place where the material was shipped) through the ports of Alicante and Cartagena [3].

The use of architectural elements originally intended for another building, was certainly decisive for the construction of the cloister, which was built following the project delivered to the Valencian architect Guillem del Rey.

Although the data about the provenance of the columns are almost clear, problems remain for the marble of the balustrade that was probably available within of the construction site. The lack of a deep knowledge of the materials poses further problems concerning the restoration work of this artifact, in terms of its behavior with respect to the decay, but also in term of the most proper intervention techniques to be employed. Although documentary researches have investigated about the last restoration of the cloister, fundamental for the interpretation of the actual behavior of the materials, it was not possible to have access to the specific details of the intervention.

II. MATERIALS AND METHODS

With the aim to reconstruct the history of the Real Colegio Seminario of Corpus Christi, including the provenance of the marble employed in the cloister, an extensive documentation has been consulted at the archives of "Fondo Historico" of the College. In order to understand the decay processes, and its extension on the monument, a detailed photographic relieve of main

morphologies of decay has been performed using the glossary of UNI NORMAL 11192-2006. In addition, 6 marble micro-samples have been taken from the balustrade and from the columns with the objective to investigate the petrographic characteristics of the materials, to recognize the decay products and to explain the different decay observed on the balustrade and the columns. For this reasons, data about the atmospheric contamination, the pluviometry, the solar exposure of the facades were also taken into account, completing the diagnostic investigation of the monument and its urban contest.

The micro-samples were analyzed using the following analytical methodologies: X-ray Diffractometry using a diffractometer Mod. Ultima+ of the Rigaku Company. The diffractometric scans have been acquired on powder, $3^\circ < 2\theta < 60^\circ$, at 30 mA and 40 KV operative conditions; FT-IR Spectroscopy using a Thermo-Nicolet spectrometer. The spectra have been acquired at 16 scans/s, between 500 and 4000 cm^{-1} . A part of each sample was used to prepare thin cross sections to be observed by means of transmitted and reflected light optical microscopy respectively, for the characterization of the marble and the surface layers (patinas and deposits). To this aim an optical microscope of Nikon Company, mod. Eclipse LV 100 POL was used.

III. RESULTS AND DISCUSSION

The results of the work derive from a close correlation between archival and analytical data. The archival study allowed us to understand the history of the construction of the Real Colegio Seminario of Corpus Christi. Interesting details regarding the materials employed on the monument are reported in the "Libro de las cuentas de la construcción y fábrica del Real Colegio Seminario de Corpus Christi" belonging to the documents of the "Fondo Historico" of "Edificio" series. In this book is mentioned the "*marmol genovés*" such as the marble constituting the columns of the cloister, but also general information about some payments of materials and craftsmen are reported, with reference to Italian marble sculptors for the construction of balusters and handrails.

The photographic campaign with a subsequent image rectification (Fig. 2) allowed us to obtain a

clear sketch of the facades and to map the distribution of decay.

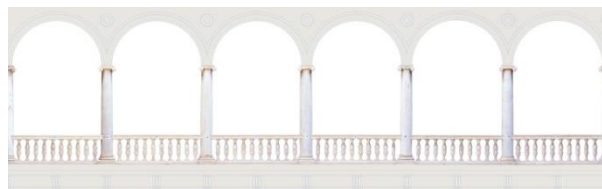


Figure 2. Image rectification of a section of the eastern balustrade of the cloister

Superficial deposits, disintegration, scaling, staining, missing parts, erosion and cracking are the main morphologies of decay found in the balustrade of the cloister (Fig. 3).

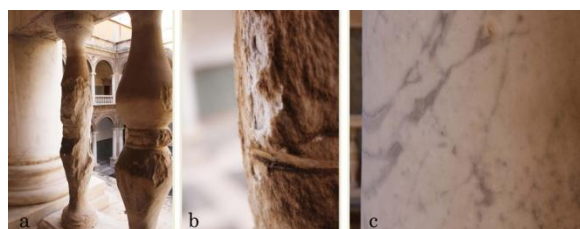


Figure 3. Details of decay of some balusters (a, b) and of a column of the eastern façade (c)

The most altered elements have been found on the facades facing the southern and western directions, more exposed to solar irradiation. The results obtained by the petrographic study indicate that the materials constituting the columns and the balusters are fine-grained calcitic marbles with a homeoblastic texture, even if two samples from the balustrade show a fine-medium heteroblastic texture. Although these marbles show different petrographic characteristics, they can be referred to the Carrara marble, which can reasonably vary from both the macroscopic and the microscopic point of view, depending on the marble quarry within the Apuan Alps district [4].

From the diagnostic point of view, the study of thin sections (Fig. 4) has shown that significant processes of sulfation do not affect the marble support; therefore, the high gypsum amount recorded in all analyzed samples has to be referred to coherent surface deposits, which are particularly rich in this compound. This is in good agreement with what observed during the visual inspections,

which excluded the presence of black crusts on the surfaces of the monument.

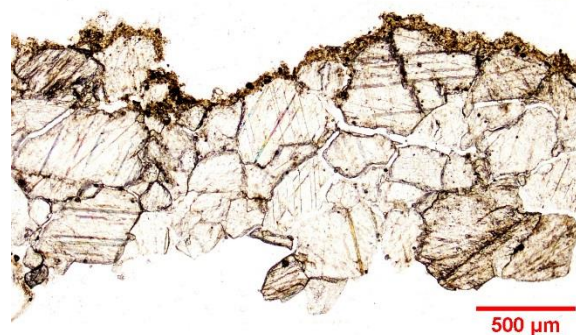


Figure 4. Thin section of a sample of baluster of the eastern facade (transmitted light, crossed polars)

The observation of thin and cross sections, integrated with the analysis performed by means of infrared spectroscopy and X-Ray Diffractometry (Fig. 5), have also demonstrated the presence, in the less degraded portions of the balusters, of a yellow-brown patina containing calcium oxalates, attributable to ancient protection treatments of marble based on natural organic compounds.

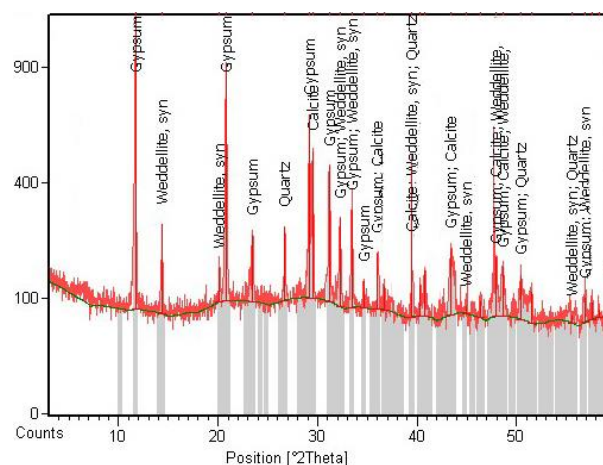


Figure 5. XRD graph of a sample

This fact explains the yellowish color of the best preserved elements of the balustrade, on which the patina of the time still survives.

The different texture of the baluster marble, made of calcite crystals larger than those of the columns, can be considered one of the factors which led to

its bad state of conservation. This is well supported by the above mentioned microscopic observations. Furthermore, it cannot be excluded that the deterioration of the material has been accentuated by cleaning operations of the marble with unsuitable techniques, without the application of a pre-consolidating product. Although the documentary research has investigated about the last restoration works of the cloister, it was not possible to have access to the details of the intervention. However, oral sources report a cleaning done through micro-sandblasting around the eighties of the last century. This type of cleaning, executed on sculptured elements, such as the balusters, if not well controlled in term of pressure, hardness and size of the sand, can generate an immediate decay and favor it also in the future, especially if this operation is not followed by a further consolidating and protective treatment. The decay can also be meaningfully accelerated for the artifacts exposed for a long time to the sun radiation. Regarding to this aspect, it has to be underlined the generally more advanced decay observed on all marble elements exposed on the western and southern façades, that are those more exposed. This datum is in good agreement with the solar irradiation pattern of the four cloister facades and with the presence of decay due to inter-crystal disintegration, detected by visual inspections and microscopic studies on thin sections. The heat inevitably causes thermal expansions in the calcitic crystals of marble, along preferential directions, which generates strong tensions between them, causing a typical disintegration well known as "*marmo cotto*" [5].

IV. CONCLUSION

The results of an archival study allowed us to state that the columns of the Collegio are from Carrara quarry and allowed us to hypothesize almost surely the same provenance for the marbles of the balustrade. From the diagnostic point of view, the analyses performed in situ and in laboratory ascertained the presence of coherent deposits, but above all a strong decay due to disintegration,

pulverization and scaling. This decay mainly involves the balustrade marble of the western and southern façades. It depends on the exposure of the surfaces to atmospheric agents and in particular to the solar radiation. With regard to the decay of the balustrade, the last restoration of the cloister, due to an inadequate cleaning through a micro-sandblasting, could have worsened the decay phenomena that we today are observing. Future developments of this research will be the determination of the provenance of the balustrade marble using an archaeometric approach and a deepen diagnostic on a larger number of samples through further analytical methodologies such as SEM, IC and XRF.

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REFERENCES

1. Benito Domenech, F. (1981). La arquitectura del Colegio del Patriarca y sus artífices. Valencia: Biblioteca de arte.
2. Llopis Verdù, J. (2007). El claustro del Colegio del Corpus Christi de Valencia, Analisis Formal y Compositivo. Archivo Español de Arte 317: 45-65.
3. Gimilio Sanz, D. (2014). Poder, humanismo y religiosidad en tiempos del Patriarca Juan de Ribera en Valencia: su colección de escultura clásica. Espacio, Tiempo, Forma 2:13-39.
4. Criscuolo, A., Lisi, S. (1998). Geologia e strutture della formazione dei marmi. Proceedings Eurominerals and Society of mining professors (pp. 9-13), 12-16 September 1998, Carrara, Italy.
5. Franzini, M., Gratzu, C., Spampinato, M., (1984). Degradazione del marmo per effetto delle variazioni di temperatura. Rendiconti della Società Italiana di Mineralogia e Petrologia, 39:47-58.