

# Reflections on Conservation Science for Works of Art

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There are intense elements of universality in the works of art, which turn ecumenical their very local but authentic characteristics. The very same seems to hold true for the related *Conservation Science*, which strives to reach a high level of maturity through a remarkable variety of unavoidable peculiarities. But it is not just the peculiarities.

The *Conservation Science for the Works of Art* infiltrates and combines a broad spectrum of modern Natural Science disciplines with Art History and Pathology of Materials. It is this unique foundation amalgam that enables Conservation Science to respond with vigilance and efficiency to the gigantic struggle between decay and beauty. Above all, it is *Science* with strict ascetic rules of rigorous deductive logic. And, as the hermits, in order to salvage beauty, it is wise to keep it at a safe distance as it is itself a two-edged knife: It is the narrow and desolate path to the meek heaven and the avenue to the abyss of narcissism. Of course, if this holds for the Conservator, it multiply holds true for the Artist. But what is the very essence of Conservation if it does not entail strict discipline of hardiness and awareness in order to preserve the authenticity of the work of art and its creator? And if, by profession, you are wandering a whole life through the narrow paths of micro-cosmos as a Chemist or Physicist, what kind of prudence you may have when you dare to intermix yourself with titanomachies of beauty, which are in essence the works of art?

These concerns are not only legible or intelligible preamble. They are the web of Conservation Science of works of art in its relentless battle against wear and rust. The platonic dictum “*let no one untrained in geometry enter*” holds for the Chemist or Physicist trying to enter the field of Conservation Science as long as the *geometry* widens to encompass the laws and rules of artistic creation. But the question still remains unanswered: what kind of connection one could find between beauty and Physical Chemistry?

One way or the other, we communicate with imperceptible subtle undulations. Whispers, words, melodies and colors are made of wavelengths and frequencies. Not much of a difference is there between a song and a painting, an embroidery or psalm poetry. Invisible, imperceptible notes and waves are also the ultimate components of the universe. A dominant perception of the natural world is currently the *String*

*Theory.* Our universe, with some abstraction, could be conceived as a gigantic combination of notes and chords, pretty much like a symphonic masterpiece of music. Photons, quarks and electrons are the notes of the cosmic song, the eternal narration of the universe. But our senses can capture just a minute part of this cosmic spectrum and too little of non-Euclidian geometries. These limitations leave ample space to the artist and the poet to recreate the unreachable.

With a little innocent noetic leap, then, the poet is right saying that *the Word is fattened*, or that *the plank yields under the pressure of the sun*, or that *at the beginning there was light* and out of it *the infinitely small and infinitely great cosmos* was born. There is also truth in painter's mind curving the time by hanging the curved clock on a branch. Harps we are releasing melodies when the delicate breeze is blowing. A burst of sound and light guides the painter's hand from the pallet to the canvas. The same force is guiding the smooth mixing of colors, the delicate handling of the dispersion of pigments and dyes, the controlled thickness and the successful application of multiple colored layers that end up in the painted masterpieces. Who doubts that Pansellinos, El Greco or van Gogh were dancing with colors and light? This is why the poet of the future will be an avid dancer of the world's Song of Songs and a deep adept of the upcoming physics. And the ascetic life, the insight and imagination will offer him the capacity to distinguish reason's plank of salvation from the varicolored rigging-ladders over the yawning abyss. With this plank, the faithful and wise use of the splendid gifts he has been bestowed, he will lead man in the garden of the beauties of understanding and mind's serene delights, the very same ultimate goal of the great Artists.

Have I answered the question on the existing relation between Physical Chemistry and beauty? Most probably, not. Wouldn't it be a blasphemy if I had? It would actually be as if one were trying to analyse love using Finite Elements or some other method of exact Science. Let us then be a bit more practical.

The Museum of Byzantine Culture is in the very heart of a multiannual effort, a conspiracy against wear and rust in the region of Thessaloniki and North Greece. The driving force is the grandiose frugality and prudence, the confessional transparency and starkness of Byzantine artwork and handcraft, the warbling water that sprouts from stone at hard times for the free spirit. Yet, there never was any discontinuation in the Hellenic art. There have always been hidden strong threads connecting Parthenon of the goddess of wisdom (*sofia*) and AgiaSofia in Constantinople, the golden jewels of Vergina and Mount Athos, the mosaics in Amphipolis and in Saint David monastery, the frescoes in Derveni and in Meteora. Truly, the artistic Athos and Olympus have never ceased facing one another and deeply communicating.

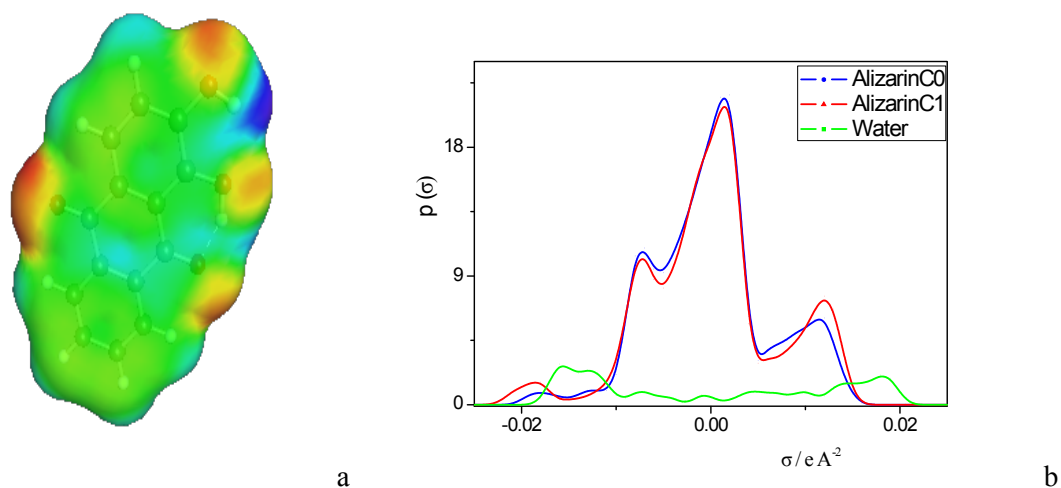
In 1996, the interdepartmental Program of post graduate studies in *Protection, Conservation and Restoration of Cultural Monuments*, is established by the Faculty of

Engineering of Aristotle University of Thessaloniki. The first lectures were delivered by leading scientists in Conservation Science from Greece and abroad. At approximately the same time, in an apparently insignificant and austere corner of Chalkidiki, the Ormylia Foundation is equipped with state-of-the-art analytical equipment and diagnostic instrumentation. The exploring dives in Byzantine art begin with the works of Pansellinos in the church of Protato in Mount Athos. A decade later, the Department of Management and Conservation of Ecclesiastical Cultural Heirlooms is founded in the University Ecclesiastical Academy of Thessaloniki as a paradigm of an earnest and prolific effort.

The unifying vision of these efforts, emerging from the glorious history of Thessaloniki, the once co-reigning city of the Byzantine Empire, aims at creating a far-reaching center of international dimension with a genuine ecumenical character. The Aristotle University of Thessaloniki, the Ecclesiastical Academy, the Museums and the General Directorates of Antiquities, Mount Athos and the Ormylia Foundation would truly collaborate and lead a unique ritual of knowledge, proffer and offerings. The ecumenical character of this effort would attract students and researchers from all over the world and not just the Balkan inland and the once Eastern Roman Empire. The effort was launched with an international conference organized in Thessaloniki in 2010 entitled: *Works of Art and Conservation Science Today*. This conference attracted hundreds of scientists from around the world and delivered glimpses and much of the above ecumenical flavor. The vision remains and waits. It often haunts our minds in the present adverse days of deep and primarily cultural crisis of our country, when culture is one of the unjustly forgotten casualties.

In the specifics, now, the Laboratory of Physical Chemistry of Aristotle University of Thessaloniki is working on the Conservation Science with an armada of tools ranging from quantum mechanics to nanotechnology. Space here is limited for a detailed presentation and, thus, we will confine ourselves to indicative references only. A number of activities are focused on the safe and effective cleaning of works of art. A new methodology has been developed regarding a rational approach to solubility and search of the appropriate solvents. This methodology, based on modern quantum mechanical calculations, is known as the method of Partial Solvation Parameters – (PSP) [1-3]. Quantum mechanics provide us with the necessary information regarding the type and distribution of electron charges on the molecular surface of the compound, as shown in Figure 1. This distribution determines the interactions of the molecule with the surrounding molecules and is quantified according to the values of the PSPs. In a sense, this methodology is the evolution of the solubility parameters approach [4-5], with which many conservators are quite familiar with. In the domain of icon cleaning, selective solvents are applied either for direct cleaning [4] or for cleaning by encapsulation in suitable nanogels [6]. With the PSP approach it is possible to quantify the basic and acidic character of a

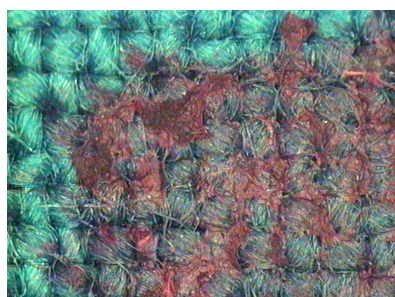
surface including solid surfaces [3]. This surface characterization of monuments can be used for their protection by predicting proliferation and growth of microorganisms, such as lichen.

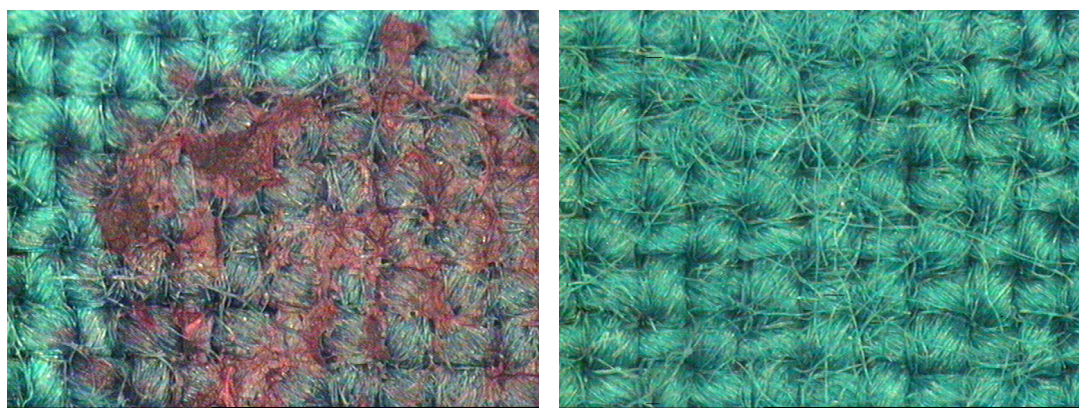


**Fig.1** a. The alizarin molecule in its basic conformation with distributed charges on its surface; color gradient ranging from blue (positive- acidic) to red (negative - basic). b. The surface charge distribution (sigma profiles) of two conformers of the alizarin molecule and of the water molecule as a reference.

The PSP methodology predicts changes in solvent strength by changing temperature and pressure. Combining this information with knowledge from the area of Colloid and Interface Science, a new environmentally friendly method of cleaning sensitive works of art on fabric has been developed in the Laboratory [7]. The objective was to replace the multi-stage cleaning of textiles and prevent or minimize the use of organic solvents. With the new method, the cleaning is achieved by using supercritical carbon dioxide, calcium carbonate and water. The soils of the fabric, depending on their nature, are either dissolved in water (water-soluble soil) or in carbon dioxide (oleophilic soil). The proposed methodology has been successfully applied to hydrophilic and lipophilic soils as well as to microorganisms. The color of the fabric remains intact and does not further deteriorate the fibers (Figure 2). It can be applied also to worn fabrics, since no mechanical stress on the fabric is required during the cleansing process.

Another field of activities [8-10] is focused on the protection of monuments and works of art with transparent and fully reversible modification of their surfaces by applying the Nanotechnology and Biomimetic Chemistry principles. Protective superhydrophobic coatings are produced with the formation of hierarchical micro / nano-structures by mimicking, as an example, the nanostructures of the lotus leaf.





before cleaning

after cleaning

**Fig.2** Cleaning of beetroot paste off cotton fabric dyed with indigo using supercritical carbon dioxide.

Suitable nanoparticles can be used to deacidify manuscripts, books, maps, and works on paper in general [11-12]. The production of acids and acid radicals catalyze the depolymerization of cellulose, leading to paper degradation. By inhibiting the production of acids the rate of depolymerization of cellulose is reduced significantly leading to protection of paper artifacts.

The rational solvent selection, facilitated by the PSP methodology, is of crucial importance for the extraction of organic dyes from plants and living organisms. It is also of equally crucial importance for the safe diagnosis of dyes and related dyeing processes of historic textiles and fabrics [13-14].

Going back to the earlier discussion regarding waves and frequencies, spectroscopy, optical and electron microscopy are widely used in the Laboratory for the diagnosis, identification and observation of micro- and / or nano-structures on monuments and works of art. The characteristic patterns of vibration frequencies of the absorbed light by the studied compound reveal its identity. These findings, often, reveal information not only for the studied materials but also for the Artist himself. Such information requires our utmost respect and care.

To conclude, the Conservation Scientist has a great load of work to do. This serious work has to be done with utmost scientific rigor and sensitivity. In this endeavor, the Conservation Scientist should remain tightly bound to the sail of Science disregarding the seducing smile of Mona Lisas from the loneliness of the museum walls and the calls of false Serene Beauties. And saving the Work of Art, man will continue listening and admiring the authentic melody of the Work and the Artist.

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