



# JARDINS DE PIERRES

**Conservation de la pierre dans les parcs, jardins et cimetières**  
***Conservation of stone in Parks, Gardens and Cemeteries***

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# STUDY-CONSERVATION-RESTORATION OF SCULPTURES & SURROUNDING IN A CENTRAL PARK OF ATHENS

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## **H**istorical review

Twenty seven Monuments in a Central Park in the heart of Athens adorn the 230 acres of Sculptured marbled busts marbled commemorative columns, insert bronze elements and columns of sepulchral sculpture cover the whole of the area. The park is called Pedion Areos and is one of the oldest, biggest and most historically important parks in Athens. Located on the north side of town it was formerly operated as a military field for exercises. Its original use, however, gave the park a military character in line with the Paris Champs de Mars, which hosts memorials, sepulchral and commemorative columns praising the sacrifice of military heroes. Its construction dates back from the reign of King Otto (1832-1862/XIX cent.) in 1857. In 1934 the park's field of Areos is planned to honor the heroes of the Greek revolution of 1821 and monuments are placed into it<sup>1</sup>. The creators of those monuments were some of the greatest sculptors of the Late Greek Sculpture and founders of the "Association of Greek Sculpture". Main representatives: Kostas Dimitriadis, Georges Dimitriadis the Athenian, Lameras Lazarus, Lazarus Sochos, Phokion Rok, Gregory Zevgolis, Michalis Tombros, Thanassis Apartis, Nina Embiricos, N.P. Georganitis, all of them contributed to the devel-

opment of Outdoor Greek sculpture. Sochos, K.Dimitriadis, Zevgolis and some others who had studied in the French capital were influenced by Rodin's sculpture and new artistic currents, which are adapted to their own personal style. The marble is still the preferred material of construction. Bronze inserts to some marbled columns were cast in Paris at the foundry of the Tiebeux brothers. In Greece there was no art foundry for die-casting so they used to do it in laboratories in Rome and Munich<sup>2</sup>.

The monuments are marble busts of the heroes with marble base, commemorative columns, inset elements of bronze as wreaths of shields, sculptures with funerary characters as Alexander Ypsilantis and monuments like tombstones for the "Fallen Australians, New Zealanders and British of the Second World War". The high of each monument differs, with the tallest sculpture this of goddess Athena (25meters) at the SE side of the Park (Vassos Falireas sculptor & architects Phaidon and Ethel Kydoniatis). All the monuments bring commemorative inscriptions and strong carving details and decorations. The age of the placement for each one differs too. The first ever placed in the park was the bust of Alexander Praidis in 1863. The latest is Dimitrakis Plapoutas bust in 1994. Some of them were created earlier than they placed in there, as the "Holy Company" which was created in 1843 (Stamatis Kleanthis sculptor), first

<sup>1,2</sup> Zetta Antonopoulou - The sculptures of Athens, Outdoor Sculpting, 1834-2004 - "The River" Editions, Athens 2003, p. 47, 143.



Fig. 1. View of the park.

placed in Panepistimiou street and then in the park in 1885. The park contains fountains, playgrounds, walking paths, water course and rich vegetation, high and low, which is in direct contact with the monuments. These features of the park in conjunction with the weather conditions, the polluted air and the human element have been a multifaceted challenge (fig. 1).

### *General Picture of the Park Space*

The conservation-protection of the monuments kept pace with the total reformation of park. The aim was to conserve the two basic elements - monuments & vegetation - without detracting either of the two. The reformation of the park and the conservation of the sculptures, were successfully achieved with the collaboration of teams with different specialties (conservators, architects, archaeologists, electricians, technical workshops). Before starting the conservation, there was conducted a careful study of the origin of the marbles, their deterioration and corrosion and technical reports were completed. Followed photographic imprinting and architectural representation of each monument. The representation of each monument's deterioration was done to a separate design. As the park also uses as refuge for homeless and immigrants, it was necessary to create a safe area



Fig. 2. The configuring of our workplace in the statue of Goddess Athena and the Burial monuments of the fighters from New Zealand, Australia and England at the Second War (photos from the Archive of Constance Kokotou, during the conservation of monuments, 2010).

of working around each monument. So, we decided to install a constant, mobile scaffolding with canvas around it, which was constituted by wooden floors and ladders according to the height of each monument (fig.. 2). The vegetation was neglected and in direct contact with the monuments and humidity everywhere around them due to muddy and stagnant waters. All the monuments were preserved in situ. There was only a thought of transferring to a museum Alexander Ypsilanti's statue due to its strongly corrosion/decay. Its replacement with a replica is not an easy decision to be taken immediately. The monuments are not preferable to be moved out from the park as they contribute to its Historical character too.

### Methods and materials

The selection of all methods and materials, based on the maintenance of Greek Conservation International Code of Ethics, International standards of conservation and Code of IIC & ICOMOS. Selected methods and materials certified by earlier studies and applications, as well as experimental procedures for artificial aging. The material properties consistent completely with the properties of materials of monuments, are resistant over time and are all reversible. The conservation of monuments had a preventive character. Based on a previous technical report of a colleague from the Ministry of Culture of Greece, we agreed to follow the methods discussed below. No previous conservation had done, only rough cleaning workers from the municipality during the Olympic Games.

#### *Preliminary interventions:*

After the completions of photographic recording and condition survey, pre-consolidation was performed as a first intervention on a set of monuments suffering from sugaring and having gypsum coatings in the surface by sulphate

of the lime marble. These two degradation features were found in many sculptures, but mostly on monuments that were placed before one hundred fifty (150) years in the same section of the park, in the courtyard area of a church. They are completely exposed to environmental and weathering factors, but also to vandalism. The selected method was spraying with a solution of calcium hydroxide in deionized water with 6 % of its weight of calcium carbonate –  $\text{CaCO}_3$ , method proven and widely used in monuments like the Acropolis of Athens and other archaeological sites. The limewater retains and stabilizes the surfaces that are mostly deteriorated, so we can move on to the cleaning phase without losing the artistic details of the sculptures.

#### *Mechanical and Chemical Cleaning*

The following methods of cleaning were used in combinations, in the same time or separately, depending on the corrosion/decay of each monument.

#### *Graffiti removal*

Most of the monuments brought graffiti: an extended phenomenon nowa-



days. The graffiti were located mostly to the rear sides of the monuments (columns) and bases (fig. 3). Most of the markers/crayons contained iron (Fe). Before apply anything to remove them, we used sponge with deionized water to soften the painted surface. Each application which differed from place to place, needed some time to react, so we used sheets of polyethylene to cover the spots and accelerate the procedure. Some felt-tip pen were removed with cotton or carboxymethylcellulose with acetone and white spirit ( $C_9H_{20}$ ), slow scrubbing with soft brush. Graffiti were removed with a sepiolite (absorbent clay in deionized water) paste with Japanese paper. Also some test done with White Spirit and softly scrubbing with soft brushes. The stains from soils generated by the graffiti removal were removed with a paste made of 20 g wax, 100 g paraffin wax, 100 ml acetone, 80 ml of soluble ammonia ( $NH_3$ ) 25 % and 50 ml white spirit. In all cases the method was monitored during the implementation in order to avoid the creation of further stains, it was applied with small brush and the rinsing was necessarily done with deionized water.

#### *Elimination of hovering particles*

The most common phenomenon, especially in the heart of Athens, is the deposition of gaseous and particulate atmospheric pollutants cause decay of the Historic marble. In order to remove these particles, we had to wash them. We selected Texapon N-40 (Abio, Athens), because it is a surfactant – soap (salt of higher organic acid with potassium (K) or sodium (Na) in their composition). It is suitable for limestones, it does not react with the calcium of marble. The elimination is performed through soft scrubbing followed by rinsing off with deionized water.

It was important to measure the pH of the leaches on samples after each washing in order to evaluate the amount

of soluble salts in them. The content of leaches in soluble salts, also helped us to decide in which point of the pH we had to stop after the treatment with the absorbent clay mentioned below.

#### *Desalination and black crusts removal*

In order to remove soluble salts, we decided to use sepiolite ( $Mg_4Si_6O_{15} \cdot 6(H_2O)$ , a magnesium mineral silicate), an absorbent clay. We chose this one as it is not cancer – causing. First the surface of the marble was moistened with deionized water to dissolve the soluble salts and after the clay was spread on to Japanese paper on the surface. The paste we created was 2-3cm thick and left about 24-48 hours depending on the situation of each monument. It was often replaced with new amount of paste. When the paste loses contact with the surface, it drifts apart everything it has absorbed, including thin black crusts (max.1mm). This is a totally controlled method, with no damages to the marble and it can be used for black crust too. At the end, the surface must be rinsed off with deionized water. Also, for the dissolution of the **deposits** and the removal of **black crust**, we tested EDTA, MORA and AB57 pastes, in separate but specific areas of marble (not mixed up with sepiolite!). The most important criteria to select them, was their absorbent faculty, the cost and the fact that they are controlled methods. Especially the last parameter is very important for the places where gypsum has formed under the black crust and at these places we avoid using paste that contains EDTA, but sepiolite in order to avoid losing this areas. In these areas paste with ammonium bicarbonate ( $NH_4HCO_3$ ) is also effective as its pH can be set up to a more alkaline PH with the addition of ammonia ( $NH_3$ ). Paste MORA is also effective with salts. The ratio of ingredients varied per corrosion of monument and per paste. All the pastes were covered



Fig. 4. Marble aftercleaning.

during the process with polyethylene sheets in order to keep their humidity in the environmental temperature and control the evaporation of ingredients. SEM analysed samples from black rust and their composition revealed also industrial sources and vehicular traffic.

#### *Biocide treatments*

Bacteria, algae, moss, lichens, microorganisms, birds, insects and plants were badly affected the monuments, either superficially leaving the marble embossed and inside its structure, causing cracks networks and moisture retention. To face this, we associated chemical treatment with mechanical cleaning (fig. 4).

First we applied absorbent clay impregnated with a biocide (Desogen, Ciba Geigy). The virtue of this method is its stability, the long period of reaction and possibility to perform several applications, without affecting negatively the marble. We also used Lito 7 and Lito 3 (Ciba Geigy) which were more active on microorganisms. We observed that in areas where paste with EDTA was placed and then Desogen biocide was used for microorganisms nearby, the biocide was really effective. After these treatments, the marble surface was rinsed with deionized water. To clean the cracks, hydrogen peroxide ( $H_2O_2$ ) 10 % max. appeared to be suitable. It was applied with syringe and needle in order to remove completely the lichens and their colouring agents. In this phase of the conservation process, we also used soft toothbrushes and various dental tools. Temperature fluctuations (sun in the morning and cold at night) also affected the inner structure of historic marble and cause mechanical decay. The marble monuments were to a great extent stained by iron oxides origina-



Fig. 5. Bronze inserts elements.

ting either from the oxidation of marble constituents (pyrite most probably), either from metal links that were used to bring together some pieces of marble. The spots of iron oxides had brown color as a chemical bond of Fe+3, so we decided to use paste of thioglycolic acid and carboxymethylcellulose (Thioglycolic acid 80 % HSCH<sub>2</sub>COOH, Ananiadis, Platonos street, Athens). The product was selected due to its neutral pH as we do not use acid solutions in monuments. The specific solution was prepared by us (5 % w/v) and afterwards was neutralized with dense ammonia (NH<sub>3</sub> RG-00200-1000, Ananiadis, Ak. Platonos street Athens). This treatment was followed by washing with deionized water.

Along with the preservation of the Historic marble, **the bronze inserts** elements were preserved too (fig. 5). All of them are made from **copper alloy (bronze)**, so the corrosion products were many, as oxides, carbonates, chlorides, sulphates, etc. The most appropriate analysis to locate them would have been radiography. But due to position and size of monuments, this was unfeasible. We took samples from the bronze inserts that we found (many of them had been stolen or had disappeared) for analysis by Scanning Electron Microscopy with energy dispersive spectrometry and optical microscopy.

The presence of salts on the surface of bronze lead us to use carboxylic weak



Fig. 6

acids such as formic acid (HCOOH, Abio, Athens) 5 % w/v and Citric acid (C<sub>6</sub>H<sub>8</sub>O<sub>7</sub>). The surface was then rinsed off with deionized water at the temperature of the environment (luckily warm those days) and before starting we covered the marbles with canvas and plastic sheets to avoid further contact.

### *Grouts, repair mortars*

The parts of the monuments that were broken, cracked, badly mended or disconnected, needed to be restored again. This work had to be done not only after the completion of marble cleaning, but also sometimes straight ahead after the "opening" of cracks with biocide. To achieve an excellent compatibility between the existing marble of the monument and the new material, we ended up to select materials having a similar porosity, thermal conductivity and mechanical strength. These materials are widely used in restoration<sup>3</sup> and have been thoroughly tested and have been strongly recommended by famous Greek chemists (Th. N. Skoulikidis, Tasks Acropolis Monuments, Eleftherna Rethymno, etc.).

Grouts consist are meant to fill up microcracks, either deep or shallow. Two mortars types were used: fine and coarse. The mortar usually covers the grout, fills up the bigger voids and connects missing/broken parts of the monuments (e.x. the leg of goddess Athena, fig. 6). The role of both of them (grout-mortar) is adhesive, covering and protective at the same time for the marble. They do not contain soluble salts, and they have great resistance to mechanical stresses.

The mortar and grout consist of cement (Danish Portland, Art. n° 765, Abio, Athens), lime (Chaux Blanche, Abio,

<sup>3</sup> Sacred Rock of Acropolis, Proceedings of the 5<sup>th</sup> International Meeting, 2002, p. 73, 163-173.

<sup>4</sup> 5<sup>th</sup> International Meeting of the Restoration of the Acropolis Monuments, 2002, p. 69, 425-637.

Athens), calcium carbonate, quartz sand (n° 1, Art. n° 773, Abio, Athens), ombra and baked sienna. The ingredients differ from grout to mortar and the amounts too. After the application (with syringes and needles in some cases) they had to remain wet for 3-5 days, so we covered them up with sheets of cellulose (Absorbant Cotton paper, Abio, Athens) that can keep the moisture of the deionized water. This part of conservation needs the ability from the conservator to be a good technician and a good artist in the same time (in order to achieve the right nuance below the nuance of marble). Conservator needs to be fast and precise at his/her movements, with strongly artistic qualities as a regard to the missing parts of monuments. All the decisions for the aesthetical rehabilitation were made in collaboration/discussion with the Ministry of Culture of Greece. Some parts have not been decided to be rehabilitated yet.

### Protection

The final protection/fixation was achieved with lime water, which consists in of



calcium hydroxide  $[Ca(OH)_2]$  dissolved in deionized water. It is specially used in monuments in the centre of cities and is chemically related to limestone. The monument is first sprayed with deionized water and then with lime water. To be successful, the treatment has to be repeated many times, the number of treatments being adapted to the needs of each monument<sup>4</sup>.

For the **protection from graffiti** and marker pens, we used Antigrafitti Art Shield N.1 (Art. n° 2027, Abio, Athens), which is emulsion from polymer waxes with PH = 7.1. It does not affect the patina of marble, creates a protective coat between marble and environment and



Fig. 8. The final appearance of the statue of Athena Goddess, Lion and the Burials, after the conservation of Monuments and the regeneration of the environment (photos from the Archive of Constance Kokotou, after the restoration of the park, 2011).



also protects the monument from air pollutants and UV rays. It acts as a sacrificial surface (as the limewater does too) and needs to be applied twice in the surface of the sculptures. If graffiti strikes again, it can be washed out with warm water and applied again. In case that the application goes wrong, Antigrffiti can be removed with the HD Paint Stripper (in our case not needed).

### Total configuration of surrounding area

The monuments stand now in harmony with their **environment** and each part of the Park - tiling, benches, new fountains - has an extraordinary aesthetical value. The statues, the busts, the funerary monuments, the commemorative and dedicatory columns, are situated in locations that do not induce degradation anymore, but highlights them, and contributes to identify each character of the monument (fig. 7). For example, the funerary monuments of Australians in front of goddess Athena and Lion are highlighted by small olive trees—symbol of eternity for Greece (fig. 8). A great achievement is the fact that now all the visitors pay attention to monuments. Not only they realize their existence, but also understand their role and character. They can be informed about the monuments, they can realize the urban fabric of the park and be happy with nature. Generally, the plants have no contact with the monuments but emphasize with their shape and healthy image the role and purpose of sculptures in the park. All the paths and routes have been replaced with ecological materials and joints were created at both sides of each route in order to run off the rain water. An islet was constructed in the "Road of Heroes" full of flowers and wooden benches around it, in order to give the opportunity to visitors of the Park to admire the busts and the nature at the same time. The fountains have been replaced either by new ones that

immediately drain the falling water (in order to eliminate humidity) and others are covered with water proof materials and sealants in order to avoid mould growing. A magical "water route" has been created and all the renovated buildings as theatre and cafes are in the upper side of the park. The monuments are illuminated with lamps not above 75mW/lumen fitted with protective **filters**. The trees create a natural wall that separates the park from the main street chaos outside, keeping the sound level lower than 35-45dB inside the park. Cleaning services work every day in the park and a security team guards it. The success of this project, was the global approach of the renovation of Park. Conservators must undertake a serious thought of all the parameters and factors. The conservation of monuments does not stop to the conservation itself as a practice but goes on to a moral part. We wish and we hope, that this beautiful work will be maintained as it is in the future.

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### **Résumé**

#### **Etude-Conservation-Rétablissement des monuments sculptures et de l'environnement dans un parc central d'Athènes**

Vingt-sept monuments, bustes en marbre, colonnes commémoratives avec insertion d'éléments en bronze et colonnes sépulcrales sculptées se trouvent dans un vaste, et très célèbre parc central d'Athènes. Des parterres de fleurs, buissons et arbres à feuillage caduc ou persistant constituent l'écrin des monuments. Des fontaines situées dans certaines zones du parc sont suffisamment proches des monuments pour créer un climat humide. Des petites églises encore en usage, des chemins piétonniers et des aires de jeux pour enfants complètent l'organisation du lieu. Les monuments sont installés depuis plus de 150 ans et n'ont jamais été restaurés. Chaque monument a été traité séparément en fonction de son âge, son état d'altération et sa situation. Une coopération avec un agronome a été nécessaire. Trois méthodes ont été utilisées : (i) les joints ont été nettoyés pour éliminer les croûtes noires liées à l'action simultanée des suies et des polluants, des mortiers ont été appliqués dans les joints pour éviter l'entrée d'eau et la croissance de moisissures ; (ii) un badigeon de chaux a été appliqué sur la surface des monuments : le traitement désinfecte par son pH et constitue une couche sacrificielle ; (iii) enfin, un antigraffiti a été appliqué car ce type d'attaque est malheureusement très commun et fréquent de nos jours.

Aucun monument n'a été déplacé. Des éclairages munis de filtres et une taille de la végétation ont été mis en place. Des sillons destinés à éliminer l'eau de pluie ont été creusés, ce qui a favorisé la conservation du marbre et de la végétation. La conservation de monuments situés à l'air libre dans une zone de végétation dense requiert patience et inventivité, et nécessite l'instauration de collaborations entre spécialistes. Il doit se créer un équilibre harmonieux entre végétation et monuments.

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