European Journal of Science and Theology, April 2018, Vol.14, No.2, 131-140

CONSERVATION PROBLEMS IN THE VATICAN NECROPOLIS

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(Received 25 September 2017, revised 20 October 2017)

Abstract

The Vatican Necropolis represents one of the most surprising sites during a visit to the monumental complex of Saint Peter's Basilica. This case study is an important example of conservative challenges in hypogeum environment where a lot of degradation phenomena affect materials and structures. For this reason, various professionals were called to intervene and to work in a spirit of positive and reciprocal collaboration for guaranteeing the preservation and fruition of both religious and archaeological areas on short and long term without causing further damages. It was possible to begin the delicate restoration according to a plan that, for the first time, considered the necropolis in its entirety. Each individual solution adopted for the rehabilitation of the necropolis was carefully evaluated on the basis of the needs expressed by different specialists, placing every intervention organically within the master plan.

Keywords: hypogeum, conservation issues, procedures, storage, microclimate

1. Introduction

The Vatican Necropolis is located under the level of the Crypt of Saint Peter, underneath the central aisle of the homonymous Basilica [1, 2]. Indeed, it has been recognized like a site doubly underground [2, 3].

The Necropolis area was originally at ground level on the Vatican hill, the fourteenth region of Rome divided by the Imperator Augusto. According to literary sources the area was extremely unhealthy and marshy. *"The historian Martial [2 – Epigrams, 10, 45, 5 and 6, 92, 3] reports that they are produced very poor quality wine that tasted like vinegar and sometimes resembled poison."*

Successively the Imperator Caligula (37-41 AD) began the construction of a circus (Figure 1) that was to be improved by Claudius (41-54 AD) and completed by Nero (54-68 AD). At the centre of the track there was an obelisk over 33 metres high [4, 5]. It remained in its original location for more than 15

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centuries and in 1586 it was moved by the architect Domenico Fontana (1543-1607) to its present position in front of Saint Peter basilica [6]. This exceptional operation, required by the Pope Sixtus V (1585-1590), called for 907 men, 40 winches and 75 horses.

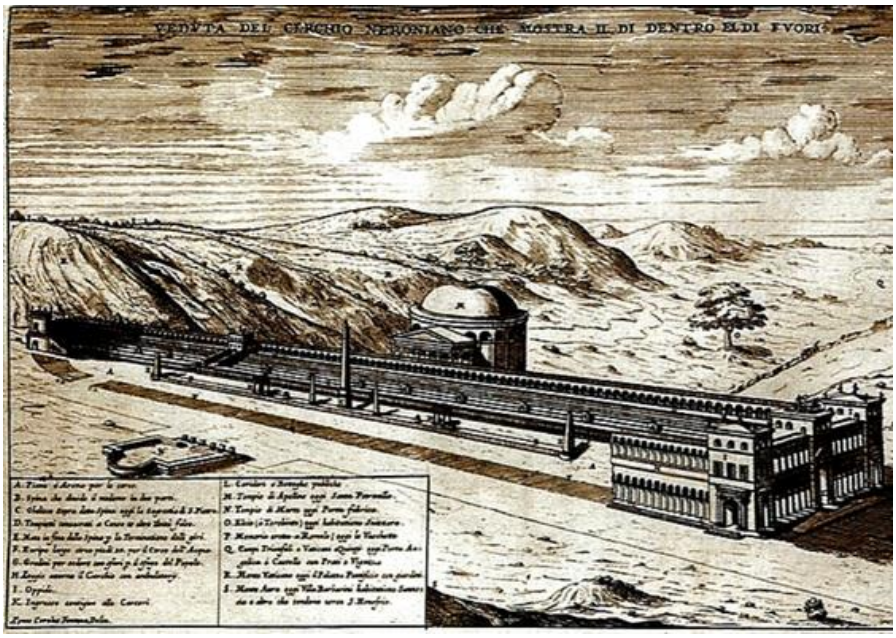

Figure 1. View of the Vatican Circus, engraving of Carlo Fontana [5] (from [2, p. 6], ©Fabbrica di San Pietro).

The circus fell into disuse as early as the second century AD, when the area was occupied by a number of graves and monumental tombs of various types and sizes, in accordance with the oldest Roman laws that prohibited the burial of the dead inside the city walls (Figure 2). Most of them were pagan, but Christian burials were also found, especially from the age of the Constantine basilica (Figure 3).

The Necropolis was used until the fourth century, when Constantine decided to level the ground and covered the entire area with soil to build the first Saint Peter's church; according to very ancient Roman custom and law the inviolability of tombs was strictly protected. It was an incredibly vast undertaking that involved the shifting of more than forty thousand cubic metres of soil. In the process of burial, it was necessary to level the parts of the tombs that protruded above the established level of the floor of the new church. The Constantine building was destroyed in 1500, and a bigger and more beautiful Basilica was constructed.

The Vatican necropolis remained buried for 1600 years.

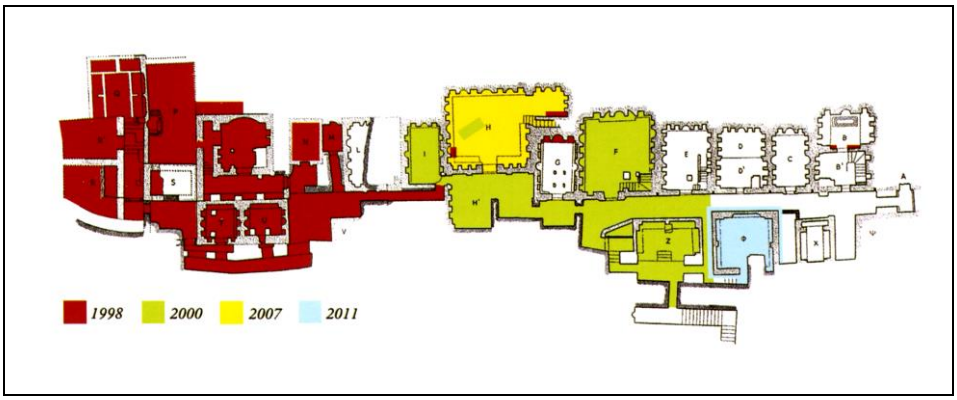

Figure 2. Plan of the Vatican Necropolis showing in different colours the restoration dates of mausoleums (from [3, p. 110], ©Fabbrica di San Pietro).

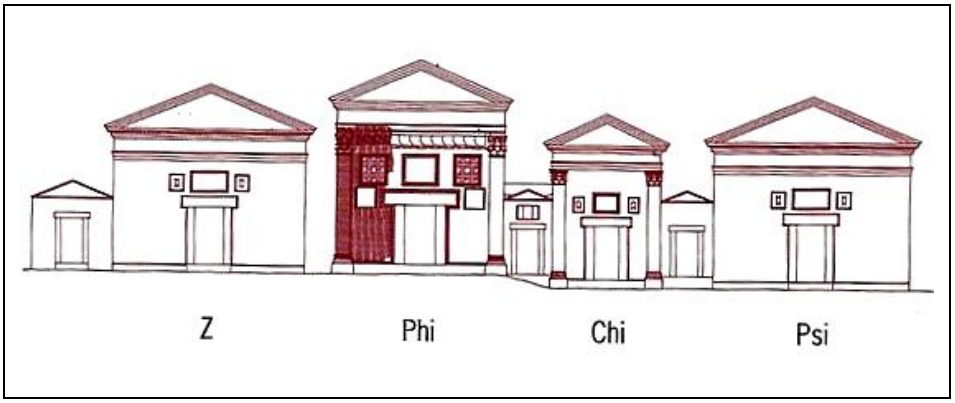

Figure 3. Reconstruction of Mausoleums Z-Psi ([7], ©Fabbrica di San Pietro).

Systematic excavation of the Necropolis began only during the pontificate of Pius XII (1939-1958). On the occasion of the works aimed to reset the floor of Saint Peter's Crypt in January 18th, 1941, the workers discovered, at a depth of one and half metres, the elegant cornice of a structure, subsequently labelled Mausoleum F (the mausoleum of *Caetennius Antigonus*). In earlier centuries, a sense of religious respect and reverential awe, as well as the wish to not disturb the tombs of the popes, martyrs and of a multitude of unknown Christians, prevented any excavations under the floor of the old basilica. Archival documents and direct evidences between 16th and 17th century provide us only summary information about some occasional discoveries made in the area of the necropolis on the occasion of works carried out in Saint Peter Basilica.

During the construction of the new basilica a lot of marble sarcophagi were found. Most sarcophagi came from the 4th century basilica and they were described by Antonio Bosio in *Roma Sotterranea* published in Rome in 1632. Those accidental discoveries never led to more thorough research [2].

Considerable technical difficulties, often unforeseen, were encountered during the excavations. For example, it became necessary to open passages in the foundations of the old and the new basilica, to deviate and ensure the correct drainage of the underground water, to strengthen and lay the foundations for the pillars of the church above the necropolis. The church, without the Constantine filling, would have been suspended in the air.

A series of elegant burial structures, lying adjacent to one another and running from west to east along an axis diverging slightly from that of the Church above, was discovered during the excavations. The 22 structures, revealed during the papacy of Pius XII, constitute only a small part of a larger monumental complex that probably extends until the river Tevere (Figure 1).

2. Conservative problems

To the first archaeologists, the necropolis appeared just as Constantine had seen it, preserved on Earth for centuries. Once the rubble added by Constantine was removed, the archaeologists discovered brick walls, stucco and mosaic decorations, inscriptions, cinerary urns, sarcophagi and splendid frescoes of the mausoleums that had preserved their original colours unaltered for one thousand and six hundred years. After many centuries, the soil offered men an archaeological site that had remained practically intact and untouched.

Figure 4. Vatican Necropolis, Mausoleum M, interior north wall with the Christian figure of the fisherman before and after restoration (from [3, p. 113], ©Fabbrica di San Pietro). Soluble salts are clearly visible before restoration.

At the end of the first phase of archaeological research in 1950, the unavoidable problems linked to underground excavation sites emerged. These problems were mainly related to unstable micro-climatic conditions and microbiological diffusion. Increasing values of temperature and relative humidity, linked to high levels of carbon dioxide and uncontrolled air currents,

caused evident and progressive deterioration patterns. The degradation phenomena were visible on the surfaces through the formations of salt (chlorides, sulphates and nitrates, Figures 4 and 5), algae and microorganisms which over time developed so covering walls and pictorial decorations [8-11]. Increasing number of visitors over time (Figure 6) also contributed to the gradual deterioration, as they brought in spores and bacteria, causing harmful micro-climactic variations.

Figure 5. Vatican Necropolis, Mausoleum N, exterior south wall before and during the cleaning operation (from [3, p. 116], ©Fabbrica di San Pietro).

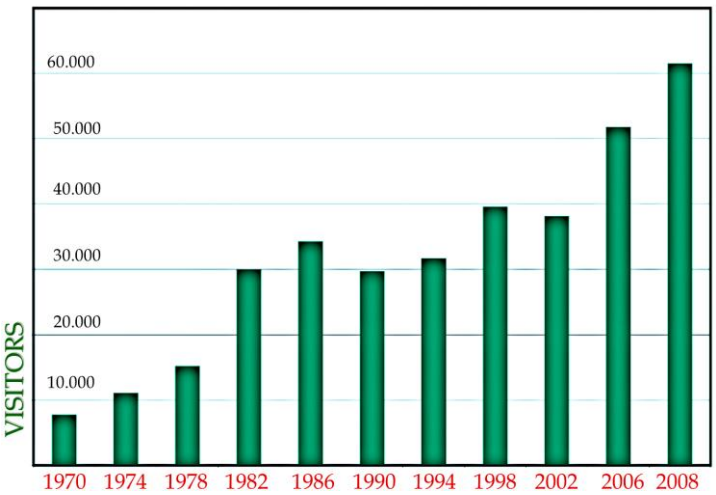

Figure 6. Number of visitors from 1970 to 2008 (from [3, p. 111], ©Fabbrica di San Pietro).

With regard to the necropolis' problems, immediately attempts to remedy them were tried by performing a series of interventions mainly planned according to urgency criteria. Above and beyond a general plan for understanding the entire excavation area, starting from 1998, the Fabric of St. Peter's arranged to embark upon a well-constructed program of works. The starting point of the working approach was based on the idea that the necropolis needed to be treated as a 'patient' to be cured.

3. Operational goals

On the base of the above defined approach, before starting the restoration activities, it was decided to acquire a deeper and more precise understanding of the Vatican Necropolis through examination of the existing materials and documentation, and the subsequent cataloguing and direct verification of the gathered data. Information was collected by examination the vast bibliography, archival and iconographic documentation and graphic survey of the structures, all for the knowledge of the 'patient'. Photographic documentation was performed by using Hasselblad cameras and lenses (40 mm, 50 mm, 120 mm and 180 mm), and artificial lighting generated by Broncolor flash. Kodak Ektachrome E100S, for colour and Timax 100pro, for black and white films were used. This preliminary work represents and will continue to represent an essential store of information for all restoration and conservation activities in the future.

Moreover, scientific investigations and microclimate monitoring were undertaken as activities aimed at supporting the restoration. On the basis of the information acquired through this monitoring, specialists were able to determine the provisions necessary to guarantee the balance of temperature and relative humidity both inside the mausoleum and outside. In particular, microclimatic monitoring was performed in the period between 1992 and 1994 by R&C Scientifica, now named Lambda Scientifica. This society was engaged by the Fabbrica di San Pietro to carry out continuous microclimatic monitoring on selected mausoleums of the necropolis.

In order to determine the thermohygrometric conditions and dynamics of the air currents in the immediate vicinity of the various areas, environmental temperature and relative humidity (RH%) have been continuously recorded over time in different points both of air and surfaces.

Laboratory analyses were essentially aimed at identifying the nature of the salts that heavily affected the surfaces by covering and disfiguring numerous paintings. Qualitative and quantitative salts analysis was carried out by using colorimetric tests and ion chromatography. Scanning Electron Microscopy coupled with Energy Dispersive Spectroscopy (SEM-EDS) and diffractometry analyses were also performed. Particular attention was focused on the investigation of mortars through mineralogical examination of thin sections and the X-ray diffraction analysis on powder samples.

The characterization of algae and other possible biodeteriogens by in vitro cultures, made possible to run specific tests known as antibiotic assays, and to select the best biocide for inhibiting their growth.

The restoration activities were carried out by a team of highly specialised restorers with invaluable experience acquired in other underground sites. Using mostly mechanical methods and with a limited use of solvents, reinforcements were set and salt formations were removed.

4. Outcomes

The study of thermo-hydrometric parameters, in underground environment accessed by visiting public, places fundamental importance for the evaluation of the conservation state and also for the definition of recommended measures necessary to preserve it.

A comparison of air temperature and RH% values with the thermal measurements on the walls, made possible to evaluate the presence/absence of periods with unfavourable environment parameters that could negatively affect the surfaces. This was obtained by assessing the occurrence frequency of risky thermohygrometric conditions. The data gathered in the period 1992-1994 showed that the entire structure of the Necropolis was not immediately affected by the daily thermohygrometric variations, following the external meteorological climate (as is typical of subterranean environments), being however affected by the seasonal variations (Figure 7). Great instability, especially of RH% was detected, as visible in Figure 7.

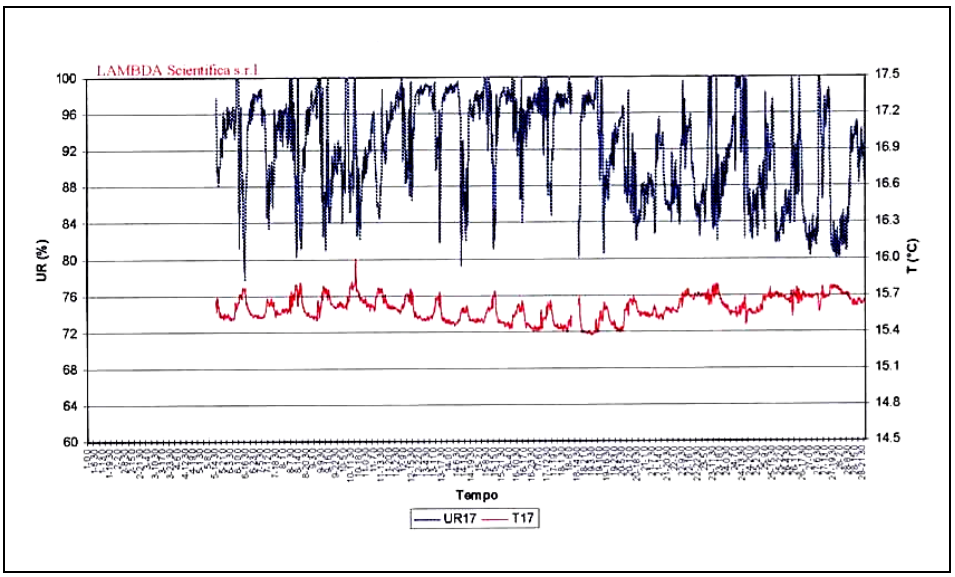

Figure 7. Microclimatic performance before installation of the crystal doors (from [9, p. 305], ©Fabbrica di San Pietro).

Thanks to the information obtained from monitoring and analyses, the causes of deterioration were identified as follows: water contained in the foundation walls, inconstant temperature and RH% values, high levels of CO_2, presence of autotrophic flora on damp surfaces with undesired chromatic effects and occasionally with micro exfoliation of stones, stuccoes, and frescoes surfaces.

The *Fabbrica di San Pietro* worked for finding appropriate solutions to eliminate or mitigate the causes of deterioration [9].

The information obtained through the microclimatic monitoring and the subsequent study of acquired data established that the temperature was subjected to normal seasonal changes and that relative levels of humidity nevertheless remained high inside of the sepulchral structures and along the visitor's path.

Study of the chlorophyll pigments of the algal flora made it possible to calibrate the lighting system in an interval of the emission spectrum where photosynthesis is attenuated, and consequently the proliferation of autotrophic populations (algae) decreases as well.

Laboratory analyses done on samples extracted from the plaster of the wall paintings and stuccoes in the architectonic and figurative decorations contributed to a better understanding of the conservative problems. In fact, these investigations revealed the presence of thick layers of salts, in particular chlorides, sulphates, nitrates and fluorides. These salts are related to the constituent materials; in fact fluorides, for example, rare contained in *pozzolana* whereas sulphates are derived from the clay embankments covering the mausoleums before they were emptied. In consideration of the quantities and qualities of salts present on the surfaces and the evident degradation of frosted plasters and stuccoes, the decision was taken to not carry out traumatic interventions such as the reduction of relative humidity values. But the chosen approach was to plan solutions for making stable the RH% values.

In particular, sliding doors, automatically opening and closing while the visitors are passing, were installed as barriers for maintaining stable the environmental conditions. This intervention allowed for the reduction of preferential currents owing to the difference in amounts found at the entrance and exit of the necropolis. The presence of trapdoors in the concrete ceiling allowed to install automatically adjustable rolling shutters for regulating the humid air flow between Necropolis and Crypt of Saint Peter.

The creation of equilibrium, through elevated gradients of relative humidity, would have furthermore inhibited the movement of water from the embankments towards the surface of the plaster and have hindered the migration of salt-rich solutions with the subsequent formation of damaging salts.

It was finally decided that each sepulchral structure would be closed off with doors and insulating panels in order to isolate the internal environment so avoiding inevitable microclimatic changes. As further protective measures for limiting fluctuations of the environmental parameters, the following solutions were adopted:

- decrease of visitor number during each access,

- reduction of the visit time in the necropolis,
- prolongation of the waiting time between the different visiting groups.

5. Conclusions

This paper reported synthetically the work methodology adopted for preserving the Vatican Necropolis, a very peculiar site under the Basilica of Saint Peter in the Vatican City. Once the restoration work ended, the maintenance therapy began, or rather the implementation of a meditated maintenance program carried out by means of a continuous monitoring of environmental parameters, frequent checks on the works' state of conservation, periodic biocide treatments and systematic and specific care. Therefore, constant maintenance works by qualified personnel is required in those parts of the St. Peter's necropolis that are exposed to the continual passing of pilgrims and visitors. Even if the causes of deterioration for hypogeum environments are quite similar, each case needs to be treated in different manner depending on the materials, structures, state of conservation, and environmental conditions. The removal of salts appearing on the brick surfaces as well as other maintenance interventions already discussed are carried out by the Fabric of Saint Peter's in order to prevent, or at least postpone difficult, expensive and heroic surgical interventions later on.

Technical solutions should be developed according to a specific case study; in fact, for example, the use of crystal doors for closing the mausoleums in Vatican Necropolis cannot be applied in catacombs, because these are generally excavated in tuff deposits, where high levels of radon are detected. Radon is a particularly harmful and cancerogenous heavy gas that remains in the air if constricted in poorly ventilated or closed environments.

The solutions specifically developed for the conservation of Vatican Necropolis seem to efficiently protect the structures and the materials as it is possible observing today.

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