



Soprintendenza Speciale
Beni Archeologici
Pompei Ercolano Stabia



POMPEII SUSTAINABLE PRESERVATION PROJECT

Final Report

**Porta Nocera Necropolis Preliminary Campaign
(22 September to 14 November 2014)**

Albrecht Matthaei – Ralf Kilian

Holzkirchen, March 17th, 2015

Fraunhofer Institute for Building Physics IBP, Holzkirchen Branch
Fraunhoferstr. 10 | 83626 Valley | Germany

Index

Overview over the activities of the PSPP at the Porta Nocera Necropolis during the Preliminary Campaign (A. Matthaei / R. Kilian)

Report on the research of history of the necropolis and the results of the archive research on earlier restorations including a glossary of building materials, construction techniques and Monoliths (P. Kastenmeier)

Report on the CONSERVATION SURVEY of the NECROPOLIS of PORTA NOCERA including tombs of the Western area and of the Eastern area (M. Martelli–Castaldi)

Documentation of the Funerary Monuments 14 EN and 07 ES (C. Elsässer)

Report on geophysical survey and photographic documentation (CNR IBAM)

Appendices

Introduction to the Nomenclature for Maps and Photos

Condition Survey maps (M. Martelli–Castaldi with S. E. Leitner)

Overview of photographs

Overview over the activities of the PSPP at the Porta Nocera Necropolis during the Preliminary Campaign

The background of the POMPEII SUSTAINABLE PRESERVATION PROJECT

The POMPEII SUSTAINABLE PRESERVATION PROJECT's main goal is to help protect unique monuments at Pompeii and, by doing this, to develop new skills for the professionals working in the conservation field. For this reason the project aims to bring together high-quality restoration with top research in the humanities and sciences and the training of young researchers. Our initiative includes the cooperation of leading research institutions in Europe. We have chosen to work at Pompeii not only because the city is a world famous heritage site but also, and especially, because it is a unique archive of restoration efforts: all the different approaches to conservation taken during the last 200 years can be studied and evaluated nowhere else in the world better than in Pompeii. The site is therefore the perfect laboratory for the development of conservation methods. It is also a great classroom for teaching conservation sciences in their best and broadest meaning. The project is planned as a 10 year initiative that will be financed – following the successful model of the HCP in Herculaneum – by private funding. In March 2014 we organized a meeting in Munich between the presidents of Italy's National Research Council (Prof. Dr. Luigi Nicolais) and of the German Fraunhofer Gesellschaft (Prof. Dr. Reimund Neugebauer). Both institutions see the conservation of world heritage sites as an international task and plan to collaborate in the future with programs in which also the natural sciences will contribute to the rescue of endangered heritage sites. In this occasion they gave us a start-up grant that has enabled us to work for one year, to conduct a preliminary campaign in Pompeii, and to continue with the raising of the necessary funds for the future of our project.

Together with Prof. Massimo Osanna, Pompeii's Superintendent, we defined an area in Pompeii where our project could start: the Necropolis of the Porta Nocera. For

our initiative the necropolis is a perfect starting point since it is a prominent, autonomous part of the city that is easily accessible and offers many opportunities for restoration and conservation.

The Necropolis lies in the southeast of the city and, so far, it is the biggest excavated funerary precinct. The Necropolis is today the hinge between the modern city and the archaeological park – in antiquity it developed, along the road, coming from Porta Stabia in the west and leading to the east in a straight line towards the ancient city of *Nuceria*. In front of the city gate there is a crossroad with a street leading to the southern *suburbium* of the city where two pre-roman sanctuaries and the large funerary precinct of the *gens Epidia* are located.

Four zones with tombs have been excavated in the area: the smaller ones in the east lie on private ground and have been reburied for modern building purposes, while the two in the west that were excavated in the 1950's and the 1980's are the focus of our project.

Excavations in this area of Porta Nocera began in May 1952. By 1956 a 210 m long stretch of the necropolis was unearthed by Amadeo Maiuri, but it was published only 30 years later by Antonio D'Ambrosio and Stefano De Caro.

The Preliminary Campaign – Organisation

Our preliminary campaign lasted two months in the fall of 2014. The main aim of this campaign was to obtain a clear impression of the necropolis, its tombs, and its problems. Further objectives were to determine what the site offers for our project, to draw general conclusions on possible areas of intervention, to develop concepts for future interventions, and to prepare a proposal for other activities. With these aims in mind we have then surveyed and mapped problems, looking first at the whole Necropolis and then on two tombs in a more detailed way.

The work on the site was carried out by two teams:

One team from Italy's National Research Council led by Prof. Daniele Malfitana: Giovanni Fragalá and Danilo Pavone worked on the photos for the 3D visualization, a virtual tour, and the basis for the future documentation system. Giovanni Leucci and his team conducted a geophysical survey in the whole area of the necropolis.

The other team was led by Prof. Monica Martelli-Castaldi and Dr. Pia Kastenmeier, including three students from the Technische Universität München and Simon Leitner as Prof. Martelli-Castaldi's assistant. They devoted their attention to the documentation of the state of conservation of the monuments, their restoration history, and the preparation of the working concept for future interventions.

Besides this work, the PSPP team was active with outreach activities: they gave guided tours for visitors, for example the friends of the Glyptothek Munich, the "Pompeji Kurs" of the German Archaeological Institute in Rome, and four School Classes from Terzigno were guests of our team. Finally on November 12th, 2014 we had the chance to present the ongoing work to a team from UNESCO who was impressed by the project's methods and its results.

Overview of the main results from the Preliminary Campaign

One basic and very important part to better understand the monuments of the Porta Nocera Necropolis was **archival work** (see details in the Report of Dr. Pia Kastenmeier). Since the archaeological publications of the Necropolis contain almost no information on the decay of the monuments and the different phases of restoration and reconstruction work that have taken place since the time of excavation, Pia Kastenmeier has studied the foto archives of the Soprintendenza, the German Archaeological Institute in Rome, and the private archive of emeritus Prof. Valentin Kockel. The final result of this work gives us now a much clearer picture of the post-excavation developments of the necropolis. This includes the following findings:

1. We know now better where the surfaces of 79 A.D. are lying directly underneath today's walking level. This is an important piece of information since the soil is an archaeological archive completely untouched by modern scientists or workmen and has to be conserved like the monuments. We also know in which parts the ground level of the necropolis has been raised by *alluvium* (i.e. deposit of earth and rubble) since the excavation – and where therefore today visitors see only part of the original monument.

2. We know more about the decay of the monuments, especially those that were left without protective roofing: they lost most of their plaster and decoration within the first 20 years after excavation.

3. We can identify different phases of reconstruction that took place mainly in the early 1960s.

4. We also noted the different measures taken for the maintenance of the monuments, beginning with the first roofing, the protection of the surfaces first with sackcloths in the early 60s and then until 1970 in several cases with glasspanes, the reconstructive leveling of the upper parts of the monuments including a topping with bitumen and *coccio pesto*, and the building of a channel around the chamber of tomb EN 2. In the coming years we intend to consult also the archives of written documents.

Another important part of our work was the **photographic documentation** of all monuments. We did this with two photo teams: two students from the TUM made a traditional photo documentation of the grave monuments, while the team from the Italian National Research Counsel produced extensive photographic surveys and photogrammetric data in order to create an orthogonal projection of all the funerary monuments. The images were processed with specific software to produce 3D models of the funerary monuments and to create an immersive photo gallery of the necropolis. The Presentation of the **3D Mesh models** provides views inside each tomb and a look at every detail of the structure. These models can also be used for

documentation of conservation issues in the future. The CNR IBAM team is now working on the creation of a web interactive platform with a plan as the foundation for a final presentation of the archaeological complex to a general audience.

To get a **clear overview of the damage to the tombs** and of the **problems of conservation** that the tombs and the surfaces of the grave precincts have, Prof. Monica Martelli-Castaldi and her team mapped different kinds of information as a basis for our future plans (see report Martelli-Castaldi). For example a wide range of structural problems were not only mapped but also described in detail so that structural engineers can next make proposals for a rescue strategy (how important this is, was demonstrated by tomb EN 24 that collapsed in May 2014). As an additional example, the team created different maps of the places where the ancient, original surfaces are still visible, and of their conditions and problems. Concerning recent damages there are for example the different problems of salts on plaster or a broad range of biodeterioration. The overlaying of different maps not only helps to illustrate the symptoms deriving from these problems but also to get an idea of their causes.

The collected data allows us to identify what kinds of specialists we will have to consult to find solutions for new restoration approaches, for example to help with the problem of heavy damage of the surfaces due to salt crystallization, to develop special foam mortars for the filling of gaps where the original stucco is detached from the wall or how to deal with the serious problems of rising damp and water infiltration. Besides the overall survey the conservation Master student Christina Elsässer **examined two grave buildings** closely (see report Elsässer) and surveyed all the different types of damage. We chose two of the most complex cases to get the best sense of what kind of damage we will have to deal with in the Porta Nocera Necropolis. The tomb 14 EN was once one of the best preserved monuments – and famous for the graffiti on the socle. Even if today most of the plaster on the façade is still in situ, it is heavily damaged and endangered: the lower layers of the

stucco are detached from the wall, the middle layers are detached from each other, the plaster and the painting layers are flaking. The chamber of tomb OS 7 has severe problems with microbiology on mural paintings. The aim here was to record and determine the different types of vegetation so that we can later include biologists in the restoration work – especially since each type of vegetation has a different impact on the surfaces and therefore on the needed conservation methods. A major **danger for the monuments is water** – water coming from above but also the ground water. The Necropolis of Porta Nocera is situated in one of the lowest points of the archaeological park of Pompeii. All the water collected on the via di Porta Nocera flows directly into the western part of the necropolis and forms there huge puddles. The water not only comes from the ancient city but also from the modern one, since this was built on top of the pyroclastic material from 79 A.D. and is, together with the channel system under via Plinio, 5–6 meters higher than the necropolis. Unfortunately a structural plan with the appropriate connections between the modern and old cities' water system does not exist and has yet to be drawn.

Shelter roofing is another central issue. In addition to the project of directing the ground water flow, the roofs will be one of the most important means to guarantee the sustainable long-term preservation of the tombs in the Porta Nocera. Even if some of the today existing roofs and the coverings over the tomb monuments in the Porta Nocera have helped to slow down the process of disintegration, they all show major problems of durability: all the iron parts are rusty and the bitumen does not resist the local high summer temperatures well, while the wood needs regularly planned maintenance and rots quickly in the humid winters. Therefore we plan to use a new construction composed only of steel and terracotta which are materials that guarantee long lasting stability and need a minimum of regular maintenance. Initial designs and drawings have been made by Arch. Stefan Giers from the TUM – others will follow as soon as we secure the necessary funding. Of course we will

invite as many specialists as possible for an open discussion about the design of those shelter roofs since their impact on the esthetics and original meaning of the necropolis space will be significant.

As a **preliminary measure for preventive conservation**, colleagues from the Fraunhofer Institute for Building Physics have begun with **climate measurements**. They placed 8 data-loggers in different parts of the necropolis to determine the relationship of humidity and temperature in the tomb chambers, under the existing roofs, behind the security screens, and in the garden areas of the tombs.

To evaluate how to handle the necropolis as a museum and to guide visitors, we also mapped different potential risks that can occur in the interaction of tourists and the necropolis, like loose parts of the decoration above head height or holes in the ground. Tourists can have a negative impact on the monuments as well when they are drawing graffiti on historic surfaces or are climbing on monuments.

Part of the **geophysical survey** was the use of Ground-Penetrating Radar (GPR) and passive and active Electrical Resistivity Tomography surveys at three different areas that were performed by Dr. Leucci and his team from the CNR IBAM. In Area 1 (see report Leucci) they could show clearly that the 6th century city wall continues also in the zone south of the amphitheater. In Area 2 (see report Leucci) we may have found proof for a street that is the continuation of the one that comes from Porta di Stabia and continues towards the north/northeast to Porta di Nola. There must have been an intersection under the non-excavated part where the street that can be seen in the eastern part of the necropolis, goes from the ring road to Nocera. In the western part the geophysical results give information on the stability of the ground and the undersurface water-flow – this information is very important for future plans to channel the water and to build foundations for shelter roofs.

The main actions and need for research can be summarized as follows:

(Scheme of the priorities and usefulness of the different actions, for further details please see also report on the CONSERVATION SURVEY of the NECROPOLIS of PORTA NOCERA by M. Martelli–Castaldi)

MAP	PRIORITY			ACTION	CONSULTANCY	RESEARCH
<i>MAP n. 1.2</i> Original structure (masonry components).			3			USEFUL Study on the different behavior to the weathering agents in relation to the internal construction materials.
<i>MAP n. 3.1</i> Dangers and risks (for visitors and surfaces)	1			EMERGENCY Remove risks for visitors	IMMEDIATE Inspection of specialist for structural stability	
<i>MAP n. 3.2</i> Loss of original height	-	-	-			More studies about this topic, in vision of new temporary roofs
<i>MAP n. 3.2bis</i> Original ground level	-	-	-			More studies about this topic
<i>MAP n. 3.3</i> Structural instability	1				IMMEDIATE Inspection by structural engineer specialized in archeological structures	
<i>MAP n. 3.4</i> Surface instability (see also MAP n. 3.7)	1	2		IMMEDIATE Consolidation of collapsing preparatory layers	URGENT Verify infiltration of water from above	EXTREMELY USEFUL and URGENT Follow up of HCP study on damage of paint layer and surface finishings
	1	2		EMERGENCY Consolidation of surface decay due to salts	URGENT Verify infiltration of water from below	EXTREMELY USEFUL and URGENT Study on consolidants and protective coatings used on archeological surfaces
	1		3	EMERGENCY Rescue of fragments fallen at bottom of structures		IMPORTANT Research of other fragments already in deposits
			3			IMPORTANT different behavior to the weathering agents in relation to the decorations and the internal construction materials.

MAP n. 3.5 Direct contact between structures and ground			3	USEFULL Consolidation of excavation-cut surfaces to avoid material sliding over excavated surfaces	IMPORTANT Verify areas with land-slide situation	A small search in archive about photos of excavation moment
		2		IMPORTANT Reburial of exposed foundations (if they do not have a specific archaeological need to remain visible)		
MAP n. 3.6 Water presence or traces	1			URGENT Repair or re-activate existing water collectors	URGENT Study in detail management of water through: a. drainages b. trenches c. open channels etc	IMPORTANT Research about active or passive measures to reduce impact of moisture on monuments and walls
	1	2		IMPORTANT Re-establish the ground surface at the entrance to the necropolis (from the amphitheater side)	IMPORTANT Inspection of specialist and/or study in detail of movement of rain water on ground surfaces	IMPORTANT Geological study of the ground water in modern and ancient Pompeii.
MAP n. 3.7 Salt presence or effects	1			VERY URGENT Repairs or new impermeabilisation of existing covers (directly on the masonry or as temporary roofs)	VERY URGENT Verify all covers to understand water penetration	
	1			VERY URGENT Repair existing temporary roofs or build new ones		VERY URGENT For many tombs, analyse possibility of new construction of temporary roofs
	1					VERY URGENT Continue HCP study on problems of the paint layer and surface finishings
MAP n. 3.8 Vegetation		2				Useful Research on plants for the soft capping of walls to prevent water uptake.
MAP n. 3.9 Biodeterioration	1			URGENT Apply a biocide to reduce damage on painted surfaces	URGENT For painted rooms, need of study of microbiological growths to define biocide and times of application	Very useful Research on the type of organisms and methods to prevent growth in the future

Summary and Outlook

The main result of our preliminary campaign was a clear overview on the conditions of the grave precincts and tomb monuments of the porta Nocera. We were able to develop a strategy and working plan for future campaigns. We intend to work in the necropolis of porta Nocera for the next 5 years, half of the life-span of PSPP, which will cost approximately six million euros. During this time we plan to restore and consolidate all the monuments in a sustainable way, to establish together with the Soprintendenza and the city of Pompeii a system that regulates the ground water level, and to build shelter roofs over most of the monuments. It is planned that up to 8 restorers will be working in situ all year round, and at least 10 summer schools for students and professionals in the conservation sciences will take place along with workshops and conferences on the different topics of the project (such as shelter roofing, digital archives, biodeterioration and plaster restoration, climate measurements for preventive conservation, etc.). The project will also constitute a basis for different related research projects on conservation problems that we confront in the Necropolis and other areas of the city as well as on questions on the archaeology of the *necropoleis* in the region, the communication with visitors and promotion of the site.