

# INTRODUCTION

## Background

The present study concerns materials used for Pompeian wall paintings.<sup>1</sup> In focus are plasters of the early period, related to the Samnite period and the so called First style. My earlier experiences in the field of ancient materials were studies of Roman plasters at the Villa of Livia at Prima Porta and fragments of wall decorations from the demolished buildings underneath the church San Lorenzo in Lucina in Rome. These studies led to the hypothesis that technology reflects not only the natural (geographical) resources available but also the ambitions within a society, a moment in time, and the economic potential of the commissioner.<sup>2</sup> Later, during two years within the Swedish archaeological project at Pompeii, it was my task to study the plasters used in one of the houses of *insula* V 1, an experience that led to the perception that specific characteristics are linked to plasters used over time. In the period 2003-2005, funding by the Swedish Research Council made possible to test the hypotheses. The present method was developed at *insula* I 9 and the Forum of Pompeii with the approval of the Soprintendenza archeologica di Pompei and in collaboration with the directors of two international archaeological teams.<sup>3</sup> It became evident that plaster's composition changes over time, and eight groups of chronologically pertinent plasters were identified and defined A-H. Based on these results, I assume there is a connection between the typology and the relative chronology in which the plasters appear on the walls. I also believe these factors are related not only in single buildings or quarters but over the site and that, hypothetically, the variations observed are related to *technology*, *craftsmanship* and *fashion*.

At the very end of the research period some odd plasters were found at Casa del Centauro and Casa del Granduca Michele, and similar peculiar plasters were observed at fragments found at

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<sup>1</sup> I wish to extend my sincere thanks to all those who have contributed to this project. First and foremost the Swedish Research Council (Vetenskapsrådet) for funding the project, and institutions and persons which gave the fundamental support: to the Soprintendenza archeologica di Pompei and its former Soprintendente Pier Giovanni Guzzo the present Soprintendente Teresa Elena Cinquantaquattro, Dr Antonio Varone and Dottssa Anna Maria Ciarallo for most valuable help. At the Swedish Institute in Rome I have had constant backing from its Director Barbro Santillo Frizell and the staff Stefania Renzetti, Margareta Olsson, Astrid Capoferro and Liv D'Amelio. I further wish to express my gratitude to Prof. Filippo Coarelli and Prof. Fabrizio Pesando and the archaeological teams of the universities of Perugia and Napoli L'Orientale, in particular to Dora D'Auria, Valentina Befani and Renata Esposito for explaining "their houses" to me, and to Dr. Susanna Bracci, Dr. Fabio Fratini and Dr. Emma Cantisani at the CNR/ICVBC in Florence for stimulating discussions on the results regarding our complex investigations. I am indebted to the former Director of the British school at Rome, Prof. Andrew Wallace-Hadrill and to the Director of the Pompeii Forum Project Prof. John J. Dobbins, for suggestions and inspiring discussions, collaborations that led to the development of this research method.

<sup>2</sup> Freccero 2000a, Freccero 2000b, Freccero 2000c, Freccero 2002, Freccero 2005.

<sup>3</sup> The study *Pompeian Plasters, Insula I 9 and Forum* was made in collaboration with Soprintendenza Archeologica di Pompei, The British School in Rome and The University of Virginia, financed by the Swedish Research Council (Vetenskapsrådet) and published in 2005.

the level of demolished buildings below the Temple of Venus. These strange, grey/brown plasters seemingly belonged to a period earlier than the First style.

In 2010 my project received new funding from the Swedish Research Council and it became possible to complete the study, this time with focus on early plasters in Pompeii.

Thirty-two houses are now included in this two-phase study. The approach in the present one is different to the investigation 2003-05 when the buildings were sampled to establish decoration periods, to identify the plaster types, and to create a system of plaster groups. During this second research period focus was set on the early period that is the First style and earlier; late decorations were not sampled unless there was a specific reason. Therefore, only few samples have been taken in few rooms and, at one occasion at one wall only. Fragments found at demolished structures below the structures visible today have been studied as well. Further, the present study includes the reference samples of the large plaster collection at *insula V 1*, the Swedish archaeological research project, with the objective to provide possibilities to compare the results and to assemble all plaster samples into one data base. That part of the investigation will be presented separately as “*Insula V 1*, a study within the study”.

## Aims and Objectives

The aims of this study are to understand the development of ancient plastering technology, if the components in the plaster can be linked to specific periods, to establish if technological factors are linked to workshops, and if a connection between relative chronology and plasters' composition over the site may be proved. If laboratory analyses confirm the results achieved by macroscopic observations it indicates that specific plaster types can be identified and their characteristics explained.

The objectives of this study are

- a) to determine a relative chronology valid from the archaic period to the last days of Pompeii,
- b) to create a reference system that may be a complementary tool for the dating of decoration layers even when the painting has vanished and thereby crucial for the Pompeian construction history, and
- c) if possible to establish if the quality of craftsmanship has had importance for the preservation of decorations. Such knowledge may eventually be used to suggest alternatives to modern conservation substances for the preservation of wall paintings.

## Problems

Earlier research has established that there is a notable distinction between plasters used at Pompeii over time. If non-subjective methods of analysis confirm observations made under the microscope, it would mean that specific plaster types can be recognized and their characteristics explained.<sup>4</sup> If these plaster types appear in the same chronological order in houses spread over the site, then it would be possible to create a reference system and use ocular plaster analysis as a complementary tool for the dating of decorations and re-decorations at Pompeii. Such a tool would be useful in cases when the painted decoration has disappeared, or when traces of an early decoration are visible as seams behind later constructions.

Problems that need to be answered are

- a) Is it possible to establish a correlation between a specific type of plaster and a specific period in time?
- b) Is a link between typology and chronology valid within single houses or applicable to houses within the area of Pompeii?
- c) Is it possible to distinguish quality differences in the plastering technique used in important buildings and private homes?
- d) Are particular plastering and painting techniques distinctive for specific workshops or solely distinctive for periods?

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<sup>4</sup> I do not believe there is a method, which in the end, is absolutely objective, since questions posed as well as interpretations of results achieved are subjective. Chemical-technical investigations produce, however, non-subjective facts.

# PROJECT DESCRIPTION

## Design of the study

This investigation can be divided into four distinct areas: studies *in situ*, analyses of samples, laboratory analyses and considerations on archaeological and art historical issues, aspects that will be discussed under separate headings.

The study within any house is planned in concordance with the archaeologist in charge in order to decide where and why to sample; there has to be a reason for sampling. The plaster layers and existing stratigraphies are studied, followed by sampling and by observations of small samples under the microscope. Documentation of the contexts, the sampling areas, and the samples is integral part of the study. As soon as the plaster types have been identified and designated to plaster groups, art historical and structural issues are regarded too; these are control instruments and, as a principle, it should be a correlation between the typology (plaster type) the chronology (period) and the style in which the painting was made. Petrographic and technical analyses in a scientific laboratory are performed separately, and the results of the investigations compared.

## Research Methods

The methods used, are

- a) studies of the context
- b) documentation and sampling
- c) qualitative analysis of the components in small samples of wall plaster,
- d) petrographical and technical investigations in the laboratory,
- e) considerations on standing structures and Pompeian styles

### a) Studies of the context

The context is the house and the wall. The house is, to start with, seen as the envelope of the rooms and the walls which are at focus. After the general inspection of the context, the documentation and main interest concerns a) the plaster layers, b) the walls and c) the rooms. Areas relevant for sampling are selected and schedules for plaster samples made to contain all key information. Characteristics of the walls such as the observable decoration periods and sizes of sampled plaster layers, indications of rebuilding, the levels at the walls of sampling areas and whether or not there are stylistically identified decorations are facts that are noted. The level sampled at the wall may be of importance; plasters at socle levels often are water

repellent and may have a different composition of filler and stucco. The main zone may be characteristic of the plaster type while decorations at the upper zone may have more plaster and stucco layers which may contain more lime. The size of the plastered area sampled is important; it is either a *layer* applied over at least two stones, a *small remain* on one stone, or it may be a *spolium*, a reused piece of plaster inserted into a cavity in the wall. The layer may be decorated and evidence of a decoration period or be undecorated. If there is a decoration and the decoration is covered with a later period, we definitely have two periods. If an undecorated layer is covered by a decoration, that may be remains of an earlier decoration or part of the painted layer on top of it – plastering was made in more than one layer. Indentations by a pick-hammer are evidence of re-decoration; this was a common method to make the new plaster adhere. A decoration could otherwise be torn down from the wall before the re-decoration was made. In that case small areas of old plaster may be found at decayed wall areas. The characteristics of the layers are also noted; there may be several plaster layers or only one or two, and the paint layer may be of white stucco or of *cocciopesto*, or sometimes, just an application of lime. These factors may be indicative of the social status of the owner, the type of room investigated, and of the period in which the decoration was made. There are some secondary factors to consider, such as the impact of the environment. Plasters in protected areas are generally in a better state of preservation than those found on unprotected walls, and in particular on areas at, or below, the present floor level. Plasters may be very frail and fall apart when touched, which excludes the possibility to obtain a solid sample. Plaster from the same decoration may be perfectly solid at another area, indicating that the frailty is due to decay, caused by environmental factors.

#### b) Documentation and sampling

Relevant plastered areas are documented on digital photos with the sampling spot indicated. These photos are later used in the schedules. Plans over the house are used for indication of sampling spots. All data has been collected in a data base as well, to which it will be open access.

Sampling begins where there is a clear stratigraphy, possibly in connection to an ascertained First style decoration with the objective of starting the study in each house at the earliest possible phase. The samples, generally about 5 mm in diameter, receive identification numbers by the initial letter of the house and the order in which it was taken, e.g., CA 1 (Casa delle Amazzoni, sample no. 1). Number one, being the first sample and type, is a reference sample. Sample no. 2 is, as a principle, removed from a layer that covers no. 1, and assumingly of a later period. Therefore no. 2 is generally a reference sample too. Each reference sample represents a type of plaster connected only with that building. The types identified in single houses are compared to reference samples in other buildings. Those that

are of the same kind constitute one group. The many plaster samples that may constitute one group are, in a typological perspective, of the same kind.

c) Qualitative analyses of samples

The composition of small plaster samples are studied under the microscope during sampling *in situ* and afterwards. The variables studied under the microscope are,

- i) the characteristics of the lime,
- ii) the components in the filler (aggregate), and
- iii) the proportions between lime and filler.

i) *the characteristics of the lime*

Lime plaster is composed of sand, slaked lime and water. Sand is the filler; lime and water make the binder.<sup>5</sup> Lime is produced by burning calcium carbonate ( $\text{CaCO}_3$ ), i.e. limestone or marble, to about 900-1000 degrees, transforming it into calcium oxide ( $\text{CaO}$ ), i.e. quick lime.<sup>6</sup> When water is added, a reaction starts, producing heat, resulting in calcium hydroxide ( $\text{Ca}(\text{OH})_2$ ), i.e. slaked lime. The slaking process continues for a long period, and to ascertain that the process is completed, the lime should be kept in closed pots or caves for years. Slaked lime can be smooth and even, but it may also contain lumps of lime that are residues of the burning and slaking process. It is generally of a white or creamy white colour, depending on the kind of limestone or marble that was used for making it. Also dolomite, ( $\text{CaMg}(\text{CO}_3)_2$ ), can be used to produce lime.

ii) *the components in the filler*

At Pompeii, the filler consists almost exclusively of volcanic particles, such as pyroxenes and pumice.<sup>7</sup> The components are linked to the area at the Somma-Vesuvius complex from where it was taken. Hypothetically, different caves provided fillers at different periods. Some aggregates are mainly black and grey others are many-coloured. The grains are shaped and coloured in different ways, due to their chemical composition and connected to circumstances during which they were originally created or later ground. The composition of volcanic matter varies due to the different conditions prevailing at each eruption.<sup>8</sup> Most particles are pumice: opaque, dark grey, black or brown, rounded, with a more or less porous surface. Pyroxene crystals appear in most aggregates and are of a high percentage in some. The pyroxenes are of two kinds: orthopyroxenes and clinopyroxenes. The former are long black, rhombic crystals. The latter are monocline, transparent and translucent. When the samples are studied under the microscope they are described according to material type; *compact grains* which are fragments

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<sup>5</sup> 1 part slaked lime and 2 parts sand is conventional but there are variations.

<sup>6</sup> On issues related to lime, see Bläuer-Böhm, Jägers 1997, Marchese et al 2001, 24, 27.

<sup>7</sup> Ehrhardt, Meyer-Graft 1998, 317; Grave 2002, 62; Sabbioni et al. 2001, 39f.

<sup>8</sup> Sigurdson 2007, 43ff.

of volcanic rock, limestone or marble, *porous grains* which mainly indicates *cruma* but sometimes baked brick as well, and *crystals* which are pyroxenes or vitreous materials. The colours of the particles are noted on the sheets. The compact volcanic grains are defined e.g. as black, grey, brown, stones are beige, pale yellow, ochre, *cruma* is red, and the crystal group contains particles that are generally uncoloured, yellow, green or grey, sometimes orange. It would be possible to describe the red grains for example in a variety from deep red-orange to dark wine red, but that would bring the study far out of its limits. The stones are occasionally rounded resembling river sand, and in that kind of filler are sometimes large bean-shaped grains which are generally of beige-brown hues. Reused materials, such as paint flakes, ceramics or glass can be observed under the microscope too.

Another aspect is the grain size but not in the sense of successive layers of finer plaster, as recommended by Vitruvius.<sup>9</sup> Some plasters have homogeneously large grained fillers and a lack of small particles that may cause cracks or voids in the plaster when it sets. Other plasters have very small grains. A well-balanced and solid plaster contains grains of various sizes, where those of a smaller size fill the spaces between larger grains.

### iii) *the proportions between lime and filler*

The proportion between lime and filler is yet another variable. Some plasters are made of clean lime and are well proportioned. Others seem to be hastily made of reused materials, mixed with fresh lime. In general, the top layer below the preparation for painting or stucco contains a visibly higher percentage of lime than the rough coat.

### d) Laboratory analyses

In order to understand the reasons for the variations noted and to explain in what these distinctions exist, the method used *in situ*, which is a qualitative analysis, has been combined with non-subjective methods such as petrographic and chemical investigations. Laboratory analyses have been performed at the CNR/ICVBC in Florence.<sup>10</sup> Several samples from each group in all of the buildings investigated were examined during 2003-05, and thirty-one samples have been analysed during this research period. The investigation consists of stratigraphic analyses of thin sections in optical microscopy, photographed in polarized transmitted light and under UV radiation.<sup>11</sup> Analytical methods used were FTIR and XRD and, in a few cases, samples were further studied with SEM.<sup>12</sup> The chemical composition and the mineralogical components of the samples have been investigated. Plasters as well as preparations for painting (stucco) have been examined, but only the plasters are used for

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<sup>9</sup> Vitruvius VII, 3.

<sup>10</sup> Consiglio Nazionale delle Ricerche/Istituto per la Conservazione e la Valorizzazione dei Beni Culturali. Analyses have been carried out by Drs Susanna Bracci, Emma Cantisani and Fabio Fratini. See: [www.icvbc.cnr.it](http://www.icvbc.cnr.it).

<sup>11</sup> An optical microscope Zeiss Eclipse 501, equipped with objectives from 1x to 40x, white light and with a high pressure UV lamp was used.

<sup>12</sup> Fourier Transform Infrared Spectrometry, X-Ray Diffraction, Scanning Electron Microscope.

classification in this study, and the stucco layers are considered as additional information. The grain size within the filler has been classified according to three variables: well-classed (mainly of one size), medium-classed (varied grain size) and un-classed (all kinds of dimensions). Its constituents, almost exclusively volcanic matter, were registered; the shape of the grains defined and their dimensions noted, measured in  $\mu\text{m}$  (100  $\mu\text{m}$  is 0.1 mm). The binder was defined according to the criteria of abundance, porosity, homogeneity, structure, i.e. micritic or microsparitic, and in some case, the opacity was noted. Based on these definitions, the plasters were placed into groups with the same characteristics. The groups of plasters that had been identified by chemical and petrographic investigation were compared to the groups identified by data collected *in situ*. The results have been compared and discussed at several meetings. Eight pigments analyses were made as well and the thin sections photographed in reflected light and electronic microscopy.

As an additional investigation aiming at ascertaining current observations, the aggregates of a selection of samples in group 0 and group A are now studied by a volcanologist to, if possible, establish if the dissimilarities observed and determined can be related to different eruptions.

A separate investigation aiming at ascertainment was made in 2005 as well when a team from Åbo University tested C 14 analysis on samples from identified and dated paintings in *insula I 9* in Pompeii and *insula Occidentalis I* in Herculaneum within the projects of the British School in Rome. The method which had been successfully used in other environments did not function at these Campanian sites.

#### e) Archaeological and stylistic considerations

Wall constructions and decorated wall plaster are linked to phases of the history of Pompeii and to phases within a house. Archaeological studies of standing structures provide established dates; certain kinds of wall constructions did not occur until after a specific date. A painted decoration is generally referred to as belonging to one of the four Pompeian styles, a reference that automatically places the decoration within a limited period of time. The periods to which Pompeian wall decorations belong are well-defined, even though there are minor disagreements for example in the dating of the beginning of a style or specific paintings. Therefore, information regarding construction methods and Pompeian styles is valuable for the understanding of collected data. Taking these kinds of aspects into consideration is of vital importance, they are all part of the same context.

## THE ROMAN CONTEXT

The Roman house, construction materials and building techniques, plastering and pictorial styles are structurally parts of the same context. Houses, building materials and pictorial styles have been thoroughly studied for centuries. The methods of ancient lime production are well known and mortars and plasters scientifically analysed. The plastering technique, the materials used, and the technical development from a presumably archaic phase to a very sophisticated method of wall plastering for painting are in focus in the present investigation. How did the Romans technically do to make the decorations last, is a question that still needs to be answered.

### Building constructions

The earliest foundations for buildings at Pompeii dated to the 5<sup>th</sup> and 4<sup>th</sup> centuries BC were made of large relatively irregular blocks of *pappamonte*, a local tufa type. In recent excavations at archaic levels of the city, this kind of early walls or foundations have been found below standing structures in several regions of the city, often along the same alignments as seen today.<sup>13</sup> Around the 3<sup>rd</sup> century BC, constructions were mostly made of large and finely cut rectangular blocks of Sarno limestone, a grey travertine of the Sarno River valley. Giuseppe Fiorelli developed a method of analyses of Pompeian houses in the 1870s, based on the houses excavated at that time. He distinguished two characteristic groups, those with atria constructed of Sarno limestone and the second group of Nocera tufa, a local solidified volcanic mud, cut into large ashlar blocks.<sup>14</sup> Tufa had been used for some of the great houses such as Casa del Fauno while houses made of Sarno stone were often of modest dimensions. The ashlar blocks joined in *opus quadratum* was principally used for façades.<sup>15</sup> Closely related is the framework technique *opus africanum*, in which standing and horizontal blocks formed frames and the interstices were filled with pieces of lava and limestone joined with lime mortar. Houses constructed in *opus quadratum* and *opus africanum* remain but, rebuilt in later periods, in most cases, only fragments of the original constructions remain.<sup>16</sup> Most walls in Pompeii are constructed of rubblework, made of pieces of limestone and tufa joined by mortar.

*Opus caementicium*, Roman concrete refers to a building material in which the core is a mix or various materials, covered by a framing on both sides. The facing was built up along with

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<sup>13</sup> Brun 2008, 63; Carafa 2007, 65f; Castrén, et al. 2008, 332f.; Coarelli 2008, 173f; Curti 2008, 48; Pesando 2008, 159ff; Wallace-Hadrill 2007, 281.

<sup>14</sup> Wallace-Hadrill 2007, 280.

<sup>15</sup> Eschebach 1995, 158; Laidlaw 1985, 41f; Franklin 1990, 15.

<sup>16</sup> Maiuri 1973, 1ff.

the core.<sup>17</sup> In the early first century BC, facings of *opus incertum*, consisting of irregular small pieces of limestone, tufa or lava set in mortar, were introduced. Regular, small cut stones set in the characteristic fishnet pattern of *opus reticulatum*, is not known in Pompeii before the Roman colony.<sup>18</sup> Tiles were introduced as wall construction material, *opus testaceum*, in the Roman period too, but had been used since the 2<sup>nd</sup> century BC for roofing and to build columns. After AD 50, brick was the dominating construction material. All mortars were, according to Adam, of mediocre quality and badly mixed; a practice which has an impact on the preservation of unroofed and unattended standing structures.<sup>19</sup> After the earthquake in AD 62, any and all of these materials were mixed and used.

## The Roman house

Walking along a street at Pompeii today, we see many entrances in the long wall of a city block. Most entrances belong to a space used for commercial activity. In general, such spaces are flanking each side of the entrance to the private home. A door at the rear wall of the commercial area indicates the business was a family trade while a closed wall may indicate the commercial area was rented or owned by a different holder.

Most houses in this investigation are traditional *atrium* houses built in the period between the late 3<sup>rd</sup> and the 1<sup>st</sup> centuries B.C. Some have structures of *opus quadratum* and *opus africanum*, other mainly of *opus incertum*, and all have been rebuilt in later periods, as can be observed in the different building materials and techniques. All private homes were entered by the small *vestibulum* and narrow *fauces*, after which the visitor entered the open *atrium* area in the middle of which was the *impluvium* with the adjoining well shaft as the focal point. Behind the atrium was the *tablinum*, through which one might see the peristyle garden if the *tablinum*'s rear wall was not closed. The dining room, *triclinium*, was often situated behind the *atrium* area, close to *tablinum* and the garden. There were small rooms and bedrooms either at one side or at the two sides of the *atrium*. If the house was a large one it might extend with new series of rooms behind the peristyle garden. In minor houses with large workshops, there might not be the link of a *fauces* between the street and the *atrium*; the visitor entered directly into the probably enlarged *atrium* area which was the workshop.<sup>20</sup>

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<sup>17</sup> Dobbins 2007, 115.

<sup>18</sup> Sear 1988, 76.

<sup>19</sup> Adam 1981, 103.

<sup>20</sup> On Roman houses and society, see Wallace-Hadrill 1994.



Fig.2. Via dei Soprastanti, different building constructions; to the left an area of *opus incertum*, in front to the right a technique of the Roman period with use of baked brick, *opus testaceum*.

Fig.3. Below, to the left. *Insula V 1*, the House of Tofelanus Valens; at the corner large ashlar blocks of Sarno limestone, after which is a large area of *opus incertum*. At the second storey *opus reticulatum* and *opus vittatum*.

Fig.4. Below, to the right: The house of Octavius Quartio, view from the entrance towards *fauces* and *atrium*. At both sides of the doorway are plaster casts of the impressive doors.

In many cases a house was extended by the incorporation of nearby properties or portions of houses. Walls were partially torn down or constructed windows and door walled up or opened as circumstances changed. Even though there are signs of rebuilding everywhere and in all periods of time, it seems such activity was extremely frequent in the period after the earthquake in AD 62 and the eruptive period that followed. Radical interventions can be observed and these signs are part of my study. If for example, a window was walled up or a new wall constructed against one already existing, there might be remains of decorations hidden; such plasters constitute evidences of chronology. In Pompeii there was an extensive rebuilding and redecoration period beginning in the late 1<sup>st</sup> century BC, when the Romans settled and took on the new fashions in Rome.<sup>21</sup>

## Plastering technique

Wall-painting in Pompeii and in Ancient Rome was made on carefully plastered walls consisting of at least two plaster layers – the rendering or levelling coat and the rough coat, on top of which was the smooth finish coat made of a mixture of lime and calcite crystals, that is the stucco.<sup>22</sup> Vitruvius explains how to prepare walls for painting.<sup>23</sup> According to his recommendations at least three layers of plaster consisting of lime and sand with successively finer grains should be applied on the coarse rendering coat. Then three layers of lime and crushed marble should be applied; each layer had to be beaten and smoothed with a plasterer's tool, the trowel, before the next one was laid on. By using this technique the walls would gain a considerable thickness making them extremely resistant and not easily damaged. A further advantage of the thickness was the slow drying process which prolonged the time allowed for painting al fresco. Vitruvius also pointed out that if only one layer of plaster and one of stucco were used, the wall would be easily damaged and it would not be possible to achieve the desired lustre. Another advice was to use hydraulic plaster at the socle levels in damp areas. Something makes Roman lime plaster extremely durable. *Reticulatum* walls with remnants of decoration still stand unattended in nature, at times even at a shore close to the sea. Modern preparations would not last for more than a few decades, unless protected and cared for. This is obviously not just a question of mixing lime and a filler, because that is how it is done today. The secret might be in the method of burning and slaking the lime, in the composition of the filler, or the proportions between the components of plaster. It may otherwise be linked

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<sup>21</sup> On the Forum area, see Dobbins 1994; Dobbins, Ball 2005; Wallat 1997.

<sup>22</sup> Plaster intended as a mixture of slaked lime, water and sand. When the lime plaster sets by taking up carbon dioxide from the air and drying out to form calcium carbonate, it becomes hard and chemically similar to limestone and marble. For studies on plasters and stucco, see Bordignon 2000; Bläuer-Böhm, Jägers 1997; Grave 2002; Ling 1999; Marchese et al. 1998; Miriello et al. 2010; Peterse 1999; Sabbioni, Zappia, Riontino 2001; Meyer-Graft, Ehrhardt 1998.

<sup>23</sup> Vitruvius VII, 3.

to the technique, or else to some, or to all of these factors. There have been attempts to reconstruct the Roman plastering technique; Paolo Mora claimed that he had reconstructed it based on Vitruvius' description.<sup>24</sup> The accomplishment was due to Mora's interpretation of the words "*politionibus*" and "*politiones*",<sup>25</sup> which he explained as signifying "*polymet*", which is fine clay used for gilding.<sup>26</sup> Experiments based on Mora's description were made in Cologne.<sup>27</sup> Polymets are not mentioned in the evaluation of the results, but instead the mixture of grain sizes in the plaster and *intonaco*, which was considered to be of utmost importance. The conclusion was that *intonaci*, prepared of fine marble dust, became dull while those "...which were composed of coarser material were quite easy to polish and produced an acceptable sheen..." Häfner's observation corresponds with my own experiences, a series of experiments and a vast investigation of decorated plasters at Villa of Livia.<sup>28</sup> Early preparations, and in particular those of the Augustan period, were of an excellent quality, made of several layers with successively finer grain size. Laboratory analyses of small samples showed that the smooth and lustrous *intonaco* or stucco had inclusions of large crystals of marble or alabaster, a fact already noted by Cagiano de Azevedo.<sup>29</sup> In the last years, an interdisciplinary team worked to re-create Roman plastering technique according to Vitruvius' description. The project was performed as collaboration between institutions in München and the Soprintendenza archeologica di Pompeii.<sup>30</sup>



Fig.5. Fragment of wall painting from the Villa of Livia at Prima Porta. The large fragment of the Augustan period belonged to a wall decoration in the atrium. The fragment measures 115 x 20cm, and has a thickness of 6.2 cm, 1.7 of which is the stucco.

<sup>24</sup> Mora 1967.

<sup>25</sup> Vitruvius VII, 3. (*Politionibus, politiones* etc. means *smoothing*.)

<sup>26</sup> Mora 1967, 64. "Le *politiones* sono delle terre argillose che oggi vengono chiamate "boli"."

<sup>27</sup> Häfner 1997, 143-152.

<sup>28</sup> Freccero 2000. Chemical-technical investigation made at the scientific laboratory at the Opificio delle Pietre Dure in Florence by Drs. Mauro Matteini, Arcangelo Moles, Giancarlo Lanterna, Maria Rosa Nepoti, and Carlo Lalli.

<sup>29</sup> Cagiano de Azevedo 1949, 145f.

<sup>30</sup> Contact: Lehrstuhl für Restaurierung, Kunsttechnologie und Konservierungswissenschaft Technische Universität München.

## Wall paintings – the Four Pompeian styles

Pompeian wall paintings have been thoroughly studied for centuries.<sup>31</sup> There is a general agreement on dating, styles and issues regarding the technique used for preparation and painting. As a consequence we still divide these decorations into the *Styles* defined by August Mau,<sup>32</sup> the *Styles* still are related in time, and the painting technique is still defined as *al fresco*.<sup>33</sup> Mau made a systematic study of Roman wall decoration and recognized that these were of four types, that the different styles chronologically followed one after the other, and that the wall decorations in Pompeii did not have the roots in Greek tradition.

There are disagreements in the dating of specific paintings, there is some doubt about the idea of a strict chronological dating of paintings based on stylistic elements, and it is known that the paintings are generally not made *al fresco* but in a mixed technique.<sup>34</sup> The ground colours of the walls were applied *al fresco* but the finer details were often painted in another medium, as revealed when the paint used *a secco* is peeling off.

There is, in addition the *candelabrum* style, a transitional period between the Second style and the Third recognized already by Mau. Recently a plain type of decoration contemporary with the First style has been acknowledged as the Zone style.<sup>35</sup> And in the last years, yet another pictorial style, earlier than the First, has been identified and given the name *stile zero* or Style Zero. There is also the taste of the commissioner to consider: there evidently were house-owners who were perfectly comfortable with mixing styles and to have imitations made when a room needed some re-decoration.<sup>36</sup>

In spite of the slight variations in dating, perception and recognition of stylistic elements, the established Four Pompeian styles combined with archaeological studies of standing structures provide established dates; certain kinds of wall constructions and certain pictorial motifs did not occur until after a specific date.

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<sup>31</sup> The Four Pompeian styles: 1<sup>st</sup> style, c. 180-80 BC. At least as old as the earliest houses built toward the beginning of the second century BC; 2<sup>nd</sup> style, c. 80-20 BC. From the time of the Sullan colony, continued until the end of the century; 3<sup>rd</sup> style, c. 20 BC-AD 45. From the second triumvirate down to the time of Tiberius. 4<sup>th</sup> style, c. AD 45-79. The phase can be divided in two periods, before and after the earthquake in AD 62. On Pompeian painting, see, e.g., Barbet 1985; Beyen 1951, 1960; Ehrhardt 1987; Laidlaw 1985; Ling 1991.

<sup>32</sup> August Mau 1882, *Geschichte den dekorativen Wandmalerei in Pompeji*.

<sup>33</sup> The paintings are generally referred to as frescoes or *freschi*.

<sup>34</sup> Freccero 2002, 62.

<sup>35</sup> D'Auria, forthcoming.

<sup>36</sup> Ehrhardt 2005, 170ff.

## Style zero

Chronologically the earliest type of decoration identified at Pompeii, found at archaic levels of the city, this decoration does not fall within the established four Pompeian styles, but rather seems to go back to a local Etrurian-Campanian tradition. The name *stile zero* was suggested by Jean-Pierre Brun in an article in 2008, and as far as I understand, the name is now stuck to paintings that were made before the First style.<sup>37</sup>

A simple motif – a repetitive wave painted in black on a white background, has become a symbol for this style. The motif of a painted wave was used in Etruscan and Campanian tomb decorations from the 4<sup>th</sup> century B.C.<sup>38</sup> It seems the pattern was appreciated in noble houses of the period, as shown in a wall painting in Cuma, showing a woman, sitting on a throne, attended by a servant. Behind the figures there is a wall. Above its high red socle is a row of painted black waves against the white background.

There are other examples of a similar ornamental arrangement in Pompeii, for example in Casa del Fauno, room 31.<sup>39</sup> Stylistically the pattern can be dated to the end of the 4<sup>th</sup> or beginning of the 3<sup>rd</sup> century BC, coinciding with the period of the first Samnite city wall.



Fig.6. Fragment of wall painting, detail of a wave pattern in black on white background.

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<sup>37</sup> Brun 2008, 61-70.

<sup>38</sup> Brun 2008, 65f.

<sup>39</sup> Brun 2008, 68.



Fig.7. Above, to the left: Casa del Fauno, *fauces* decorated in the First style.  
 Fig.8. Above, to the right: Casa del Centauro, *cubiculum* 3, southwest corner.  
 Fig.9. Below, to the left: Casa del Centauro, *cubiculum* 3, south wall, detail.  
 Fig.10. Below, to the right: Casa di Iulius Polybius, *vestibulum* A, north wall. First style decoration and walled up door painted in the Second style.

## The First style

The First style, also known as the incrustation style, was the standard decoration from the end of the Punic war to the end of the social war.<sup>40</sup> The implemented pattern is simple but, within the established structures the decoration could be very sophisticated. The wall as a principle was divided into three main zones; the high socle, the middle zone and the upper zone crowned by epistyle, frieze and dental cornice.<sup>41</sup> In some houses, such as the Casa del Fauno, the decoration partially was quite elaborate and three-dimensional, but in other areas much more restrained.

This three-dimensional decoration was made of plaster and stucco shaped into a geometrical pattern of standing and horizontal rectangles in relief. The strongly projecting dental cornice was built up with several layers of plaster and attached to the wall by regularly inserted projecting nails. The last stucco layer was carefully smoothed to become soft and lustrous to resemble marble. Pilasters crowned with capitals were flanking doorways and used to make distinctions between areas.

The distribution of colours was relatively constant. A yellow ochre hue was often used to paint the monochrome high socle, above which was the likewise monochrome projecting, flat string course, followed by a row of large drafted orthostates painted monochrome or to resemble marble. Marble imitation in general could be made in realistic manner or it might be completely fanciful. The upper zone consisted of courses of horizontal panels of fake marble crowned by the elaborate unity epistyle, frieze and dentil cornice in high a relief, often kept white. Between the main and the upper zones was a profiled string course.<sup>42</sup> The simplest overall pattern was a ca 1 m high yellow socle separated by a projecting string course from a white upper wall with a purple or green fascia and white wall crown next to the ceiling.<sup>43</sup> This type of decoration is called the Zone style.

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<sup>40</sup> The Punic wars 218-201. End of the civil wars 89 BC Sullan colony, 80 BC Roman republic.

<sup>41</sup> This basic system continued to be used in the Pompeian wall decoration.

<sup>42</sup> Laidlaw 1985, Fig.1, Terminology.

<sup>43</sup> Laidlaw 1985, 28.



Fig.11. Casa di Cerere, room 4. The decoration of the antechamber and the alcove are separated with a painted pilaster with Corinthian capital.

## The Second style

The Second or the architectural style was presumably first used at the House of the Griffins at the Palatine in Rome, a decoration dated to 80 BC. In Pompeii it was popular in the period of the Roman republic, after 80 BC, supposedly as an effect of the close contact with Rome as many Roman veterans stayed in the city. Paintings in this style were common during the Republic, less in the Augustan period. Well known examples are the representative decorations in the house of Augustus at the Palatine, made in the period between in 36 and 27 B.C.<sup>44</sup>

The pattern of stone walls in stucco relief in the First style was transformed to fit a flat wall in the Second; the tactile relief structure vanished and was substituted by paintings of marble in the middle zone appearing to be in relief by using the technique of painting light and shadow. Other typical features are painted pilasters and fake doors. Moulded plaster remains only at the edges of walls and as framing around lunettes.<sup>45</sup> Often the crowning with the frieze and dentil cornice remains; maybe they fitted into the new system, or they were difficult to remove.

The style is divided in two phases: in the first phase, dominating between 80-50, the wall is closed, with no perspective.<sup>46</sup> If there are decorative paintings, these are small panels with figures or animals. Towards the end of the period painted garlands appear between pillars and pilasters at the upper part of the wall.

The second phase, around 50-20 BC is the renaissance of painting.<sup>47</sup> There are openings towards the sky, views in perspective at the upper zone, masks hanging on cornices, scenes and landscapes in imaginary windows.<sup>48</sup> Other particulars of the later period are monochromes, bands with epic motifs and the melographies, figure paintings in more than life size, as the famous mystery paintings in Villa dei Misteri at Pompeii. At the end of the period, illusionism gradually vanishes; the large vistas disappear and the architectural structures tend not only to become two-dimensional but also designed to be totally lacking their supporting capacity. Pilasters that carry vaults and architraves are substituted by reed and candelabra, a fact that made Vitruvius complain about contemporary fashion which he found were outbreaks of bad taste.<sup>49</sup>

The candelabrum style was, according to Mau, a transitional period between the Second and the Third Style, in Rome dated to around 30-20 BC.

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<sup>44</sup> Ehrhardt 1987, 2ff.

<sup>45</sup> Stroocka 2007, 308.

<sup>46</sup> The main periods traditionally are 80-50 and 50-20 BC, Barbet's classification is 100-60, 60-40, 40-20 BC, and Sear mentions 90/80-20/10 BC.

<sup>47</sup> Beyen 1938, 32f.

<sup>48</sup> Barbet 1985, 37.

<sup>49</sup> Vitruvius, VII 5:3-4.



Fig.12. Above, to the left: Caserma dei Gladiatori, decoration in the *candelabrum* style.  
Fig.13. Above, to the right: Casa di Iulius Polybius, room GG, east wall, Third style decoration.  
Fig.14: Below: Casa del Frutteto, the black *triclinium*.

## The Third Style

The Third, or the ornamental style, evolved from the transitional candelabrum style. This linear and elegant, rather rigid manner was fashionable in the period from Augustus to Nero. The paintings in the pyramid of Cestius in Rome dated to 12 BC are regarded as the earliest examples.

The new invention is the tripartite system of the wall. Horizontally there is still the division in three zones, each in a different ground colour. Vertically the wall is divided into three parts; a large central panel flanked by two narrow ones or two pairs of narrow panels. The central panel usually is occupied by a painting with a mythological motif, framed by a cornice.<sup>50</sup> The style is sometimes called the Egyptizing style due to the predisposition to use exotic motifs and in particular impressions from Egypt and Egyptian mythology.

Two of the houses in *insula* I 9, Casa del Frutteto and Casa del Bell'Impluvio, have well known decorations in the Third style which are representative for the different trends. Famous are the garden paintings in Casa del Frutteto, one of which was painted on a blue background and the other one on black. In the blue room there are motifs pointing at Egypt and the Isis cult, and in the other, against a black background is a tree housing birds and a winding snake. Both houses have a black *triclinium* with large central paintings between slender decorated columns and stems. In the *tablinum* at Casa del Bell Impluvio is a vista at the upper zone, in which imaginary architecture is visible against the blue sky.

In Casa di Cerere most walls are decorated in the Second style but there are also examples of the Third, as in one room there is a painted flying bird holding a string of pearls in its beak, a motif that becomes popular in the Fourth style.<sup>51</sup>

In the later Third style, after Augustus' death in AD 14 there is a gradual stylistic change, and the style becomes less rigid and more painterly.

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<sup>50</sup> Bastet, de Vos 1979.

<sup>51</sup> Barbet 1985, 113.



Fig.15. Casa di Amarantus, *tablinum*, wall. Fourth style decoration, detail.

## The Fourth Style

By far the most decorations in Pompeii belong to the Fourth style, as the earthquake in 62 AD and those that followed caused much damage in the city and most houses needed at least partial repair. Many wall paintings had to be replaced.

Fourth style decoration is regarded as a combination of the Second and the Third style. The tripartite system of the Third style is kept, and there is a revival of the illusionistic approach of the Second. The upper zone opens up again to vistas and now even the side fields do. However, the earlier large central painting on the wall tends to become smaller while the motifs remain the same.

Repetitive patterns occur as subdivisions of the wall, and these so called *embroidery borders* appear as if stencilled to the background.<sup>52</sup> Sometimes these repetitive patterns resemble modern wall paper, which provided the name the *tapestry style*.<sup>53</sup> Flying or floating figures often decorate the centres of these imaginary tapestries. Undulating plants, swans, dolphins, and griffins are common motifs too.

As pointed out by Ehrhardt, the entire system of distributing spaces was copied, not only the central painting. Some Fourth style decorations made after the earthquake are quite visibly different from the surrounding decorations, but sometimes they so much resemble earlier decorations that one can be mistaken.<sup>54</sup>

There is a slight disagreement regarding the end of the Third and the beginning of the Fourth style: the question is if the Fourth style began in late Tiberian or the early Claudian period. This pictorial style has traditionally been related to the Golden house of Nero constructed after the great fire in 63. The rooms were decorated by the court painter Fabullus, who in fact is one of the very few painters known by name.<sup>55</sup> At the death of Nero in 68 large part of the house was decorated in the advanced Fourth style.<sup>56</sup> Most probably this style started already in the 40s or 50s AD, as a transitional style where Third style ornament was combined with new patterns, such as the re-entrance of outlooks in the upper zone.<sup>57</sup> In Pompeii, the earthquake in 62 is a turning point, after which the Fourth style had overthrown the Third. Some paintings in the Third style were however, still appreciated and continued to be copied.<sup>58</sup>

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<sup>52</sup> Ling 1991, 71.

<sup>53</sup> Clarke 1991, 61-63.

<sup>54</sup> Ehrhardt 1987, 133.

<sup>55</sup> Ling 1991, 71f.

<sup>56</sup> Strocka 2007, 317.

<sup>57</sup> Ling 1991, 72.

<sup>58</sup> Richardson 2000, 2f.



Fig.16. Above: Casa di Amarantus, *tablinum* 5, Fourth style decoration, embroidery borders.  
Fig.17. Below: Casa di Venere. Fourth style decoration in the peristyle, south wall.

## Workshops and painters

Who were the masters of Pompeian wall painting?

Little is known about painters and painters' workshops. Attempts with use of different criteria have been made to identify painters and their paintings. Beyen had identified ten different workshops in 1951, and these were named after the houses in which their most important works had been made.<sup>59</sup> The style of each workshop at a given period was homogeneous, but he could recognize the "hands" of individual artists. The method is based on the principle that each artist has something that may count as a personal fingerprint. This fingerprint may be the way the artist paints the nose or the ear of a subject; details that are not regarded as important and therefore not given any particular attention.<sup>60</sup>

This approach has not given much result as far as the early periods are concerned, mainly because few figure paintings remain. In some studies interest has focused on decorative details such as candelabra, garlands, and other details seen separately or as part of an established structure which might lead to a specific book of patterns that belonged to a specific workshop or master.

Ehrhardt found similarities between some Third style decorations Casa del Frutteto, Casa del Bell'Impluvio and Casa di Fabius Rufus that may point at one painter or a workshop, which might have been responsible for paintings in other houses over the site as well.<sup>61</sup>

De Vos recognized some workshops that produced decorations after the earthquake in AD 62. The most elegant paintings of the period were made by the masters that decorated the Casa dei Vettii. Another workshop, of lesser capacities, was active in the vicinity of Via di Castricio.<sup>62</sup> According to de Vos, the painters of this *bottega* made rough paintings in modest houses, mainly in the commercial quarters where the workshop was situated. Only occasionally they managed to make some painting of a higher standard. Typical features that reveal the workshop are tapestry borders in colour that contrasts to the background, stretched garlands, still life's of fish and birds but also portraits in *tondi*, just to mention some motifs. More recently, Richardson has made a vast study of figure painters in Pompeii.<sup>63</sup>

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<sup>59</sup> Beyen 1951, 235ff.

<sup>60</sup> Richardson 2000, 10.

<sup>61</sup> Ehrhardt, 1987, 135ff.

<sup>62</sup> De Vos 1981, 119ff.

<sup>63</sup> Richardson 2000.



Fig.18. Above to the left: Edifice of Eumachia, space 222. Detaching wall plaster.  
Fig.19. Above, to the right: Casa del Bell'Impluvio, salt efflorescence, *triclinium* 8.  
Fig.20. Below: Temple of Jupiter. Detached decoration.

## Preservation and conservation at archaeological sites

The preservation of excavated paintings was, and still is, a gigantic problem. Comprehending ancient technology, reconstructing and using it, should be an advantage for the preservation of excavated wall paintings. As pointed out by Marchese et al, knowledge about materials is the necessary base for conservation programmes and interventions.<sup>64</sup> Franca Parise Bodoni noted – in 1981 - that less than 20% of excavated wall paintings and pavements remain due to lack of maintenance, as well as to conservation interventions.<sup>65</sup> Portland cement is one of the well-known causes of paintings being lost. In natural humid or damp environments it produces salts that flourish like mushroom colonies, disintegrating the painted surface. The analyses of such salts in Casa del Bell'Impluvio, room 8, east wall, verify that these are caused by cement.<sup>66</sup> Acrylic resins are just as mismatched to lime plasters as is Portland cement. Plastic is an excellent water-resistant material: a good quality that becomes negative on a wall painting, since it prevents the evaporation of natural humidity. Enclosing water into walls or works of art leads to material destruction. This is a problem especially in open-air environments, where humidity caused by rain and capillary suction is normal and must be considered before any conservation intervention starts. Capillary rise of water inside unprotected walls is a great problem at Pompeii. Studies on the composition of plasters and mortars show that the mortar in general is of a mediocre quality with many lime lumps.<sup>67</sup> Because of the low quality, water penetrates and the building plasters swell, in the end provoking the detachment of wall plasters and finally destroying the wall. Since major part of the walls in Pompeii is unprotected, water penetrates from the top as well. Water or dampness is the single most destructive element for material decay; nothing really happens in the absence of humidity. Simple roofing and clean base levels might be good options to preserve the standing structures.

An interdisciplinary conservation project with a modern approach in conservation, research and documentation that could serve as a model was initiated in Herculaneum in 2001.<sup>68</sup> One of the main problems to deal with from the start was, in fact, how to eliminate stagnant water.

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<sup>64</sup> Marchese et al. 2001, 23. “*La conoscenza dei materiali di un’opera d’arte antica, dal piccolo oggetto al grande edificio, rappresenta la base necessaria per ricostruirne la storia e la tecnologia e per programmare eventuali lavori di restauro e di conservazione*”.

<sup>65</sup> Parise Badoni 1981, 71.

<sup>66</sup> Sample BI 6 sali. Constituted principally by thenardite ( $\text{Na}_2\text{SO}_4$ ). Traces of gypsum and sulphates with sodium and calcium aphthalite, ( $\text{K}_3\text{Na}(\text{SO}_4)_2$ ); syngenite  $\text{K}_2\text{Ca}(\text{SO}_4)_2 \cdot \text{H}_2\text{O}$ .

<sup>67</sup> Adam, 1981, 103.

<sup>68</sup> Wallace-Hadrill et al. 2006, 233ff.

## Conservation materials

Conservation history from the late 18<sup>th</sup> century and onwards is a story of new inventions, important achievements and serious mistakes. Pompeian wall paintings have been the subject of many kinds of unkind treatments, such as Morriconi's miraculous mixture for polishing the paintings.<sup>69</sup> This mixture, which is all but beeswax, has contributed to the preconceived idea that beeswax is harmful to paintings on plastered walls, when in fact, beeswax does not have properties that can dissolve frescoes or cause serious damage to paint applied *a secco*. Many modern conservation materials are not compatible with ancient technology and furthermore, they age rapidly, often provoking damage to material they were supposed to restore.<sup>70</sup> Acrylics are dissolved in toxic solvents, such as trichlorethane and xylene.<sup>71</sup> These are not good for the conservator, and solvents of this kind "...*may on occasions swell the underlying material or cause dyestuffs to bleed...*".<sup>72</sup> Protective layers of natural beeswax observed on excavated wall paintings the Temple of Isis,<sup>73</sup> and at the Roman villas at Stabiae were removed.<sup>74</sup> After treatments the paintings were protected with an acrylic resin.<sup>75</sup> There is no official reports on what happens when chemicals are superimposed, as they are used in reality; in laboratories they are tested singly.

Conservation is a slow and sometimes very costly affair. Regular maintenance is the only possible way to avoid expensive conservation interventions.<sup>76</sup> First aid interventions and security repair with an appropriate lime plaster or stucco is a good investment for preserving Pompeian wall paintings, stucco decoration and mosaics. Lime, sand and water are not expensive and they are non-toxic. Lime plaster and stucco have resisted for 2000 years.

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<sup>69</sup> Vlad Borrelli 1980, 81. Morriconi's recipe for surface protection was a mixture of turpentine, alcohol, amber, copal varnish, rubber and sandarac. It had the disadvantage of turning yellow and even to provoke the detachment of colours.

<sup>70</sup> Modern acrylics, such as Paraloid B72, are visually recognized by a hard and uniform lustre. They are transparent when applied but have the disadvantage of turning yellow-brown. Acrylics are, in practice, impossible to remove. In *Science for conservators* (Wilks 1999, 115-116), acrylic resins, such as Paraloid B72, are defined as "*a copolymer of methyl acrylate and ethyl methacrylate. They remain soluble and are easily replaced, and are not affected unduly by light.*" Considerations on lime and barium hydroxide, and a less enchanted view on acrylics, see C. A. Price 1996, 17f, 29f.

<sup>71</sup> Torracca 1990, 52, 56-62; Mora 1998, 94f.

<sup>72</sup> Wilks 1999, 116.

<sup>73</sup> Cinti 1992, 121-122. "*Dimetilformammide, Xilolo, Tricloroetilene. I solventi sono stati usati sia puri che mischielati tra loro e applicati mediante impacchi con carta giapponese...*"

<sup>74</sup> Miniero Forte 1989, 32f. Beeswax was removed with "*Clorotene... benzina... impacchi di tricloroetano*". Cleaning was made with "AB57", a mixture of chemicals, such as ammonium bicarbonate, sodium bicarbonate, EDTA and Desogen, a biocide, containing other chemicals. Consolidation was made with "Paraloid B72 al 3% tricloroetano".

<sup>75</sup> Cinti 1992, 122. EDTA, "*sale bisodico dell'acido etilendiamminotetracetico*"... "*Paraloid B72, Rohm-Haas, al 3% in Tricloroetano*".

<sup>76</sup> Wallace-Hadrill et al. 2006, 246ff.