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GÖTEBORG STUDIES IN CONSERVATION • 9

ENCAUSTO AND GANOSIS

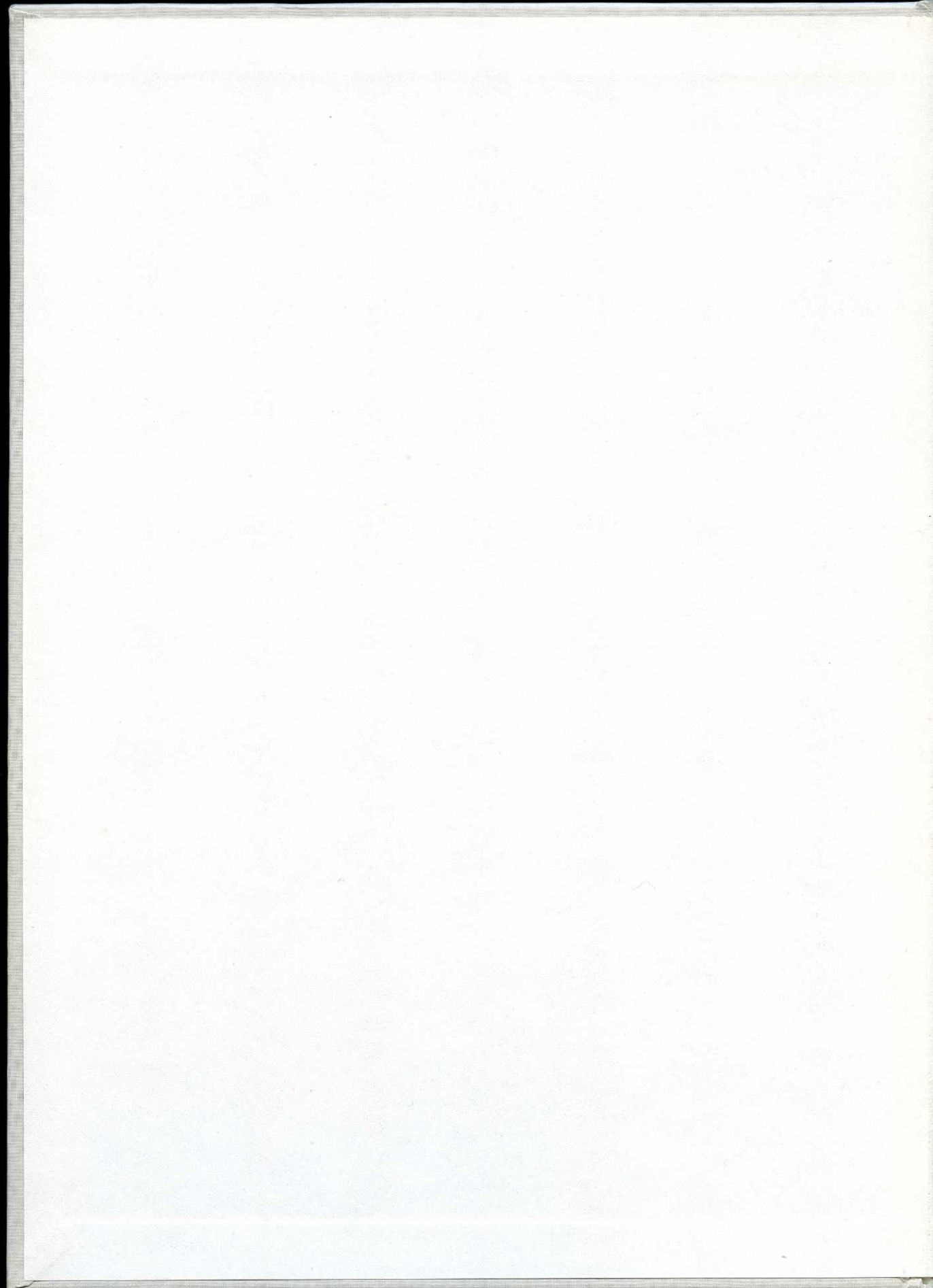
Beeswax as Paint and Coating during the Roman Era and its Applicability in
Modern Art, Craft and Conservation

AGNETA FRECCERO

Institute of Conservation



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Programme in Postgraduate and Doctoral Studies in the Discipline of Conservation

Revised version of the dissertation for the Ph.D. Degree, "Roman Painting. Wall Paintings, Fayum Portraits and Polychrome Statuary. Conservation, Materials and Context".

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ENCAUSTO AND GANOSIS:

Beeswax as Paint and Coating During the Roman Era and its Applicability in Modern Art, Craft and Conservation

Abstract

Ethics in conservation and the relation between theoretical guidelines and their application in real life is the comprehensive subject of this study. Choices of materials in conservation, whether traditional or modern products are, or should be, preferred and issues regarding the basis on which such choices are, or should be, made are problems relating to the level of applicability of theoretical programmes in real life.

The ancient techniques, encaustic painting and *ganosis*, are at focus in this dissertation, and the materials used for such painting and coating have been studied. The principal material connecting these techniques is beeswax, used in its natural, or raw state as paint, or transformed into saponified wax, i.e. Punic wax, either as paint or as a surface coating. These techniques are related to Fayum portraits, i.e. painting on wooden panels, with Roman wall painting, and with Hellenistic and Roman polychrome statuary as a coating. The materials, beeswax and natron, ingredients in such paints and coatings, are studied and described, as well as the relation between these paints and preparations. Some pigments used during Antiquity, relevant in this study, are briefly described, being part of ancient paints. Ancient and modern interpretations of the terms *encausto* and *ganosis* have been studied.

Issues concerning whether or not these materials and techniques might be accepted in professional conservation and modern building construction are discussed. Experiments have been made with the intention of reconstructing these ancient materials and techniques and testing their applicability in modern environments, aiming at reducing negative factors for the environment and health. Finally, theories have been exposed to situations in real life, and the results are presented in six case studies.

Keywords: Encaustic painting, Punic wax, *ganosis*, beeswax, mummy portraits, Fayum portraits, polychrome statues, Pompeian painting, Roman painting, conservation.

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PREFACE

This dissertation is a result of my experiences as an artist and a conservator, within the fields of painting and conservation. Being previously professionally educated at the University College of Arts, Crafts and Design in Stockholm, the first three years studying sculpture, and the last two painting, I lived a rather “normal” life of an artist for the next twenty years, when I decided to invest in a second profession. My first contact with conservation ethics, methods and materials, was at the Istituto per l’arte e il restauro, Palazzo Spinelli in Florence, where I studied the conservation of stone, in periods between 1989 and 1991. Beside traditional materials, modern conservation materials were used, including toxic or cancerogeneous substances. The use of such materials seemed rather shocking to me and especially alarming was the fact that young people were more or less in constant contact with these dangerous products, which might be harmful for their health. When working with conservation projects in Sweden after completed training, this experience was confirmed; great quantities of unhealthy conservation materials were constantly used, and no adequate protective measures were taken to avoid negative effects caused by the various substances. During this period of professional preparation I was involved in a six month long project on cleaning ancient tombstones at the parish church of Solna, close to Stockholm. Most of the cleaning was made by using a natural soap (Sw. såpa), and the result was quite satisfactory. The substance, made of derivatives from pine, has a pleasant smell, it is harmless to the skin and does not kill the surrounding grass and flowers. Not all undesirable signs of ageing could be cleaned off the stones, which was not intended either. In a few cases, a more efficient cleaning agent had to be used, e.g. on black crusts, but at least 90% of the cleaning was made with “såpa”. Two years later these stones were still clean, but it must be stated that a maintenance plan needs to be established in order to keep such objects in a continuing good state of preservation. This example also illustrates the issue of *how* to conserve, considering the aesthetic factor.

Artists often exclaim, “stop conservation of art”. The reason for such an attitude is that conservation often means that all signs of ageing are lost on ancient works of art. Not only that, but the material itself looks different after modern conservation interventions. To a certain extent I do agree. Cleaning and conservation is often so thoroughly made, that returning for a beholder to a much appreciated work of art, now conserved, is often a complete delusion – the marble is too white and has a strange dull lustre, and the wall painting seems pale and dull.

My experiences of conservation methods, in Sweden as well as in Italy, have made me suspect, that the pressure from scientific reports and from the chemical industry is very hard to neglect for the conservator, and that such modern products many times are used unquestioned. It is not my intention to suggest a complete return to ancient technology, but rather to point out that there are serious problems with some modern methods. Therefore we ought to consider, and reconsider, ethics in conservation, in order to accept, in each single case, only the methods causing less harm to objects and/or nature. Ancient methods deserve not to be forgotten. Some are useful the way they are still adapted, while other methods may be improved to suit modern needs.

The combination of personal experiences, as related above, connected with the assumption that ancient and traditional materials were less harmful, taken as a whole, led to my decision to study some ancient materials and techniques. Among the vast number of ancient materials, possible to investigate, I have primarily concentrated on beeswax – *how* and *when* it was used, and *if, how* and *when* it can be used today.

Beeswax as a traditional material for conservation was introduced to the students at the Palazzo Spinelli. Except for objects of marble, lime- and sandstone, ceramics, gypsum etc., I also had the opportunity to conserve some three-dimensional objects of wax, such as a votive figure, vegetable and part of a large anatomical study. The malleability of beeswax at various temperatures was necessarily studied in order to restore miss-shaped parts, and pigmentation of the beeswax was made for producing colours, necessary for reconstructions. Beeswax was also used for the conservation of old furniture, gilded frames, altar-screens etc. In these cases the beeswax was diluted with white spirit, and the mixture used as a surface protective for ancient, or old works of art and handicraft, at terminated conservation.

Since I found wax interesting and challenging to work with, the teacher in charge of conservation of wax objects at Palazzo Spinelli suggested to me to write about *encausto* in my diploma thesis. Although the term as well as the concept, at that time, was unknown to me, it seemed to be a good idea for a study, as I imagined there would be many interesting facts about wax to discover. At that time, in 1994, it was not an easy task to find information regarding encaustic painting. Since then, and in particular during the last two or three years, several important publications on the subject have appeared, which has been of great advantage for my studies. My diploma thesis, presented at the institute, did not explain the specific nature of encaustic painting, but could rather be regarded as an initial study, the outlining of a theme. This initial study was very limited and the practical problems involved merely stated. Therefore, it was essential to continue studies and look deeper into the complex problems.

During the two following years, when I had been accepted as a member of the Doctoral programme in Conservation at Göteborg University (ICUG), my studies were principally concentrated on terminology, techniques and historical background, but also by experimenting, in order to try to make Punic wax. In May 1997 the results were presented, and approved, as a licentiate thesis at ICUG. Since then the historical and art historical background has been further and more precisely investigated, as well as materials and techniques. Some new experiments have been made, now in connection with an investigation of the mummy portraits in the Nationalmuseum in Stockholm, which I was commissioned to undertake. Analyses of the materials used for some portraits have been carried out by the academic staff at the scientific laboratory of Opificio delle Pietre Dure in Firenze. The results of this investigation are fully presented in a publication at ICUG.¹ The investigation is briefly referred to in this doctoral dissertation as a case study, presenting the process of planning and performing the study. Finally the investigation has been published by the Nationalmuseum with the title *Mumieporträtt*.²

Materials and techniques of Roman mural paintings and the possible use of Punic wax for mural painting, or as a protective surface coating for some of these paintings, were next to be studied in depth. Literary evidence and research results available have been consulted, and mural paintings *in situ*, or fragments of mural paintings, have been examined by various methods. The results from these studies are presented in the case studies nos. 3 and 4.

¹ Freccero, 2000, b.

² Freccero, 2000, a.

The same scientists at the Opificio in Florence, as mentioned above have performed the chemical-technical investigations presented in case study no. 4. The results of these studies are aimed at leading to suggestions concerning materials, adaptable for conservation in this field, and possibly also for methods of application in contemporary building construction, if proved to be suitable for modern building standards.

I wish to thank my mentor, Professor Jan Rosvall, for a pleasant and inspiring collaboration through these years, his constructive criticism and professional interaction, which made this study possible. I am also grateful to my former teacher at Palazzo Spinelli, Rosanna Moradei, Professor Sture Samuelsson, KTH (i.e. Royal Institute of Technology) in Stockholm, Professor Carl Nylander, Director emeritus of the Swedish Institute of Classical Studies in Rome, and Dr. Lars Karlsson, research fellow at the same institute, who encouraged me when I took my first, unsteady steps in this field, and later. My gratitude is also extended, to Professor Umberto Baldini, Florence, for his positive understanding of the present research encouraging me to continue, and to Daniel Fuglesang, Lund's University, for checking the language of this text.

The structure of this dissertation automatically necessitated collaboration with other professionals. Consequently, I have received fundamental help and support from several highly qualified individuals, teams, or institutions, and to all these I am grateful. My most sincere thanks to the Soprintendente, Professor Giorgio Bonsanti at Opificio delle Pietre Dure di Firenze for accepting to support the long-term research with materials from Fayum portraits and fragments of wall paintings from Prima Porta, and to Dr. Mauro Matteini, Dr. Archangelo Moles, Dr. Giancarlo Lanterna and Dr. Carlo Lalli, at the Scientific Laboratory at the Opificio, who performed the scientific analyses, and contributed with the facts which constitute the scientific basis in these projects.

I want to thank Dr. Görel Cavalli Björkman, Head of Research, and conservator John Rothlind, Chief conservator at the Nationalmuseum, for giving me the opportunity of studying the Fayum portraits, which became my first real case study. I also want to mention conservator Astrid von Hofsten, remembering the pleasant and instructive teamwork while selecting and preparing for the scientific analyses. In addition, my sincere thanks to Dr. Nasry Iskander and his staff at the conservation department at the Egyptian Museum in Cairo, for professional help, and to Professor Dr. Sandro Massa at CNR (Consiglio Nazionale delle Ricerche) in Rome, who instructed me and opened my eyes to the microscopical realities of natron salt. Also, I want to thank Dr. Susan Walker at the British Museum in London, who critically read and commented on the extended case study concerning Fayum portraits.

The investigations of Roman wall paintings could not have been done without the opportunity of working with real material. The archaeologists, Dr. Olof Brandt and Dr. Peter Liljenstolpe, both leading excavations on behalf of the Swedish Institute of Classical Studies in Rome, gave such opportunities to me. Dr. Brandt had the courage to give me the responsibility for the mural fragments excavated at San Lorenzo in Lucina, and followed the progress of work with great confidence and enthusiasm. Dr. Liljenstolpe proposed the possibility of studying mural fragments at the Villa of Livia at Prima Porta, which led to an extended research project concerning the wall painting materials at Prima Porta, and co-involving the Soprintendenza Archeologica di Roma, XX Circoscrizione, represented by the Soprintendente, Dr. Gaetano Messineo and archaeologist Dr. Matilde Carrara. To Professor Anne-Marie Leander Touati, at that time the Director at the Swedish Institute in Rome, I want to extend my particular thanks for giving professional support in contact with representatives from external institutions, connected to the projects mentioned above.

Further, a special thanks to Ann Marie Kjellander and Alessandro Panini Finotti for friendly, stimulating and inspiring project periods with or without students at the Villa San Michele, and to Katarina Liselius, Bengt Andersson and Håkan Josefsson at White arkitekter for support and stimulating collaboration during the various stages of experimenting with Punic wax.

Finally, I want to express my gratitude to all those who contributed economically to my studies, to my many journeys to Rome, Florence and to Egypt, and to the present publication. Without their support this would not have been possible. My particular thanks to the *Faculty of Arts* for the fellowship financing the last years of my studies and to *Stiftelsen Svenska Institutet i Rom*, for the one year research grant at the Swedish Institute at Rome. Further, I am deeply grateful to *Birgit och Gad Rausings Stiftelse för humanistisk forskning*, Lund, *Fondazione Famiglia Rausing*, Rome, *Fondazione "C.M. Lerici"*, Italienska Kulturinstitutet, Stockholm, *Forskningsstiftelsen för Samhällsplanering, Byggnadsplanering och Projektering*, Göteborg, *Ericsson Business Networks AB*, Mölndal, *Adlerbertska forskningsfonden*, Göteborg, *Adlerbertska stipendiefonden*, Göteborg, *Magn. Bergvalls Stiftelse*, Stockholm, *Åke Wibergs Stiftelse*, Stockholm, *Elna Bengtssons fond*, Stockholm, *Craafordska Stiftelsen*, Lund, and last but not the least, *Tekn. Dr Marcus Wallenbergs Stiftelse för utbildning i internationellt industriellt företagande*, Stockholm. I am happy for all the experiences and the inspiration these years of research has brought.

The present publication is the revised and final version of the dissertation presented at the Institute of Conservation on March 2, 2001. Based on considerations expressed at the disputation some changes have been made. The number of pages in this edition is much reduced since all appendices have been removed. In addition, the sections concerning the general art historical aspects on the development of Roman painting and polychrome statuary have been reduced. A few additions have been made. The suggestion by Professor Carl Nylander to study some later editions of Vitruvius, VI, has shed light on one problem concerning the term *punica*, another inspiring hypothesis presented concerning the origin of Punic wax is included in this context, and will be further investigated in the future. The present text, therefore, is a more concentrated version of the doctoral dissertation, *Roman Painting. Wall paintings, Fayum portraits and polychrome statuary. Conservation, materials and context*. The original edition i.e. the complete version of the dissertation is available at the University of Göteborg.

Rome, April 2002
Agneta Freccero

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INTRODUCTION

Choice of Topic

The principal argument of this dissertation is that we have a common cultural heritage to preserve. As a consequence, questions such as *what* and *how* to preserve it become of vital importance. Alternatives such as making no efforts in conservation at all, or preserving everything made by mankind, in this context, will not be considered as realistic choices. The first alternative would mean a tragic waste of symbols and values while the other would lead to an overcrowded world of things, since continuous production is imbedded in the human nature. Preservation by necessity is selective. In the field between *nothing* and *everything* there are possibilities of acting, and an almost infinite choice of materials and methods to use, ancient and modern. This leads to the vital problem in this context, *how* to preserve cultural heritage.

My first contact with traditional and modern conservation materials was at the Palazzo Spinelli, where conservation of stone was my principal subject. I also had the opportunity to participate in the conservation programme of gilding. The teachers instructing in traditional methods were excellent craftsmen. Working with traditional materials such as various kinds of gypsum and chalk, waxes and clays, was pleasant, while some modern chemical products, such as mastics or *polyfilla*, substituting natural materials, were often uncomfortable to work with due to their consistence or intense smell. Liquids and substances such as white spirit and animal glues, had odours that were easier to accept than those of *Diluente nitro* or modern stone mastics. The smell is, of course, not a criterion to be considered, but it becomes important during work, especially if causing headache or nausea. The fact that many modern materials used in conservation are toxic or even cancerogeneous, was of concern, and made me avoid working with certain materials, and later to consider alternatives, such as materials, which had been used before the invention of modern chemical products. Beeswax and mixtures of beeswax make part of the vast group of traditional materials.

My diploma theses, *La pittura ad encausto* prepared in 1992 at the Palazzo Spinelli, can be considered as my first attempt of understanding ancient methods of using beeswax as paint and for surface coating. In 1995, writing my thesis for the Licentiate degree on *Wax Painting, Encausto and Ganosis*,¹ some problems regarding encaustic painting and *ganosis* were presented. Issues concerning ancient sources and terminological problems were studied in particular, as was the scholarly debate on the encaustic methods, which has taken place generally during the last two centuries. Some of these aspects, substantially revised, are presented in this dissertation. The issues presented above, connected to conservation principles and practice, and to the choice of materials in conservation, lead to a discussion about the role and the responsibilities of the conservator as a professional individual.

¹ Freccero, 1995

Problems

Problems linked to modern conservation programmes of relevance in this context are at focus in this dissertation. One objective is to clarify if there is a correlation between theoretical guidelines internationally agreed upon and the conservation work actually taking place in the "real world".² In this case heritage sites and works of art, principally from the Roman culture, visually exemplify "the real world". Our reception of Roman art is closely linked to remaining archaeological evidence, and the archaeological circumstances during which the objects were found are important, since the ethics valid in any period, dictate how excavation might be carried out and how objects are to be handled.³ With the term, object, in this context, archaeological remains, wall paintings, mosaics, statues and all kinds of minor art and handicraft, i.e. anything excavated at a particular site, is intended. Current ethics and cultural valuations are often manifest in the excavation programme, i.e. the way the project is carried through and how the site and the objects are handled, during and after the excavation period. Studying the material aspects of Roman art, consequently, means considering the archaeological context and measures taken or not taken, to preserve archaeological finds.

Another set of problems concerns *if* and *how* traditional materials are adaptable and/or acceptable, in modern conservation. *If* traditional materials are adapted in conservation, the next questions are *when*, and finally *how* they should be used. By asking *when*, the answer might be "at any occasion", since the chemical similarity between the original and traditional conservation materials are often compatible, or such materials are reversible and therefore not bringing long-term changes to the object conserved. The answer might also be, "just in some particular cases", when, for some reason, similarity between materials is requested. *How* traditional materials ought to be used is the final and most important, question, since material and structural resemblance make possible the performance of indistinguishable reconstructions. This issue also leads to the general question, of what kind of conservation interventions are acceptable, i.e. *how* to preserve. The last, but not the least important problem, concerns the possible effectiveness of such traditional materials if they were to be used also in modern building constructions. These problems are presented in depth under separate headings in the following part of this chapter.

Conservation theory and practice

Studies in the history of conservation reveal, that ever since the first written documents on this subject were expressed, and more elaborated treatises on conservation

² Van Gigch, 1991; van Gigch and Rosvall, 1991; Rosvall and Lagerqvist 1992.

³ Pagano, 1992, 1994.

were launched, there has been a considerable gap between theory and practice.⁴ Theoretical guidelines in earlier periods as well as today, suggest that “as little as possible” should be done.⁵ Conservation practice on the other hand, has often resulted in massive treatments. This discrepancy has been studied with the objective of indicating some possible reasons and, hopefully, to determine a possible weak point in the theoretical guidelines set up. In earlier periods, suggestions of care-taking were made by individuals, mainly concerned with the preservation of artistic values. During the last few decades, general guidelines in conservation have been formed on an international level by ICOM,⁶ ICOM-CC,⁷ IIC,⁸ ICCROM,⁹ and ICOMOS.¹⁰ On the national level, conservators’ organisations have been developed, e.g. NKF.¹¹ Codes of ethics and other principal guidelines have been formulated, as e.g. the recently revised AIC Code of ethics 1999.¹² Issues of conservation principles, evidently lead to a set of serious questions concerning reconstruction, restoration and conservation, and ultimately to ethics in relation to conservation interventions. The problems are accentuated only as a set of issues within a few major themes such as:

- a) the selection of objects to conserve
- b) the kind of conservation desired
- c) the choice of means within conservation
- d) the different kinds of ethical considerations connected to conservation interventions, such as when an object ceases to be authentic and becomes transformed into something else, followed by the question whether to accept such transformation or not
- e) how to handle the conserved objects after terminated treatment.

Some specific questions to consider and answer were the following:

- a) what should be conserved and why?
- b) should objects be conserved at any cost? Should conservation be considered as more interesting and important than maintenance? Is it, or is it not, possible to accept that there is a limited lifetime for any object? Would it not be accepted as preferable to make repeated conservation treatments with simple methods, if these do not alter the material constitution of the object, rather than to make massive treatments which may have a longer persistence, but which alter the chemical and pictorial composition after treatment of the matter?
- c) should conservators and/or producers of conservation materials be the persons responsible for the choice of methods used? Why should substances which are harmful/toxic/cancerogenous be used, instead of less dangerous compounds? Why neglect the negative effects upon health? May conservation of art, in relation to conservators’ technical interventions, be considered as more important than human health?

⁴ Coles, 1995; Marconi, 1984; Wolters, 1988; Zander 1993.

⁵ Blomé, 1977; Brandi, 1977; Fielden and Jokilehto, 1993; Marconi, 1984; Price, 1996.

⁶ The International Council of Museums.

⁷ The International Committee for Conservation, within ICOM, founded in 1967.

⁸ The International Institute for Conservation of Historic and Artistic Works, founded in 1952.

⁹ The International Centre for the Study of the Preservation and Restoration of Cultural Property, founded in 1959.

¹⁰ The International Council on Monuments and Sites, founded in 1966.

¹¹ Nordiska Konservatorsförbundet (The Nordic Association of Conservators) of which NKF-S is the Swedish section.

¹² The Code of Ethics of the American Institute for Conservation of Historic and Artistic Works.

d) is it possible, or even desirable, to conserve anything “for ever” with the application of various chemicals? It seems obvious that application of penetrating chemicals on works of art is causing a change in their material structure, and consequently the material saved is not the same as the original, and therefore no longer “authentic” in the sense that original substances, applications and appearance are observable. Is it preferable to conserve an object, such as a mural painting or a statue, impregnated with material compounds which obviously have the double effect of partly preserving the shape, partly chemically altering the object, or would it not be better to make a surface application of a not so penetrating substance, creating a “sacrificial coating”, which is anticipated to eventually disappear and leave the material composition of the object principally unaltered?

e) when the object has become conserved and treated, the next issue to decide is whether it is supposed to remain under the conditions that caused the decay, or if some new preventive arrangements should be made in order to avoid a repetition of the deterioration process. There are several issues on this subject to consider, such as removing delicate authentic objects, placed in open-air environment, and replacing them with carefully produced copies, or to create adequate measures for delimitation of exposure to humidity, frost, heat, wind, air pollution, vandalism and other main causes of decay, in order to protect them. The question raised is, therefore, what are the possibilities of acting for professionals with responsibilities for cultural heritage.

Materials

As indicated above, there is nowadays a possibility of choice between traditional materials and those provided by the chemical industry. Beeswax was used during Antiquity as paint in the encaustic techniques and for surface coating. Encaustic paintings, according to tradition, were generally made on a support of prepared wood, but wax-paint could also be used on marble and various other materials.¹³ Used as a coating, it could be applied on marble statues, on architectural details and on wall paintings. Since beeswax during Antiquity was used in some, nowadays practically unknown techniques, the intention of this project was to study various objects, possibly painted or coated with beeswax in any form, with the objective of determining the visual aspect and the composition of the materials used.

¹³ Lucian *Eikones*; Plinius *Naturalis Historia*; Plutarch *Vite parallele*; Vitruvius *De architectura*.

Encaustic paintings on panels have been carefully studied in a collection of Fayum portraits. The scientific report regarding this project has been separately published within the Acta series at Göteborg University.¹⁴ The Nationalmuseum in Stockholm also has published it, in a revised form, as the annual 2000.¹⁵ Beeswax, used as a coating, or as paint on plastered walls has been given greatest attention, and investigations are still being performed, while polychromy on statuary just has been outlined. The technical aspects between applications on plastered walls and on statuary are, however, very similar. The materials investigated primarily are natural beeswax, and Punic wax, i.e. transformed beeswax. The issues of Punic wax and its ingredients, e.g. the natron salt, has been given much attention, in order to understand and, possibly, to be able to reconstruct the substance. The technical aspects connected to the encaustic techniques, also included studying the supporting materials and the preparations, being considered as parts of the same unity. Therefore, the plastering techniques, and the compositions of stucco, plaster and binders were studied as well as pigments, being part of the paint.

Terminology

Some unclarities are connected to the terms *encausto*, *kauasis* and *ganosis*, of importance in this context. These are latinized Greek terms referring to ancient painting techniques and methods for surface coating on art and architectural details. The basic material is beeswax, and a common factor is the use of heat. Heat is needed to melt the beeswax, whether this is used as paint in its natural state and with the addition of pigments, or boiled with chemicals in water, to create Punic wax. Heat is also used to enable wax to partially penetrate into the surface of stone or plaster, in the *ganosis* procedure. Much of scholarly-professional debate over the ages concerning this subject has been connected to different interpretations of the previously mentioned terms and the question of the use, and value, of heat.¹⁶ According to Pliny there were two methods established for encaustic painting when a third was invented.¹⁷ Pliny stated that the encaustic techniques were known long before the Classical Greek period, and that it had been discovered in Egypt. The first method consisted of melting the natural beeswax and adding some pigments into it. The second of the early methods was an engraving technique, used on ivory. A pointed metal tool, *cestrum*, was used as an engraving instrument. This method was principally used for small decorations, and according to Homer, it was invented in Asia Minor and brought to Greece.¹⁸ The third method was invented in Greece, and the new discovery was to make possible the use of a brush for spreading the colour on to the surface. This method was initially used to paint ships of war, and Pliny wrote that "...this kind of painting, applied to ships, is not damaged by sun, wind or salt water..."¹⁹

¹⁴ Freccero, 2000:b.

¹⁵ Freccero, 2000:a.

¹⁶ Berger, 1904; Büll, 1963; Hoppe 1991.

¹⁷ Plinius, NH XXXV, 149.

¹⁸ Büll, 1963, p. 336.

¹⁹ Plinius, NH XXXV, 149.

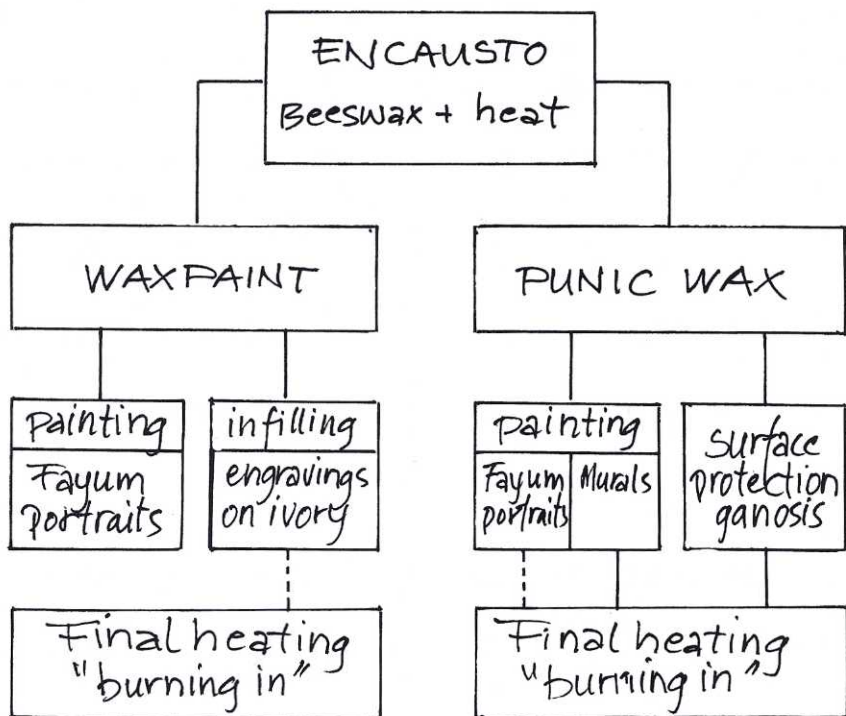


Fig. 1. The relations between *encausto*, *beeswax*, *Punic wax*, *ganosis* and *heat*. *Beeswax* is the natural material used as production basis for all these techniques. *Heat* is initially used to melt the beeswax either to make waxpaint, or to saponify it, which implies to make a wax emulsion, i.e. *Punic wax*. *Wax-paint* could be used for painting, e.g. pictures like the Fayum portraits, or for infill, i.e. engravings on ivory. *Punic wax* was either used for painting, e.g. Fayum portraits and murals, or for surface protection, *ganosis*. *Final heating* may have been used for the engravings on ivory and for some paintings made with *Punic wax*. Heating was used for murals and for surface protection, i.e. *ganosis*.

Encaustic technique

Tools required

I

Melted and pigmented beeswax,
used for painting.

A *cauterium*, a spoonlike tool made of metal.

II

Melted and pigmented beeswax,
used for filling the lines of engravings
on ivory.

A *cestrum*, a pointed needle.

III

Emulsified (and pigmented)
Beeswax, i.e. *Punic wax*.

A brush.

Fig. 2. The three encaustic methods, according to Pliny. *Ganosis* consisted in the application of *Punic wax* with the addition of some oil, which was heated after drying.

Beeswax, in form of Punic wax, was also used on plastered walls, as a coating for some pigments, among them *indigo*, *orpiment* and *lead white*, pigments that tend to alter in contact with the oxygen in the air.²⁰ The wax applied to the colours formed a protective shield and prevented a direct contact with the air. Consequently the pigments remained unaltered. Pliny states in a chapter describing *vermilion*, that the exposure to the “sun and moon” is harmful for this pigment.²¹ In order to avoid alteration of the pigment, hot Punic wax mixed with oil, could be spread onto the wall. Then the wall had to be heated in order to make the paint “sweat”, and finally the wall should be rubbed with a linen cloth. Vitruvius describes the same process, and states that “... *this process is called ganosis by the Greeks*”.²² *Ganosis* was commonly used on marble statues as well as on architectural elements.²³ It has been suggested that un-pigmented Punic wax was spread upon the nude parts of statues, in order to preserve the stone surface intact and at the same time give a slightly warm hue to its whiteness.²⁴ Punic wax was also used on painted parts on statues in order to protect the painted decoration in exposed positions from a rapid disappearance.

All terms referred to above have been used over the years according to different authors' individual interpretations, which make it impossible to take the meaning of any of these terms for granted. Generally *ganosis* has been used as a definition for any kind of protective surface treatment, while *encausto* mostly refers to painting techniques. *Kausis* on the other hand has not been commonly used. Sometimes the term *encausto* is used to describe the *ganosis* process. In my opinion, some early misinterpretations connected to the translations from Greek into Latin, may have caused this lack of clarity already in Antiquity. These issues are presented in the chapter “Terminology”.

The Roman context

The discovery of Herculaneum and Pompeii in 1738 and 1748 respectively, shed new light upon Roman art and architecture. These sites and numerous Roman villas, covered with volcanic material since the eruption of Vesuvius in AD 79, are by far the richest classified archaeological sites in the world. Immense amounts of arts and crafts have been discovered, documented, studied, and interpreted.²⁵ The so-called “Pompeian wall paintings” have been given particular interest, and speculations regarding the technique used started immediately after excavations. Interest was particularly concentrated on the characteristic surfaces, which appeared very smooth and shiny when the paintings were excavated. Scholars and scientists from different disciplines have tried to understand and explain how these paintings, with

²⁰ Plinius, NH XXXV, 49.

²¹ Plinius, NH XXXIII, 40.

²² Vitruvius, VII, 9, 3.

²³ Platon, *De rep.* IV 420 c; Plinius, XXXV, 133; Plutarchos, *Quaest. Rom.*, 287 b-c; Vitruvius IV, 2, 2.

²⁴ Ashmole, 1972; Manzelli, 1994; Moorman, 1988; Reuterswärd, 1966; Richter, 1928.

²⁵ Curtius, 1929; Ling, 1991, 1997; Maiuri, 1931; Mau, 1908; Moorman, 1988; Schefold, 1962; Strocka, 1980; Wallace-Hadrill, 1994; Zanker, 1998.

brilliant colours and shiny surfaces, were made.²⁶ The lustre of the surfaces, however, tended to fade away after some time, and in order to maintain them shiny, various wax mixtures, and other substances were spread upon them.²⁷ Such applications were made already at the time of excavation, but also subsequently, as maintenance. These kinds of coatings have made it difficult for later scholars to define the original chemical composition of the paintings, since it is not always possible to determine the time when a specific application was made.

Whether the *ganosis* treatment was used to protect polychromy on statues and architectural elements, or if it was just applied un-pigmented on un-coloured parts to give the white marble a slightly warmer hue, has been suggested but not conclusively established. Early documentation of identified objects does not include scientific analyses of the materials used for painting and coatings. The lack of reliable information from earlier excavations is one of the reasons why there are difficulties in understanding the *ganosis* tradition.

It is a known fact that documentation of the objects was not given much attention at earlier excavations. On the contrary, much enthusiasm and inventiveness was directed at collecting beautiful works of art, offering them to international collectors or museums for future exhibition.²⁸ The objects were thoroughly cleaned before presenting them in private or public exhibitions. Through this approach, much of the excavated material has suffered great damage. Today, excavation methods have radically changed, and the existence of excellent equipment for analyses are available and therefore some unsolved questions might be answered.

Wax does not chemically alter with time, and ancient beeswax is of the same composition as recent wax.²⁹ Therefore, analyses of beeswax found on the surface of an ancient object, does not reveal the age of the wax. Saponified, or Punic wax does not alter, but remains, in principle, of the same chemical composition.³⁰ On the other hand, wax, which has been spread as a protective, through chemical reaction with the oxygen in air, tends to become harder, and its melting point rises.³¹ Since wax does not disappear and generally does not alter, it is possible to determine the presence of wax - including ancient Punic wax - by scientific analyses, for example by gas chromatography and FTIR.³² It may also be possible to determine if the application was made at the same time as the painting, by studying sections of samples. Other materials, such as lime and glue, may be added into the Punic wax. Augusti tested different ways of conserving and restoring Pompeian wall paintings. Among

²⁶ Early publications: Diderot: *L'histoire et le secret de la peinture en cire*, 1753; De Caylus: *Mémoire sur la peinture à l'éncaustique*, 1755 ; V. Reuqueno: *Saggi sul ristabilimento dell'antica arte dei greci e romani pittori*, 1784; Astori: *Della pittura colla cera all'éncausto*, 1786; Winckelmann wrote a report on his impressions from the excavations of Herculaneum, published in 1762, and published *Geschichte der Kunst des Altertums*, in 1764. Between 1814 and 1830 several works on the subject were published, among them Quatremère de Quincy: *Le Jupiter Olympien* , 1814; J.J. Hittorf: *Restitution du temple d'Empédocle à Selinonte ...* , 1851; G. Semper: *Vorläufige Bemerkungen über bemalte Architectur ...*, 1834.

²⁷ Pagano, 1994, p. 369; Jokilehto, 1986, p. 88.

²⁸ Ciarallo and De Carolis, 1998, p. 7; d'Ambrosio, 1998, p. 21.

²⁹ Mills, 1994, pp. 53, 173, 190.

³⁰ Hillyer, 1984, p. 2.

³¹ von Tell, p. 29.

³² Hillyer, 1984, p. 2; Mills, 1994, p. 50.

these materials was Punic wax.³³ According to Augusti, this kind of wax carbonates when applied on lime-plaster. Beeswax, according to Augusti, is not possible to identify in cases when it has been chemically transformed, as described above. Recently performed chemical analyses have been made on some pieces of excavated Pompeian wall paintings, not previously exposed to any modern conservation treatments. Examinations of certain samples have revealed remains of an organic matter underneath the strata of red paint, an observation that was noted to the surprise of the research team.³⁴ The fact that beeswax was found below the surface layer may signify that it had been used as a binder, i.e. as paint.

Beeswax is also associated to another type of Roman painting, the so-called “Fayum portraits”.³⁵ At the end of the 19th century and the beginning of the 20th, principally Graf and Flinders Petrie made excavations at sites in the Nile Valley.³⁶ Large amounts of portrait mummies were found during early excavations. Many of these had portraits painted with encaustic on wooden panels. The discovery of the mummy portraits resulted in a new wave of interest among scholars for the Roman painting techniques, and new hypotheses and opinions on the characteristics of encaustic painting were published.³⁷

Case studies

In order to examine the problems presented above, some case studies have been made. The principal problem investigated, has been the relation between theoretical guidelines in conservation and the situation in “real life”. The contexts investigated, have primarily been connected to Roman culture. The case studies, aims, objectives and methods of research, are separately presented under the following heading, *Case studies*.

³³ Augusti, 1950, pp. 159-162.

³⁴ Dr. M. Pagano, Soprintendenza di Napoli, Scavi di Ercolano, personal communication, October 1994.

³⁵ The portraits are named after the Fayum district, situated in the Nile Valley, south of Cairo in Egypt.

³⁶ Theodor Graf (1840-1903), Viennese dealer, and Sir W.M. Flinders Petrie (1853-1942), English archaeologist.

³⁷ Donner von Richter, *Ueber Technisches in Malerei der Alten ..*, 1885; E. Berger, *Maltechnik des Altertums*, 1904; A.P. Laurie, *Greek and Roman methods of painting*, 1910 .

AIMS AND OBJECTIVES

The aims of this investigation are

- a) to study the connection between conservation theory and practice
- b) to study the actual possibilities of choice in conservation, especially between traditional and modern materials and techniques respectively
- c) to investigate the applicability of some traditional materials within the field of conservation, as well as to
- d) explain the historical and cultural context in which the encaustic techniques were developed, further
- e) to try to reconstruct these techniques, and
- f) to study their usefulness in modern building construction.

The objectives are

- 1) to indicate the necessity of being professionally conscious and having a critical attitude towards general guidelines in conservation, and in particular those connected to economic and political interests,
- 2) to indicate the necessity of searching alternative methods in conservation, whether these consist in a return to traditional materials, or in modern approaches, safe for mankind, the cultural heritage and the environment,
- 3) to indicate the necessity of working in teams composed of groups of relevant professions, thereby gaining multiple and creative perspectives on problems to resolve; to provide continuing education and better understanding of the complexities in the field of conservation, and the capacity of making correct decisions to achieve optimum results.

Conservation theory and practice

The objectives are to establish the development in the field of conservation concerned and to describe the attitudes towards conservation interventions of the past, the present and the indications for the future. The aim is to contribute in formulating a relevant approach to application-oriented conservation, which considers environmental, human and cultural factors.

The history of conservation may be described as a linear development, starting with *repairs* of buildings and artefacts in Antiquity, followed by *repairs and reconstructions*, which were the guidelines for the following centuries, later to be expanded by the concepts *reconstructions or restorations*, developing into the comprehensive discourse based on the holistic concept of *conservation* which has become the term of honour in the present period. These terms and concepts are described, and comparisons between these concepts and their application in the “real world” have been made. I have also considered it important to indicate possible inconsistencies between a theoretical system and its application in real life, or a possible discrepancy between laboratory tests of materials, and the application of established theories and laboratory test results, in real life situations.

Possibilities of applications in modern building constructions

A set of series of experiments has been performed as "real life" tests *in situ*, which consequently are not repeatable and observable the same way as are tests performed in a laboratory *in vitro*. The reasons for the choice of starting with "real life" experiments were at least two, and fundamentally that the "real life" situations provide all kinds of details which, taken together reflect the situation in the environment during particular periods. This kind of "real world" is assumed to be similar to that in which the materials are anticipated to be inserted, unlike the man-controlled laboratory situation.

The "real life" process is a slow one compared to the rapid artificial ageing in a laboratory, and therefore, better to start with since the results must be waited for. Laboratory test series may be performed in the future, when there is a need of studying specific materials or combinations of materials in specifically determined environments, and each detail needs to be studied separately. This was not the case on this occasion, when instead the general aspects of the paints, preparations and environment were observed, but also the applicability of these paints, and their aesthetic appearance. The objective has been to study the possible usefulness of these materials in conservation, and as potential techniques for modern wall painting and surface coatings.

Historical materials and material technology

The principal objective of studying traditional materials and techniques is to establish the possible correspondence between the materials and techniques actually used, and those of the ancient descriptions. If it is possible to observe a definite correspondence between the ancient objects studied and the materials used, as well as available information in ancient sources, then the issues raised above might be fully or partially explained. If, on the other hand no such correspondence is evident, there are new questions to be made. One of the main objectives is to establish the existence and use of some debated ancient techniques, e.g. encaustic painting and *ganosis*.

A second objective is to investigate how the use of traditional materials corresponds with modern conservation principles and practice. The aim is, in this respect, to understand the positive and negative aspects of the introduction of such materials in modern conservation. A third objective is to study the possibility of finding a suitable method for conservation and restoration of Roman wall paintings, and finally to develop a method to be used in construction, which is environmentally safe and suitable for modern building standards.

The aim is to test, if the techniques described are technically practical in reality, and to establish a connection between ancient descriptions, terms, concepts, and available preserved examples.

Historical and cultural context

According to ancient writers, the encaustic techniques were known and used during Antiquity. Evidence has been found, e.g. the Fayum portraits. There are, however, many disagreements and unclarities concerning these techniques. In order to gain a clear view on the materials and the corresponding techniques, as well as their status during Antiquity, the cultural context in which these techniques evolved has been studied.

Studying the cultural conditions has been important in order to understand and explain encaustic, here intended as a descriptive term for a paint or an emulsion based on beeswax, within its historical context. Due to the fact that these techniques were already used during Antiquity, for *painting* (on wooden panels, ivory and marble) and as a *surface coating* (on polychrome statues and architectural elements), these two aspects have been regarded as equally important to consider. The period investigated is principally between the Roman Republic and the end of the Roman Empire, and with particular regard to the well-known Hellenistic influence on Roman culture. The historical objects investigated, in publications and/or *in situ*, are primarily Roman wall paintings and Fayum portraits.

The aim is to understand if these techniques were commonly accepted and used during Antiquity, or if they were considered as marginal techniques, seldom used. By obtaining an overview of these issues, the usefulness of the materials, their advantages and disadvantages, would be possible to comprehend. The results achieved might be compared to those presented in publications, confronted with surviving evidences of ancient culture.

Terminology of materials and definitions

The objectives of this part of the study are to describe and understand the terminology involved with the subject, and to define the concepts and terms connected to *encausto*, *kausis*, *ganosis*, *Punic wax*, and various forms of *politio*, as well as to study as to what extent these terms and concepts are correctly used in publications on the subject. The aim is to create a reliable and intelligible terminology, and furthermore to establish a clear connection between terms and related concepts. In case the term *encausto* is used only to signify a wax-painting, which has had the surface heated in order to "burn in" the wax-colours, and existing descriptions of *encausto* as well as technical evidence confirm, that wax-paint used, as described above, is distinctive for the encaustic technique, then there is no discrepancy between the term and the concept. If, on the other hand *encausto* is used to represent wax-paintings which have been heated, paintings made with Punic wax, and paintings, or three-dimensional objects which have been given a final application of wax, heated or not, then there is an inconsistency between the term and the concept. In the first case there is no problem, in the second an agreement has to be made about when to use the term *encausto*, in order to avoid misunderstandings.

The terms *encausto*, *kausis*, *ganosis* and *Punic wax* are used in all literature concerning classical Western painting methods and surface protections containing beeswax. As stated above, European terminology is not clear and easily understood.

In order to clarify this complex of problems a comparative study has been made. Ancient Greek words have been compared with Latin translations or counterparts, of the same words. The changes in interpretation of these terms as well as of the conceptions of the methods that have altered by time have been studied, with the intention of understanding the reasons for existing unclarity and ambiguities connected to the matter. If such discrepancies as mentioned above are found, the intention is to establish a correct, relevant and consistent terminology on the subject. Some of the lack of clarity might be explained by confusion of terms and discourses, and such confusions might depend on problems such as incorrect translations, transcriptions or plain misunderstandings. A suggestion of how to use some terms is presented.

Case Studies

Case study 1: Palazzo Calabresi in Viterbo

The present case study relates to a process connected to an architectural environment. The decision to conserve and restore the building for future use had already been made when the Swedish partner was invited, but it was not decided *how to do it or for what purpose*. When entering the project, issues immediately were raised concerning important aspects of the building complex. Interior and exterior observations of the building were made, including documentation and measurements of the façade. Since the project co-involved persons from different professions, it was necessary to cross the borders between professions. This case study refers to the process described above. Sampling and material analyses were also performed, and a documentary report with all information was made and presented.³⁸ The participation of the Swedish group ended at that point, and conservation actions taken are therefore according to decisions made by the Italian co-ordinator.

Case study 2: Fayum Portraits in the Nationalmuseum in Stockholm

This case study refers to the initiation and development of a project concerning some museum objects, possibly leading to future conservation interventions needed. The project started with the definition of a set of questions, which needed to be answered, connected to the material and origins of the paintings. The process described concerns the *investigation of ancient materials*. Also referred to are issues such as *definition of problems* and the successive *investigation and documentation methods*. The survey contained many more issues investigated, such as historic and art historic factors, the cultural and religious context and the methods of early exca-

³⁸ *Restoration Project of the Graffito Decorated Façade of Palazzo Calabresi. A Rafael Project 1998*. Unpublished report presented at the ICUG 1999.

vations and conservation, all factors that not are presented in this context, but available in a conservation report, and also as a separate publication.³⁹

Case study 3: San Lorenzo in Lucina in Rome

The present case study refers to the process connected to the caretaking and conservation of some Roman mural fragments, excavated within the period of a few years, and successively kept in separate boxes.⁴⁰ It had to be decided *if, how and for what purpose* the fragments should be conserved, followed by considerations on *how and for what purpose* to expose them. The questions immediately posed, and those arising during the working process are described, as well as the methods tested and used in conservation. The necessity of historic and art historic explanations and understanding and the need of documentation and chemical-technical investigations of materials have been in focus. Due to the characteristics of these fragments, they are intended to be used for an exhibition with didactic intentions, such as to explain how Roman murals were made and what kinds of materials that were used.

Case study 4: Prima Porta outside Rome

This case study refers to an investigation comprising analyses of materials used during the Roman period at Prima Porta north of Rome. The fragments investigated derive from different find contexts located at, or close to the Imperial Villa. The material analyses are made according to the same principles, but it seemed better to separate the contexts studied into three sub-projects, a, b, and c, within case study 4, since each context contains fragments either from one particular period (case studies 4a and 4b), or contains materials from the various building periods observed within the Villa of Livia (i.e. case study 4c). The technical, material and artistic development of mural painting at the Torre di Prima Porta and at the Villa of Livia are at focus, since the sites form a specific Roman context, where mural paintings from at least three centuries are preserved.

Case study 4a: Torre di Prima Porta, First Style decorations

This study refers to the *process of examination, conservation, sampling and material analysis* of the fragments excavated in 1985 at the Torre di Prima Porta. The main issues, at this initial stage of a larger investigation, have been *testing measuring* as a tool for identification of technical quality and for dating, as well as *testing materials for cleaning* and *testing saponified beeswax* as a surface protective. Samples for chemical-technical analysis of pigments and binders as well as of the composition of stucco and plaster layers have been removed and are investigated at the Opificio in Florence. Stucco and plaster were observed under binocular microscope.

³⁹ Freccero, 2000:a and Freccero, 2000:b.

⁴⁰ Report planned to be published in a project publication by the Swedish Institute of Classical studies in Rome.

Case study 4b: Villa of Livia at Prima Porta, Third Style decoration

The present study has been made according to the same principles as described above. In this study one loose fragment from the atrium wall related to another, still *in situ*, has been investigated. The decoration is dated to the Augustan period.

Case study 4c: Villa of Livia at Prima Porta, with Second style decorations and decorations from the Antonine as well as the Late Roman, Post-Pompeian periods. In this case study mural fragments from various periods in Roman culture have been investigated, starting with some fragments dated to the Augustan period and ending with those from the Post-Pompeian period. The fragments have been investigated according to the same principles as described above.

Case study 5: Villa San Michele at Anacapri

The conservation of marble objects from the Roman period and later is the content of the present case study. In this didactic as well as research-oriented project, issues connected to the choice of conservation materials have been in focus. The project started in 1998, followed by a campaign in 1999, and a third planned for 2001, where the results are presented in a set of conservation reports.⁴¹ These reports are available at the Villa San Michele and at ICUG.

Case study 6: Experiments

As part of the project, experiments have been made with the objective of reconstructing ancient wax paint and the ancient wax emulsion, *Punic wax*. The set of problems investigated were related to the usefulness of beeswax as paint, i.e. its malleability, durability and aesthetic appearance. Punic wax as described by Pliny, and as interpreted by later authors, has been studied with the aim of rediscovering the ancient material, and observing its possible adaptability as paint and a surface protective. After initial testing, a substance defined as Punic wax by this author, was used for painting on various materials, and as surface protection on marble. This product was chosen as the *Punic wax* after a long series of tests, which had been made according to ancient and later descriptions. The experiments were published in a report in 1997.⁴²

⁴¹ Stenkonservering i Villa San Michele, Anacapri Loggia di Hermes, 15 maj-15 juni 1998; Stenkonservering i Villa San Michele, Anacapri 17 maj – 12 juni 1999.

⁴² Enkaustik. Experiment med Puniskt vax. Rapport 4.96. Forskningsstiftelsen för Samhällsplanering, Byggnadsplanering och Projektering. (Encaustic. Experiments with Punic wax).

THEORETICAL PERSPECTIVES

Conservation Principles

Important theoretical perspectives, providing the frame for this dissertation, concern issues of understanding conservation in its broadest respect, as being a recently established profession and a young academic discipline, but also a traditional craftsmanship. Between the two extremes lie some of the major conflicts in conservation, e.g. in choices of conservation methods and materials. The conservator, being naturally involved theoretically and practically in issues coinciding with other disciplines, easily becomes professionally co-involved in truly interdisciplinary projects. Consequently, the professional education of conservators is of greatest importance, and training programmes set up on an international level ought to be established in order to have a commonly recognised professional training. Such training, in combination with a clear professional vocabulary would facilitate communication outside the national sphere. The prevailing cultural value systems and their impact on ways of choosing conservation methods are of vital importance in conservation, since such values form the base for attitudes towards the issues connected to the conservation field as a whole. The cultural value system is reflected in the general attitudes and approach taken in selection and performance, e.g. in the choices made in conservation. Within the cultural value system decisions are made, e.g. *if, when* and *how* to preserve an object (building, site etc.), explanations to *why* it should be preserved, and *by whom, to what cost*, and so on.

Types of values:	Criteria:
Knowledge values	Values which provide the base in need and reality for anything which has to do with cultural heritage understood as a necessary component of any civilization; i.e. as observed in a longitudinal perspective, normally under relatively stable conditions.
Emotional values	Values which allow us to affix desires to certain things, i.e. as apprehended on individual level, concerning intangible existential dimensions, often of collective concern.
Economic values	Values which relate to local or general norms established by society, by asking "How much does Society (or at least one individual) value these things?"
Use values	Values which focus on the degree to which individuals and society at large accept an object and the use of it, or not, i.e. as understood on an operative level within a "market" exchange system, i.e. defined on society level.

Fig. 3. The system of principal values prevailing in conservation. After Rosvall et al. 1995, p. 14.

In the beginning of this century Riegl tried to define common values which were given to any kind of object.⁴³ Feilden divided values into three groups: emotional, cultural and use values.⁴⁴ Important emotional values are those of identity and continuity, while use values are, e.g. functional, economic or political. Among the cultural values are the historic and aesthetic, while Feilden does not specifically mention values. van Gigch et al (1983) recognised four types of values, based on an earlier model by Feilden, as illustrated in Fig. 3. The same conservation methods cannot always be used for objects representing such different values. If the value is mainly historic, maybe in the form of an inscription or as a symbol for a historic event, the historic value is maintained as long as the inscription is legible or the meaning of the monument is remembered, and therefore these aspects of identification should primarily be conserved. It is, however, difficult to define the values of an object of art, since those values may be artistic, historic, symbolic and economic. An initial value is attached to any object, and this may be a use value, an economic, an emotional or a knowledge value.⁴⁵ By degradation, decay and deterioration any value decreases. A model for explaining value systems has been designed by Beckman (Fig. 4), where two crossing axes refer to experiences and domains.

Architectural restoration, aiming at restoring any given object to a state defined at a certain historic period, so called “stylistic” restoration, should be avoided, since such interventions lead to the modification of the authenticity of the building.⁴⁶

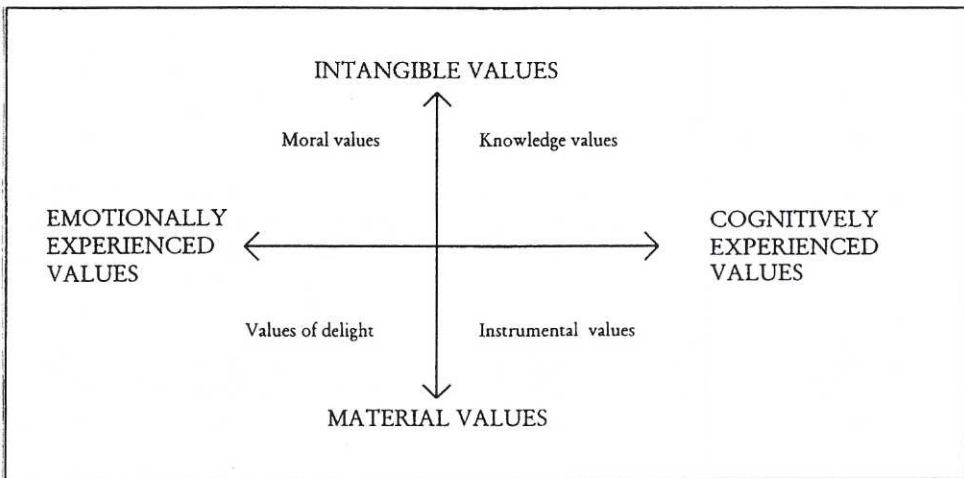


Fig. 4. Value system as explained by Beckman. After Lagerqvist, 1996, p. 24.

⁴³ Alois Riegl, Austrian scholar. Author of e.g. *Altorientalische teppiche* (1892), *Stilfragen* (1893), *Der moderne Denkmalkultus* (1903)

⁴⁴ Feilden, 1988, pp. 56-57.

⁴⁵ Rosvall and Lagerqvist 1992, pp. 4-5.

⁴⁶ Rosvall 1988, p. 30; Zander, 1993, p. 43.

When modifications of ancient buildings have been performed, these should not be removed, but remain as historical evidence. As Zander puts it, "...*nobody would certainly dream of abolishing the noble signs from the 16th, 17th and 18th centuries in Santa Maria Maggiore in Rome, in order to restore it to its 5th century appearance...*".⁴⁷ Historic evidence must not be destroyed, falsified or removed.⁴⁸ Other important questions are connected to the actual conservation intervention, and include the materials used (traditional or modern) and on which authority suggests what materials to use (e.g. the chemical industry, chemists or conservators) and why they are chosen (for reasons of superior quality or because they are easy to apply). A further set of questions refer to valuation of originals and copies, authentic or non-authentic etc, and the impact of such values on choice of materials and methods in conservation. Finally, the tendency not to question experts' opinions and recommendations has to be considered.

Conservation Theory and Practice

"Conservation shall consist of the minimum effective conservation"

*"Prevention is the highest form of conservation"*⁴⁹

Various scholars have repeated these concepts in more or less the same terms during the last centuries. In 1772 Goethe stated that it was difficult to do too little, since the damage is caused by doing too much.⁵⁰ Victor Hugo suggested, in 1832, legislation for the maintenance of buildings, since, according to his experience, restorations might be as harmful as decay.⁵¹

A first international document, presenting guidelines in conservation was formulated in Athens in 1931, followed by the Venice charter (Carta del restauro di Venezia 1964) as a result of the agreements at the second international congress in Venice 1964. The necessity of systematic maintenance was one of the guidelines expressed.⁵² Marconi expressed in 1984 that interventions have to be careful in the restoration of buildings, and not entrusted solely to technicians who are exclusively interested in the consolidation of the materials and structures.⁵³ Four years later Wolters declared that the abyss between theory and practice in conservation could be noted every day, since the reality at the workshops is totally different to that of

⁴⁷ Zander, 1993, p. 43. (...È chiaro che nella romana basilica di S. Maria Maggiore nessuno oggi sognerebbe di abolire i nobili segni dai secoli XIV, XVII, XVIII per ricostruire il pur limido aspetto del secolo V).

⁴⁸ Feilden, 1988, p. 72.

⁴⁹ Feilden and Jokilehto, 1993, pp. 11, 41.

⁵⁰ Kåring, 1995, p. 244.

⁵¹ Kåring, 1995, p. 133.

⁵² Blomé, 1977, p. 206.

⁵³ Marconi, 1984, p. IX.

⁵⁴ Wolters, 1988, p. 123.

the reality presented at conventions.⁵⁴ Zander makes a similar reflection in 1993.⁵⁵ Torracca made, in 1989, the following statement about the present attitude towards the antique or ancient elements in our environment, in briefly summing up the situation and its complex problems:

*“Nowadays the antique is much appreciated in our towns, but just on the condition that it occurs as a noble ageing; one thing is the wrinkles and another is the skin diseases, above all if those are the result of a blameworthy negligence. Our eye today is trained in distinguishing between the patina of time, the slow chemical oxidation or the patient development of colonies of microscopic organisms, and the obscure concretions under which acids are working, or the rugged erosions caused by the rains, scratching the stones like rasps.”*⁵⁶

Although the ideal of minimum intervention has been expressed and continuously repeated, practice has often proved to be the opposite. One problem seems to be defining and agreeing upon what is intended with the well-established expression “minimum intervention”. Another issue is withdrawing from transgressing the limits agreed upon. Nowadays, the reconstruction of missing parts on objects of art is generally not accepted, but interventions, which change the chemical composition of entire monuments, are. As long as there is no clear and generally accepted definition of “minimum”, the gap between ideal and practice will remain. Before entering into a discussion of *if, when, what* and *how* to conserve, some concepts in conservation terminology will be examined. Concepts such as *authenticity* and *originality* will be explained and changes in attitudes towards originals and falsifications will be described. The need of correct and reliable documentation in conservation will be stressed.

Conservation Terminology and Concepts

Standing before an object (building, monument etc.) with obvious signs of decay it has to be decided if and how to restore or conserve it. Those questions have to be part of a general policy. Such a policy ought not be stated once and for all and followed uncritically. It should rather be an open discourse from time to time, since opinions and taste differ from one period to another, which in fact has been pointed out quite recently by Jokilehto, referring to changing attitudes towards restorations made by Viollet-le-Duc.⁵⁷ Obviously it is not possible to conserve everything, and a conscious decision of whether or not to conserve ought to be the basis for following decisions, such as how to proceed, i.e. what techniques and materials to use.

⁵⁴ Zander, 1993, pp. 13-14.

⁵⁵ Torracca, 1989, p. 33. (*Nelle città la vecchiaia è oggi molto apprezzata, a condizione però che si tratti di un nobile invecchiamento; una cosa sono le rughe ed un'altra le malattie della pelle, soprattutto se esse sono il risultato di una colpevole sciatteria. Il nostro occhio oggi è esercitato a distinguere tra la patina del tempo, lente ossidazioni chimiche o paziente sviluppo di colonie di organismi microscopici, e le condizioni fumose sotto le quali gli acidi lavorano, o le ruvide erosioni causate da piogge che raschiano le pietre come raspe.*)

⁵⁷ Jokilehto, 1997, pp. 54-55.

The mission of conservation may be easily resolved if the object (building, painting etc.) is private property and if it is not considered to be an important cultural heritage. If a private building is partly destroyed, the owner may repair it, more or less the way that suits him/her better, taking economical and aesthetic aspects into consideration. A problem arises if the object is regarded as public cultural heritage, whether it is a church or a palace, a monumental arch, a statue or a painting. In such cases some ulterior decisions have to be made before work is initiated. The first question arising is whether to restore the building or not. By not taking any actions the building is destined to become a ruin. A ruin is historical evidence, which has lost its practical usefulness, often also its legibility as an original structure or object. Ruins are all things that testify to human activities, but which have received, by decay, a completely different aspect from what they were originally given. Zander makes a distinction between living and dead monuments.⁵⁸ Dead monuments are principally archaeological areas, ancient necropoles, excavated towns such as Pompeii, or ruins of abandoned castles, while living monuments are, for example historical centres and ancient towns, palaces and churches that are still used. Conservation of a ruin may be a process only aiming at maintaining the status quo.⁵⁹

Decisions to be made regard how interventions should be performed, followed by for what purpose the building shall be repaired, restored or conserved. Linked to this is also the question of future maintenance, an issue that must be integrated in the decision process. This is the crucial point in dealing with problems in conservation. Today many methods are available for documentation and scientific analyses. Possible materials and techniques in conservation have increased in number, and have been developed and refined. These achievements must be used critically and consciously, or otherwise the general idea of our present tradition may risk to be uncritically followed, which of course, in a longer perspective, would give rise to reactions, and perhaps worse, poor results.

Conservation

Conservation was defined as follows, by Sir Bernard Feilden at the symposium "Air Pollution and Conservation" in Rome 1986.⁶⁰

Conservation may be defined as the dynamic management of change in order to reduce the rate of decay. The cultural, scientific, technical and natural heritage and resources must be considered as authentic documents and valuable components. Interventions should be limited to actions strictly necessary to insure the continuing conservation of this heritage, but the techniques and materials used should not impede future treatment or examination. Conservation requires comprehensive socio-economic, legal and cultural planning, integrated at all levels.

⁵⁸ Zander, 1993, p. 44.

⁵⁹ Brandi, 1952, pp. 115-116.

⁶⁰ Air Pollution and Conservation, p. 23.

The natural process of decay is ever on going, and has to be calculated with, but it may be slowed down or practically eliminated, if the causes are recognised and adequate measures are taken. The causes of decay have been usefully illustrated by Plenderleith and Werner in 1979, see Fig 5. The term conservation indicates that an object, site etc., shall be preserved (for the future). *Conservation* does not imply any particular method, technique or ethic consideration, but can be used to substitute a number of terms related to interventions of a more precise nature. The term can be used to imply “*the action taken to prevent decay and to prolong life*”.⁶¹ Conservation is also “*the dynamic management of change in order to reduce decay*”.⁶²

Conservation may be defined as one scholarly discourse, based on a set of hypotheses, on how to react to destruction. It is on the one hand a number of guidelines, based on, e.g. ethical, cultural and chemical-technical considerations and on the other a set of possible choices for the conservator when actually performing any kind of conservation intervention.

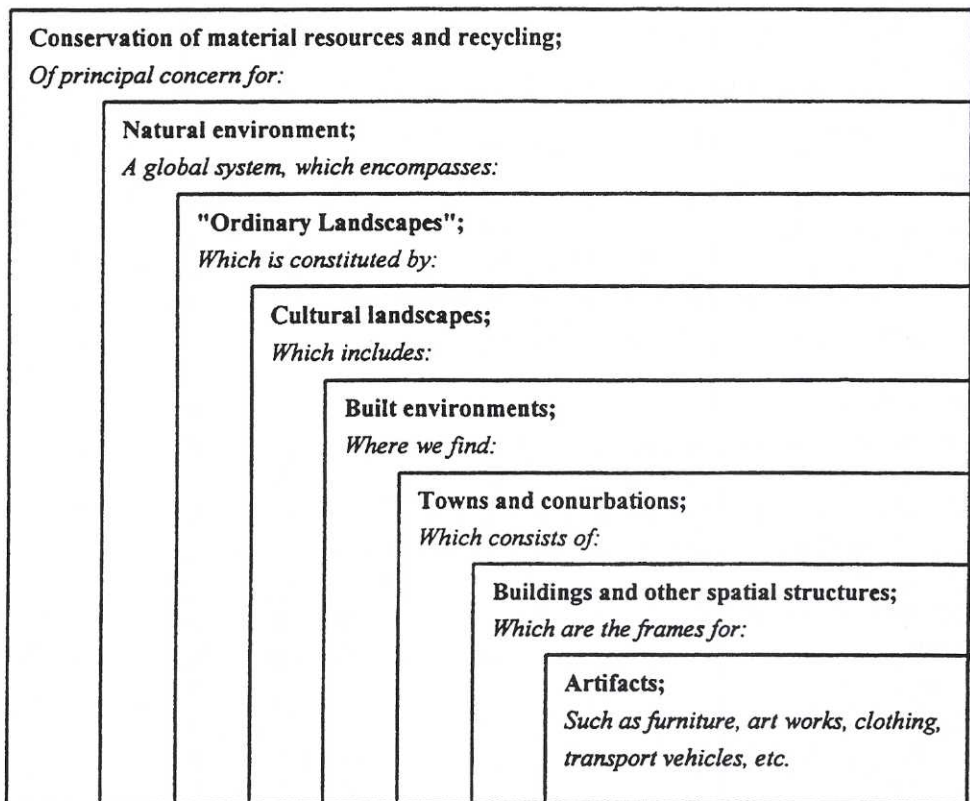


Fig. 5. Conservation hierarchic levels and their relations, as defined by Rosvall et al. 1995, p. 3.

⁶¹ Feilden and Jokilehto, 1993, p. 61.

⁶² Rosvall and Lagerqvist, 1992, p. 6.

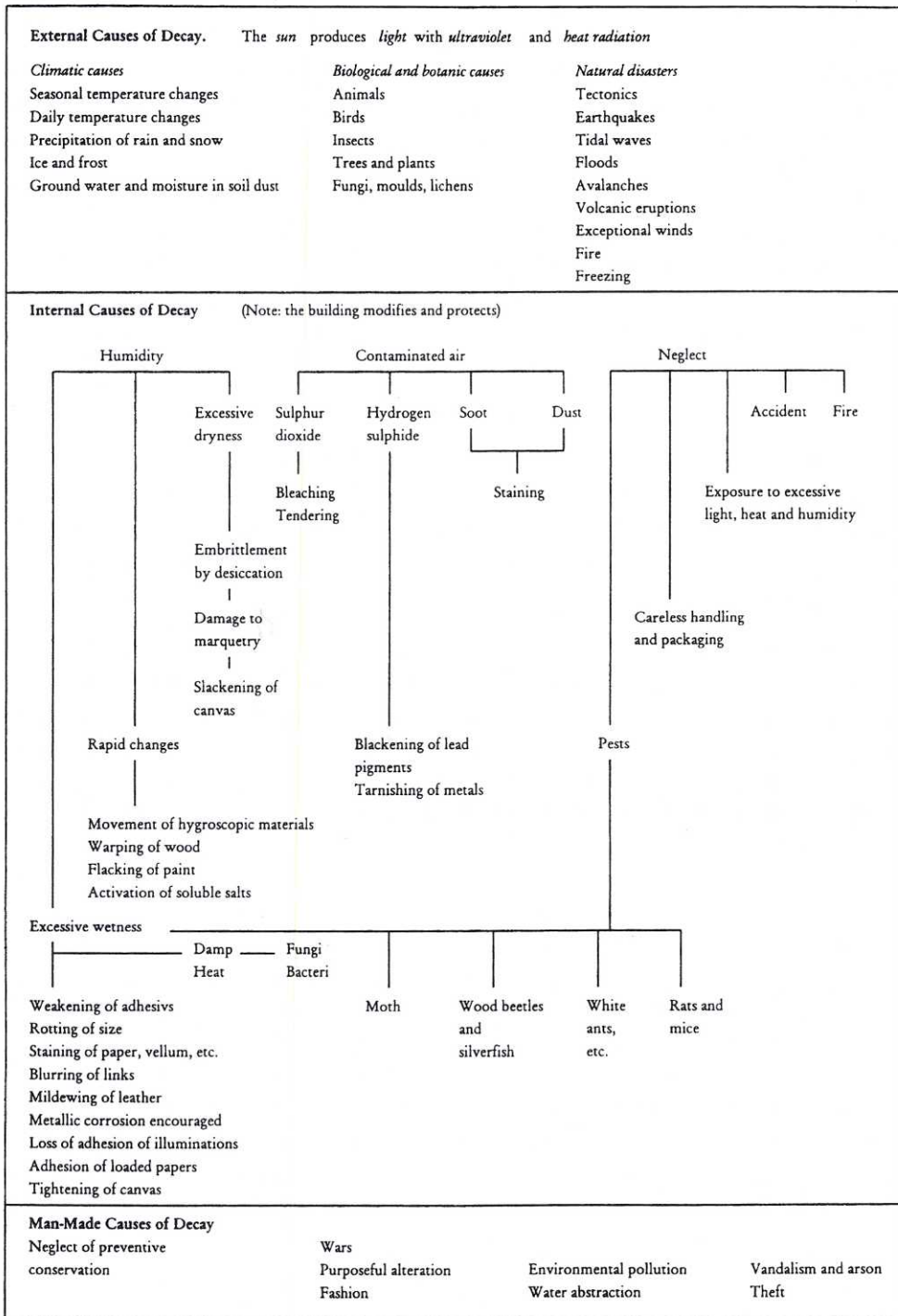


Fig. 6. Matrix illustrating the causes of decay and damage to cultural resources. After Feilden, 1988, p. 64.

Integrated conservation

Integrated conservation is, according to the definition made by Feilden, indicating that scholarly and scientific methods have been combined with a planning strategy, aimed at solving the physical, environmental, social and economic problems of conservation.⁶³ By Rosvall et al. integrated conservation has been defined as

*“... a scientific-professional platform for pragmatic decision-making in city councils and other bodies. Integrated conservation means a holistic approach to the issue of preservation, which includes the preconditions and techniques for involving the aid of any scientific or humanistic discipline, together with all available methods needed to ensure the practical implementation and execution of the resources required.”*⁶⁴

Preventive conservation, maintenance and regular inspections

Preventive conservation is, according to Brandi, the action taken to prevent the object from the involuntary necessity of future conservation interventions.⁶⁵ The growing awareness of minimum intervention has led to the acceptance of the fact that, as stated by Price, “prevention is better than cure”.⁶⁶ Maintenance includes actions aimed at reducing the negative factors causing decay, such as, e.g. protection from the capillary rise of ground water, protection against rain and moisture condensation, protection against biological factors of decay and of dirt.⁶⁷ In order to satisfactorily carry out such care-taking regular inspections of the objects concerned have to be performed and considered as an integral part of the maintenance plan. Ferroni recognises the necessity of creating microclimates suitable for restored works of art, and calls for scientists from various fields to work together for solving existing problems.⁶⁸

Repair

Repair may be considered as to be the earliest and simplest method of conservation. Something gets broken, and it becomes mended or repaired, according to trivial decisions in a more or less normal process. Repair is simply the way of returning the object into a state where it can be in use again, a way of reassuring its material stability for functional demands. Repair, as described above, aiming at the restoration of the material stability, is what Brandi defines as restoration of manufactured goods or industrially produced objects, a kind of restoration different to that demanded for works of art.⁶⁹ Melucco Vaccaro uses the term cultural heritage to substitute the terms manufactured goods, and in this terminology is also included

⁶³ Feilden, 1988, p. 71.

⁶⁴ Rosvall et al., 1995.

⁶⁵ Brandi, 1977, p. 56.

⁶⁶ Price, 1987, p. 13.

⁶⁷ Rosvall, 1988, p. 52.

⁶⁸ Ferroni, 1999, p. 101.

⁶⁹ Blomé, 1977, p. 36.

works of art.⁷⁰ Cultural heritage has been defined as “*all the signs that document the activities and achievements of human beings over time*”.⁷¹

The cultural heritage includes movable as well as immovable objects. Immovable objects are, e.g. archaeological sites and architecture, but mural paintings also belong to this category, since they are part of the walls, sometimes even chemically. In practice, however, murals are often detached from the walls and transferred to museums or private collections. Taken out of their original context, they automatically lose authentic characteristics.

Reconstruction and reintegration

Reconstruction is a term referring to more complex projects, either “virtual” in a modern electronic system format or traditionally in analogues verbal-visual presentations or based on some of these, or actually executed in “reality”, i.e. referring to a presupposed material loss which has had to be re-made and inserted into the object, thereby reconstructing part of the object. Reconstruction may, on a modest level, consist only of the simple insertion (infill) of a missing piece or in the re-making of large areas. Infill, as defined by the UNESCO Guidelines aims to “... *re-integrate the lacunae in the urban fabric by contemporary constructions and designs, but taking also into consideration the design of their historic context*”.⁷²

In this context no value judgement is given to the term reconstruction. Reconstruction may also indicate the recreation of an entire building, usually to its assumed original appearance.⁷³ Virtual reconstruction occasionally may be preferred to actual reconstruction. Such reconstruction does not cause any material changes to objects or sites, but provides the possibility of testing various solutions.

Closely related to the concept of reconstruction is that of re-integration, both measures taken aiming at the filling of the material loss of a lacuna. Reconstruction indicates that the original shape and appearance of the object is fairly well known and restored to a destined previous state. Re-integration should be interpreted as integrating the infill of the lacuna with the general appearance of the original object, an act that, however, must also be considered as an individual interpretation of the original status.⁷⁴

The methods of reconstructing missing areas have changed. In earlier periods, naturalistic re-integrations were made, not intended to be distinguishable from the original. Such reconstructions often tended to mirror the personal taste of the conservator, who occasionally even extended conservation to further “embellishment” of the original. Respecting the original and making reconstructions possible to distinguish is nowadays of absolute importance. Therefore, some reconstruction methods have been developed.

⁷⁰ Melucco Vaccari, 1989, p. 201.

⁷¹ Feilden and Jokilehto, 1993 p. 11.

⁷² Feilden and Jokilehto, 1993, p. 92.

⁷³ Edman, 1994, p. 7.

⁷⁴ Jokilehto, 1997, p. 47.

Monochrome areas painted in a so called neutral colour previously seemed to be a possible solution, since the method did not mirror the taste or capacity of the conservator, nor did it permit any personal additions to the original form. The method was soon abandoned, since the “neutral areas” in practice were not neutral but became interpreted as monochrome pictures within the painting or the sculpture. *Chromatic selection* and *abstraction* was invented in order to solve the problems with the “neutral areas” without returning to speculative naturalistic interpretations of form and colour.⁷⁵ By selecting, a few unmixed colours and applying them in thin and short lines in concordance with the surrounding areas, the integration does not disturb the interpretation of the object when seen at a distance. When looked at closely, the reconstruction becomes obvious. *Tratteggio* or *rigatino*, as explained by Brandi and further defined by Baldini and Melucco Vaccaro, may be regarded as a variation on the same theme, restoring the object but not falsifying it.⁷⁶ This method, theoretically, solves the problems of reconstructions and reintegrations, when used by a competent conservator with a critical mind. If, on the other hand, the technique is used in a too rigid manner, it tends to become a “picture” in itself, just as the, so-called, neutral areas are.

Mural paintings should be regarded as part of architecture. The main issue should therefore be to integrate the infilling of such lacunae with the surrounding environment.⁷⁷ Such conservation intervention should be carried out critically and with respect for the original context. It has proved to be of vital importance to use pigments and binders with characteristics compatible to those of the original, to avoid some unexpected effects caused by metamerism, which may occur when the appearance of materials changes in exposure to different kinds of light.

There is a problem connected to the re-integration of modern materials into ancient works of art, this being the question of how to diversify the modern integration from the original object, in order not to produce a falsification. Korres relates to the problem and describes different attitudes to reintegration techniques throughout various periods, beginning with the Roman restoration of Greek temples.⁷⁸ According to him it is not advisable to diversify integrations too much, since these integrations disturb the perception of the work of art. Furthermore, he states that Roman integrations of columns in the Erechteion in Athens, are clearly visible at close inspection but not at a distance, and consequently made according to the later concept of Brandi. Those columns were carefully made in order to look like the Classical columns, but nevertheless clearly recognised as Roman copies. Korres therefore suggests that it is not necessary to make extreme differentiations, since it is impossible to perform reconstructions of ancient objects in an identical manner. The differences are “built in”, so to say, due to changes in thinking and mentality, as well as in material aspects and in the technical skill of craftsmen.

⁷⁵ Casazza, 1988.

⁷⁶ Baldini, 1988, 1989; Melucco Vaccaro, 1989.

⁷⁷ Jokilehto, 1997, p. 53.

⁷⁸ Korres, 1997, pp. 199, 203-204.

Related to reconstruction is also *anastylosis*, defined in the UNESCO Guidelines as an action which

*"...aims to make the spatial character of a ruined structure more comprehensible by reinstating its lost original form, using the original material which is located at the site and in satisfactory condition. Anastylosis as an intervention refers in general to structures consisting of clearly identifiable components."*⁷⁹

Issues of ethics that arise in such cases are connected with the kind of reconstruction made, and of defining the reasons why that method was chosen. If a reconstruction actually is performed it has to be due to a valid argument, which must be followed by an equally valid decision on how the reconstruction should be made.

Restoration

Restoration is a complex term, which implies giving back to the object something, which is lost. Objects restored today are often buildings, which are in a bad state of decay, and the concept, restoration, is nowadays normally not used for professional conservation of works of art. In certain cases it is an adequate term for the work to reproduce the former shape and look of the building. If the structure of the house and its material and substantial details are known, restoration of the building to its previous state by repairing it and partially reconstructing it may be done. Restoration in this case implies giving life back to the building by repairing it, and reconstructing its details.

During restoration interventions not only the structure may be restored, but also its value, i.e. the manifest or symbolic value of the building. The value is not necessarily manifest within the building structure itself, but it may just be related to the period in which the building was erected.⁸⁰

Restoration of a work of art is definitely much more complicated, if not - which is often the case - impossible. The choice of methods must be directly linked to the object, according to Brandi. If the object is industrially made or if it is considered as a work of art, the demands for restoration treatments must differ, since the artistic value is not the same. If the object is a work of art, it must be understood that only the material becomes restored, "*si restaura solo la materia dell'opera d'arte*".⁸¹

According to Cagianò de Azevedo, the term "restore" does not refer to simple repairs, but consists in "*the critical action of repairing the offences made to works of art by the influence of time and of human beings, but also in the interpretation of*

⁷⁹ Feilden and Jokilehto, 1993, p. 63.

⁸⁰ Edman, 1994, p. 6.

⁸¹ Ibid.

the work of art as such".⁸² In Brandi's terminology, we may solely restore the material of a work of art, not art itself.⁸³ Restoration should only consist in a minimum of modifications, leading to an improvement in material and an increased legibility. Modern practice in conservation referred to throughout this dissertation is mainly Italian, which successively has spread internationally.

Methods in Conservation

Conservation of "form", i.e. the material morphological appearance of an object, has been much debated, and a general tendency nowadays is not to reconstruct missing details in a work of art or other kinds of historical objects, if there is not an evident practical need of repair. Infills or stuccoing of lacunae are usually made, and the colour and surface structure of the infills are mostly made to be seen up close but not at a longer distance. Missing parts of a statue in open-air conditions are often filled with some kind of pigmented stucco, depending on tradition and climate. Such interventions have probably become less extensive due to the increasing awareness of the need to respect the authenticity of works of art. Chemical treatments, on the other hand, are often massive. In modern terminology conservation interventions include various chemical treatments, which are intended to preserve or restore the material structure of the object. Chemicals are widely used for cleaning, consolidation and surface coating. The techniques used for cleaning today are, according to Melucco Vaccaro, much more destructive than those which were used during the last century ...*"siamo infatti consapevoli che le attuali tecniche di pulitura cioè quelle che attengono alle superfici, sono oggi assai più distruttive di quelle ottocentesche"*⁸⁴

Cleaning

Cleaning is the basic, and complex issue in conservation. Cleaning has to be an act of conscious intervention, since what has been removed will be removed forever. Consequently, any form of cleaning has to be made after careful considerations of possible methodological choices. Methods, which are appropriate for objects, placed in protected environments probably have very small or no effect at all on objects in outdoor environments. On the contrary, methods used outdoors probably are more efficient than necessary on indoor objects.

⁸² Cagianò de Azevedo, 1949, p. 145.

⁸³ Brandi, 1977, p. 7.

⁸⁴ Melucco Vaccaro, 1989, p. 202.

Black crusts are one of the main problems as far as open-air objects are concerned. They appear on surfaces on all kinds of calcareous stone, which are not regularly washed by rain or cleaned by regular maintenance. The black crusts are mainly composed of atmospheric gases and acids, such as carbonic, sulphuric and nitric acid and of various particles from the air.⁸⁵ The combination of these chemicals plus substrate results in the formation of a dark film upon the surface, which remains on the surface and grows constantly if the object is not cleaned at regular intervals. The aesthetic aspect of these crusts is often tragic, but the development underneath the crust is not less so. It is known that marble transforms into gypsum and consequently pulverises during the continuous process of crust formations, a degradation that finally results in partial losses of the surface. Ammonium carbonate in paper pulp or mixed with clay is regularly used in open-air environments to remove crusts, incrustations and other hard surface deposits. The method is effective and it is often used before testing any other substance. Ammonium carbonate is often applied for between 2 and 24 hours to remove black crusts. A negative effect is that it bleaches the surface, quite notable on white marble, which sometimes becomes extremely white.

Works of art placed in gardens or other milieus with extensive vegetation seldom develop any black crusts, but are mainly attacked by lichens and other forms of microbiological growth, often combined with the presence of various insects. Such growth is not as harmless as it may seem. Some white "crustaceous" lichens extend their growth several millimetres inside the material and decompose it to some extent, by means of the production of organic acids.⁸⁶ Biocides have the double effect of cleaning and destroying biological growth, such as algae and lichens, and are frequently used on stone objects exposed in open-air environments. They have proved to be very effective, without damaging the stone. Negative side-effects may be that the surrounding growth becomes exterminated as well, if the biocides are not handled with care.

Objects in public halls or museum buildings present other kinds of decay, specific for their context. Problems, which frequently occur, are the presence of various surface deposits, often fat. The kind of cleaning desirable has to be decided from case to case, considering the objects' material and the composition of the surface deposits. Natural soaps such as the Swedish "såpa", an efficient and mild cleaning agent on "dirty" surfaces may, in addition, be used for maintenance purposes, to avoid more complex conservation interventions.

Pre-consolidation

Before cleaning begins, a pre-consolidation of the object is often necessary. On a painting the treatment may merely be the injection of glue in order to stabilise a flaking paint layer. If it is a mural painting, which tends to detach from the mortar layer, a mixture of lime and hydraulic lime or *pozzolana* can be injected between the layers. If the layer lifts at the edges, so that filling may be performed with a mixture of higher density, this open space could be filled with a stucco with the inclusion of

⁸⁵ Torracca, 1997, pp. 34-35.

⁸⁶ Torracca, 1988, p. 51.

crushed bricks and a small quantity of acrylic resin.⁸⁷ In case the object is of stone with a so-called sugaring surface, pre-consolidation is generally made with applications of ethyl silicates, which penetrates and hardens the surface, in order to make cleaning possible.

Consolidation

After cleaning, a consolidation of the object is often made, with the intent of taking precautions to avoid any rapid future decay. Consolidation today is generally made with synthetic chemical components, applied for stabilising the surface, and to some degree the interior matter. In stone conservation, consolidation is generally made with ethyl silicates, which penetrate the surface and link the crystals artificially. A total impregnation of the object is generally intended, aiming at filling its pores until saturation, allowing the substance to form crystals inside the stone. This treatment demands great quantities of fluid solution for a porous stone. Impregnation of marble or limestone with an ethyl silicate not only brings chemical changes to the material, but also is also visible on the surface, even though the substances may be transparent and “invisible”. Whether it is possible to define the stone as original or not after such impregnation is another question. Alternative methods, compatible with the stone material, have been studied in Florence for many years. Artificial calcium oxalates have proved to be useful for consolidation and surface protection of stone as well as of mural paintings.⁸⁸ Calcium oxalate is a good protective agent, being a low water-soluble compound with good optical properties. Such coating, in addition, remains practically colourless, unlike natural calcium oxalates, which become reddish, yellowish or black with the passage of time. Another consolidation method for mural paintings, tested in Florence, is based on the use of calcium hydroxide.⁸⁹ Also in this case, the approach has been that conservation materials should have compatibility with the substrate, and that the materials, in principle, should be of the same chemical nature as those used by the artist.

Surface coatings

After cleaning, the surface becomes “nude”, especially if the object was cleaned with any efficient substance, removing the natural “patina”. Therefore the surface should be protected by coating it with some suitable substance. If this is not done, the surface becomes easily exposed to a rapid deterioration process. Surface coatings are often applied as the final treatment, on wall paintings as well as in stone conservation. In the past, applications of protective surface films were made with

⁸⁷ Forcellino, 1988, p. 130.

⁸⁸ Matteini, 1999, pp. 31, 33.

⁸⁹ Baglioni and Giorgi, 1999.

natural materials, such as drying oils, waxes and animal fats.⁹⁰ Today such treatments are usually made with available chemical products. No perfect coatings are known today, and therefore coatings are often avoided.

Surface protectives are known since antiquity, and have probably been used in all cultures. Traces of ancient surface protectives have been found on monuments from the Roman Imperial period. These layers are referred to as *patine ad ossalati* or oxalate coats, and were probably made of lime with a proteic binder, such as glue or casein.⁹¹ Analyses of samples from, e.g. the Colonna Traiana or Arco di Tito revealed distinctive layers, mainly consisting of calcium oxalate, calcium phosphate, amorphous silica compounds and gypsum. There were no traces of oil or other fats.⁹²

In Sweden oil paint was commonly applied on limestone and some sandstones for centuries, and this custom continued until it became fashionable to expose the stone surface. There are, however, remains of paint on architectural elements, e.g. in the historic centre of Stockholm, the Old Town. Also in Göteborg the habit of using oil paint on stone has been documented.⁹³

In other northern European countries, such as Germany, casein seems to have been used as a protective on stone for centuries.⁹⁴ In Italy surface coatings seem mainly to have been made on a lime basis. Such lime-based applications, often containing marble dust, *pozzolana* dust or *peperino* dust, are commonly called *scialbatura*. The choice of stone dust, mixed into the lime, was a choice dependent on the stone surface to be protected. These are all superficial applications, i.e. sacrificial coatings, and since they are not liquid enough to penetrate deep into the stone, they are unable to change the interior characteristics of matter.

Sacrificial coatings may protect stone surfaces for some years, and since such coatings gradually disappear the applications have to be repeated at regular intervals. Traditional protectives, mentioned in ancient literature and confirmed by recent analyses, ought to be rediscovered and tested again.

Casein, glues or Punic wax may be added into the lime-wash or *scialbatura*. The materials, or mixtures mentioned, do not normally alter in a surprising way, but rather wash off as time passes. On the other hand, the chemical products nowadays available in commerce are transparent, and they are made to penetrate the surface and impregnate the stone. They will not normally wash off, and they alter the chemical composition of the stone to some degree, but it is not known exactly how they alter in a longer perspective. The only certain factor is that nothing can be conserved unaltered for an indefinite period of time.⁹⁵

⁹⁰ Torracca, 1988, p. 93.

⁹¹ Melucco Vaccaro, 1967, p. 40.

⁹² Guidobaldi et al., 1984, p. 127.

⁹³ Lindqvist et al., 1989, p. 287.

⁹⁴ Reinhard Meyer Graft, conservator in the German Pompeii project. Personal communication, December 1998.

⁹⁵ Massa and Paribene, 1982, p. 11; Urbani, 1982, p. 10.

Documentation and Conservation

*“The condition of the building before any intervention and all methods and materials used, must be fully documented.”*⁹⁶

Documentation as a research process and the necessity of documentation in conservation has been stressed by Lagerquist.⁹⁷ As soon as any action in archaeology and conservation is taken, it has to be carefully documented, in order not to lose important information.⁹⁸ A set of questions has to be formed in order to register important and valid information. By identification of problems in conservation operations and by composing an operative-oriented model for documentation, it would be possible to exclude invalid information.⁹⁹ It is not the quantity of information, which is important, but its quality.

Documentation in conservation should consist of verbal descriptions, photographs, drawings and measures. In complex cases, even other methods, such as photogrammetry, CAD-CAM and 3D-animations can be comprised in the documentation programme. The absolute need of adequate documentation has been pointed out also by Coles, whose general guidelines, concerning documentation and recording of actions on archaeological sites, also include the necessity of making an interpretation of the finds in their context, and to publish the results.¹⁰⁰

As stated above, any conservation intervention will lead to a change in the material, either as visible evidence or as a transformation of the material structure. In order to remember the state of preservation before any action is taken and to provide material for comparisons before and after interventions, relevant documentation has to be made. The inevitable destruction of evidence starts at an excavation site as soon as work begins, and consequently any action must be carefully recorded on site records, written reports, photographs and drawings.¹⁰¹

In architectural restoration or conservation there is the same need to document the interventions, since the building will obviously undergo some changes due to the necessary interventions. According to Zander any conservation programme should be prepared by a group of professionals, led by the conservation architect and should include an art historian, an archaeologist and a conscious artist.¹⁰² This team is recommended to form a site vocabulary in which important terms and concepts are defined in order to avoid misapprehensions and to establish a correct diary, which will provide correct and commonly understood information for the final documentation.

⁹⁶ Feilden, 1988, p. 55.

⁹⁷ Lagerqvist, 1996.

⁹⁸ Lagerqvist, 1996, pp. 96-97, 110, 119.

⁹⁹ Lagerqvist, 1996, p. 28.

¹⁰⁰ Coles, 1995, pp. 59-61.

¹⁰¹ *Ibid.*, pp. 60, 66.

¹⁰² Zander, 1993, p. 37.

Photographic documentation to accorded scale and in absolute frontal view should thereafter be made, and constitute the ground for drawings in, e.g. scale 1:5. Based on these drawings the architect and the designer continue to work with the final object in order to construct a correct and easily understandable graphic documentation. Upon this drawing transparent sheets may be applied for indication of further important information, such as existing lacunae, the colours of the painting etc.

Documentation, made by artists during the 18th and the 19th centuries at the excavation sites, provides valuable information, in spite of the personal interpretations and the obvious signs of fashions in painting, which often reveal the taste of the period in which the painter was active. In many cases these coloured drawings are all that remain of the once so impressive mural paintings. Present documentation of studies, based on the drawing and painting techniques mentioned above, often occur in contemporary studies and conservation reports, and are often compared to such older documentary material.¹⁰³

Although at present no generally accepted standardisation in the recording of cultural heritage exists, it is commonly agreed that documentation should be carefully made, independently on the site or of the object concerned. As stated above, any conservation action will change the authenticity of the object, and the process must therefore be recorded and documented before, during and after intervention. The work at an archaeological site, e.g. at Pompeii, nowadays consists of a combination of documentation of previously excavated areas and new excavations. Traditional methods and modern equipment are used parallel to each other. Documentation can, in addition, be made as exhibitions of the site, the working progress and the results achieved.¹⁰⁴

Authenticity and Originality

Authenticity, in the Western world, is a concept based on the idea that a work of art is understood to be unique, i.e. singular and not repetitive.¹⁰⁵ The authenticity of a building is represented by its history, readable as various forms of changes, rebuilding and decay.¹⁰⁶ A copy of such a work of art is generally considered to be a fake, just as is an object restored “too much”. It is, however, difficult and subjective to define a precise distinction between restoration and fake.

Originality, in this context, is not understood in the same way as in Eastern tradition, where there is obviously no obvious barrier between “original” and “substitute”, at least as far as buildings and museal arts are concerned. Chinese and Japanese temples, for example, survive culturally due to the successive change of the deteriorated materials of the buildings, where it is understood that

¹⁰³ Martorelli, Bragantini, 1980; de Vos, 1980; Paris, 1998; Scagliarini Corlàita, 1998; Ling, 1991.

¹⁰⁴ Rosvall, 1988, p. 11.

¹⁰⁵ Marconi, 1984, p. 55.

¹⁰⁶ Edman, 1994, p. 7.

“authenticity” is embedded in the body of the building, and not in its singular elements of wood, even if these might be carved and painted decorative elements. Singular pieces, consequently, may be re-made to substitute missing parts of the total structure, thus securing the identity and authenticity.

The attitude towards substituting missing parts has been normal for Europeans, e.g. the Italian conservation of mosaics, where small pieces of disassembled mosaics have successively been replaced with new ones, in order to maintain the identity of an object.¹⁰⁷ Even though such possible replacements of details seem natural regarding the conservation of buildings and artefacts, and for repetitive motifs in stucco, stone, brick or wood etc, the problem is not the same concerning paintings and statues, at least with respect to their critical parts, such as human faces, individually important components etc. The originality of a building is, according to Edman, its personal character, linked to the building at a particular time. Through any conservation treatment the identity of the building is exposed to some kind of change in its identity.¹⁰⁸

A painting is made as one entity of materials. It may be made with millions of brushstrokes and mixtures of colours or with just a few brushstrokes and colours. Those are the personal fingerprints of the artist, which, per definition cannot be re-made, the way a single missing piece of a mosaic seemingly can be re-inserted. It does not matter if the painting is a mural painting with the different *giornate* visible, or if the painting has been made by many hands, such as the artist and the painters working in his studio. The painting must still be seen as one complete object, existing entirely within its own delimited area. In Brandi’s terminology, the work of art is a unity present as an entirety and not a unity, which is achieved by a totality.¹⁰⁹

A missing area of a sculpture, a mosaic “painting” presents the same problems as in a painting, since a new interpretation of the missing area has to be made, if it is decided to be reconstructed or restored. Therefore, when confronting a missing area of an object, a decision has to be made on how to intervene without disturbing the legibility of the object, and without falsifying it, or reducing its authenticity.

There is a considerable difference between a building and, for example a statue or a painted portrait, and it is therefore necessary to discuss these objects in different ways. A building is not only the exterior, with surface proportions of the façade, since it mainly consists of its structural form, its skeleton, which defines its size and its space. Hence the building material must be considered as well as the decorative elements, its coatings and its surface structural system. Connected to the building is the environment in which the building constitutes a part, and its history. Such aspects have to be considered when performing conservation interventions with and on the surface or in the structure of the building, beginning with documentation of its history and by making analysis of the building materials and pigments used. Other kinds of analyses, e.g. of the structural system, iconography and historical development must also be executed.¹¹⁰

¹⁰⁷ Marconi, 1984, pp. 54-55.

¹⁰⁸ Edman, 1994, p. 7.

¹⁰⁹ Brandi, 1977, p. 13. (“... il carattere di unità all’opera d’arte, e precisamente l’unità che spetta all’intero, e non l’unità che si raggiunge nel totale. Se infatti l’opera d’arte non dovesse concepirsi come un intero, dovrebbe considerarsi come un totale, e in conseguenza risultare composta di parti...”).

¹¹⁰ Gatto, 1988, p. 103.

The colours of a building offer an instructive document of the changes in taste and fashion during different periods. Rome in 2000 is a striking example. The previously warm ochre coloured central part of the city, now appears in pale pastel hues, resembling the colours of Italian ice cream – peach, pistachio, strawberry and vanilla. It may be difficult to decide which phase in a building's history that should be chosen to be represented by means of conservation measures. This work should be carried out by a multi-disciplinary group of skilled experts, representing different and adequate fields.¹¹¹ The issue concerning materials in ancient buildings is still not thoroughly investigated. Such studies must be made, since the outcome of a conservation intervention very much depends on the selection of materials, with special reference to their different chromatic and visual characteristics.¹¹²

A painting or a statue may also be regarded as decorative elements within an architectural scheme, just as architecture preferably must be analysed and interpreted within its environmental setting. The environmental setting, architecture and decorative elements are interacting parts, together contributing to a whole, and none should be given a value superior to the others (see Fig. 5).

Originals, copies, replicas and fakes

The conception of copies and originals during Antiquity was different compared to that of the 18th century and to modern times. Original Greek works of art were much appreciated by the Romans. Copies and replicas of appreciated works of art were common and the restoration and reconstruction of statues were part of maintenance. While Greek artists presumably made singular statues, Roman artists had an industrial production of copies of Greek art.¹¹³ The difference between a *copy* and a *replica* is, in brief, that the copy was a reproduction of an existing statue, maybe made with the use of a pointing machine, while the replica reproduced a type of statue, and was, consequently, a more or less free interpretation of an original. Definitions of the terms and concepts behind words such as copy, original, replica, model and prototype relating to Classical Antiquity have been thoroughly made by Leander Touati.¹¹⁴

It is known that the Emperor Hadrian, for example, collected originals as well as copies of Greek and Hellenistic originals, located in Villa Adriana at Tivoli, and that the copies were of an excellent quality.¹¹⁵ Since Hadrian was a wealthy man, economic reasons may be excluded as the cause for collecting copies. It seems as if, by Roman standards, a good copy or replica, was given the same value as a good original.

¹¹¹ Marconi, 1988, p. 105.

¹¹² Forcellino, 1988, p. 126.

¹¹³ Bartman 1994; Hamberg, 1945; Leander Touati, 1998; Moorman, 1988; Poulsen, 1949; Richter, 1928.

¹¹⁴ Leander Touati, 1998, pp. 82-86.

¹¹⁵ Melucco Vaccaro, 1989, pp. 33-34.

Winckelmann, who exerted a massive impact on issues of art and antiques during the 18th century, presented an essay on the conservation of works of art, delineating the problems of integration in sculpture. He had observed that statues had been transformed through restoration, thereby gaining another character.¹¹⁶ Statues that had been “repaired”, often presented a large number of new pieces, and in some cases it occurred that fragments from one original were used to produce two statues.¹¹⁷ According to Winckelmann, there had to be rules established to make possible the distinction between restored parts and the original object, pointing out some problems that often occurred. He suggested that integrations should be shown or indicated at least in publications, in order to avoid confusion or misapprehensions about what was antique and what were later additions. These general recommendations or guidelines were, at least in principle, followed by the friend of Winckelmann, Bartolomeo Cavaceppi, who was one of the most active restorers of sculpture in Rome during this period.¹¹⁸ On the other hand, Cavaceppi had expressed the opinion that if reconstructed parts did not exceed one third of the object, the entire statue should be considered as antique.¹¹⁹

Maybe as a reaction to over-restoration and economical profits and the production of “antiques” during the 18th century attitudes regarding these issues have changed. For later generations much value has been given to the originals, while the copies have been regarded as second-rate art or even as fakes. As Brandi puts it, “...the copy is a historic falsification and an aesthetic falsification, and may only have a purely didactic justification...”

Nowadays it may be necessary to re-evaluate copies, due to the environmental problems we are still incapable of solving, making originals exhibited in open-air environments deteriorate, dilapidate and disappear. Under circumstances such as those mentioned above, the copy becomes a substitute, rather than a fake.¹²¹

¹¹⁶ Jokilehto, 1986, p. 91.

¹¹⁷ Caira Lumetti, 1998, p. 6.

¹¹⁸ Jokilehto, 1986, p. 91.

¹¹⁹ Antonsson, 1958, p. 25.

¹²⁰ Melucco Vaccaro, 1989, p. 215. (“...La copia è un falso storico e un falso estetico e pertanto può avere una giustificazione puramente didattica...”).

¹²¹ Istituto Centrale per il Restauro, which is the Italian National Agency for Conservation.

THEORETICAL FRAME

The UNESCO Guidelines in conservation, as presented by Feilden and Jokilehto (1993), have been accepted as the basis for any action in the field of conservation. These, consequently, must be regarded as the frames within which conservation issues are discussed and interventions are performed. Other such important guidelines and principles of ethics, have been formulated by Feilden (1998), by van Gigh and Rosvall (1991), and fundamental codes of ethics have been formulated on the national level, the Code of Ethics of AIC (1999).

Publications relating theoretical systems and theories concerning conservation, such as Brandi (1977), Baldini (1988, 1989), Casazza (1989), Melucco Vaccaro (1989), Lazzarini and Laurenzi Tabasso (1986), have been important for my studies. These publications constitute the basis for conservation theory during the last thirty years, and are, consequently, of great importance, whether the reader approves of the ideas presented, or not. In my own case, many issues have been important, either because I have approved, or disapproved of the ideas or solutions presented. For example: The *selezione cromatica* (chromatic selection) and *astrazione cromatica* (chromatic abstraction), as presented by Casazza (1981), are considered as scientific methods respecting the object restored, by not falsifying its originality. One of the problems intended to be resolved by using these methods was to be able to eliminate the "figure" which tended to appear on larger reconstructed areas, where a "neutral colour" had been applied. My main disagreement is against the belief that any singular method might be the better method on all occasions. Secondly, even a "scientific method" is an interference with the original structure, and is, therefore, adding something to the original object or, at least, changing it. Thirdly, independent of the method used, the competence of the conservator is most important for the result. In my opinion, there is no method perfect in conservation on all occasions. Any kind of intervention becomes an "addition". Chromatic selection and *rigatino* are useful and in many cases the reconstructions have been successful. In my opinion, openness of mind and interactions between disciplines are therefore more fruitful than dogmatic programmes.

Very inspiring and fruitful for my own studies, have been some comparatively short publications on theoretical issues, e.g. Coles (1995), Ferroni (1999), Giannini (ed. 1992), Lippi (ed., 1993), Mora (1996, 1967), Urbani (1982,1984), Wolters (1988), Zanardi (1982) and Zander (1993). Furthermore, there are many research reports describing conservation methods, which have been of great importance for this investigation, and in fact all reports mentioned in the bibliography have contributed to the theoretical framework of this study, as far as material investigations are concerned, and it is, therefore, impossible to mention some as more important than the others. The main thing, which all reports have in common, is the systematic procedure of each problem investigated, the clear definition of the methods used, and the documentation of the process from start to conclusion.

RECENT RESEARCH OF RELEVANCE

In 1939 the Istituto Centrale per il Restauro (ICR) was founded in Rome, and its first director, Cesare Brandi, was also the great theoretical scholar of Italian conservation.¹²¹ His discourse, expressed in “Teoria del Restauro”, is still the paradigm which forms the application-oriented principles base of ICR, and, consequently, nationally for Italy.¹²² Since the middle of the 20th century, new attitudes, and a scholarly-scientific approach to conservation problems has successively been introduced, not only in Italy but gradually also elsewhere. Research and testing, for a long period of time have been directed towards industrially produced chemicals with the objective of developing scientifically adequate and stable conservation materials. Recently an interest in traditional methods has arisen, since these modern materials also change by aging, which is not a favourable characteristic, and have additional disadvantages, such as aging without grace and being pollutive. In the 1950s research and debate on encaustic techniques was intense during a period within the field of conservation, as a result of the vast areas and frequent periods of excavations of Pompeii and other important sites in the Vesuvian area, and new results were published.¹²³ In the 1960s, Rome became the natural centre for development of new ideas, mainly as an effect of modern conservation theories which, by then, were spread and accepted outside the ICR through the scholarly-scientific reports which were published by conservators and scholars at this institute.¹²⁴

New ideas and hypotheses have gradually developed in connection to the excavations in the area of Naples, mirroring the achievements and new intentions in the approach to archaeology. Considerations on conservation methods and treatments, as well as chemical and technical analyses have become increasingly important, compared to the normal proceedings in earlier periods.¹²⁵ Research concerning ancient coatings for stone has, since some years, been established in Rome and Florence, where interest has been focused on the oxalate coatings that are still visible in protected areas on ancient marble.¹²⁶ These coatings have been identified as limewater with the addition of some, not yet identified organic material.

Quite recently, in the late 1990s, a new programme on an international level was initiated at Pompeii, mainly directed towards alternative and non-destructive methods of conservation, e.g. strictly performed methods of documentation, but also including new excavations, measurements, chemical-technical analyses and conservation treatments of the sites and the objects. Some results of this work have been published, e.g. within the vast German Pompeii project “Häuser in Pompeji”. A conservator has been a member of the excavation team since the beginning of the project. He has developed a method of analyses of the composition of stucchi and plasters, which has become essential for the successive scientific, photographic and graphic work.

¹²² The first edition of *Teoria del restauro* was published in 1963.

¹²³ E. Aletti, 1951; C. de Azevedo, 1952.

¹²⁴ C. Brandi, 1953; M. Cagiano de Azevedo, 1949; A. Melucco Vaccaro, 1986; P. Mora, 1967; von Graeve, 1981.

¹²⁵ M. Pagano, 1992, 1994.

¹²⁶ Bralia et al. 1989, Del Monte and Sabbioni 1987, Gratziu and Melucco Vaccaro 1989, Matteini and Moles 1986, Seaward and Giacobini 1989, Torraca 1986.

¹²⁷ The conference was held by Pontifica Commissione di Archeologia Sacra, Città del Vaticano.

Some questions about the Roman wall painting technique are still not satisfactorily resolved. The only certain fact is that the murals are not true fresco-paintings, even though the basic monochrome paint layer generally was made *al fresco*. Mostly, the decorative painting was made on this monochrome basis. A recent conservation and research project has provided important information about the materials and techniques used in early Christian catacombs, mainly in Rome. The project was presented at a conference in Rome, and a series of conservation reports were offered to the public.¹²⁷ A similar research project, concerning materials and techniques in the Roman catacombs, was presented as a doctoral dissertation.¹²⁸ Consequently, late Roman wall paintings have been given a lot of qualified interest of late. At the same time, some results from recent excavations in Pompeii, begin to be available to the public. In 1997 the first volume, presenting the British Institute project at Pompeii was published.¹²⁹

There are no disagreements among scholars concerning the mural technique, i.e. of how the *intonaco* or how the preparation of the first paint layer *al fresco* were made. Disagreements concern the decorations painted upon the monochrome layer. Some murals are true *frescoes*, but generally the decorations of Roman murals were built up in several paint layers, upon the basic fresco-layer. These additional paint layers are not made *al fresco*, but painted in other techniques. The binders used for painting on a drying or a dry preparation still have not been fully determined, even though it is known that colours made on lime-basis were used, at least preparations which were not completely dry. Other possible binder(s) might be any glue or gum. In some cases, it has been stated that several kinds of binders were used, but in no case is there a general answer available to the question.¹³⁰ The paintings are still mainly referred to as *frescoes*, even in quite recent publications.¹³¹ Since refined analytical methods are available today, it would be possible to determine the binders, i.e. the painting techniques. Therefore, an investigation of the compositions of the binders used in Roman mural painting and surface protection, is made as part of this dissertation, with the objective of identifying the assumed existence of beeswax, in its natural form or as Punic wax, present in Roman murals.

¹²⁸ Bordignon, 2000.

¹²⁹ Ling, 1997.

¹³⁰ Ling, 1991, p. 204.

¹³¹ Catalogues such as *Alla ricerca di Iside*.

RESEARCH METHODS

Due to the design of the study, a set of research methods has been used. There is no common method available applicable for all issues represented, since these consist of matters related to the fields of architecture and the fine arts, crafts, humanities at large, natural sciences and technology. Relevant written documents ranging from Antiquity to recent professional research publications on the issues investigated have, however, been generally applied, like comparative studies between those written arguments and real life evidence. The methods chosen, and the theoretical framework on which these have been based, were, as follows.

Material investigations

The methods used for the material investigations comprise of observations and analyses made on ancient materials. Before these practical investigations started, materials and material technology were studied in the disciplines chemistry and material science, as well as the history and technology of pigments. Such studies, of course, had to be included within the theoretical framework throughout this research, and consisting, later on, primarily of surveying research reports in the fields of conservation and material analyses. The materials relevant for this study were mainly natural beeswax, Punic wax, and the prepared supports upon which these products were used. When Roman wall paintings were studied, the preparation, i.e. the stucco, was studied as well as the supporting material, i.e. the plaster, as being part of the same body. The hypothesis is that by being aware of the construction and composition of the preparations for painting, some indications may be observed regarding the period of construction, about context, and about the social standard of the commissioner. In cases when the supporting material was wood, this has been noted but not studied, being a completely different kind of material, and not immediately important in the study.

Ancient pigments have been studied as being part of the painting materials used during the period investigated, and their chemical composition has been studied, for identification purposes. By knowing the characteristics of these pigments it becomes possible to make some preliminary assumptions about the social standard and cultural outlook of the commissioner of a particular decoration investigated, since some pigments were very costly and others not. By taking into account which were the pigments used in ancient times, it further becomes possible to make conclusions regarding the period when a particular painting was made, since some pigments were not known during Antiquity, and such pigments can, therefore, not appear in ancient painting. Some other materials have been regarded, e.g. tempera, included in the study for comparative reasons, as being one of the principle paints during Antiquity.

An assumption is that the choice of materials, used for the decoration, shows whether the decoration was made for a place of great importance, or not. The technical and artistic skill of the craftsmen and of the painters are, of course, equally important, and therefore, in this study, a mural painting investigated, is studied as a

material, technical and artistic unity, and not only as a piece of art, by describing the image with its pictorial motif and composition and the decoration on its painted surface.

In order to combine theoretical studies with investigations of materials actually existing, a set of case studies was performed. The methods adapted for material investigations concerning Fayum portraits and Roman wall paintings, were partly performed by the staff at the scientific laboratory at the Opificio delle Pietre Dure in Florence. The materials mentioned above, i.e. preparations, binders, pigments and possible surface coatings, have been studied in two extensive material investigations, which are presented as case studies in the present dissertation. The aim has been to study the chemical composition of the preparation and of the paint respectively, with focus placed on the possible presence of beeswax. Preliminary investigations were made before the samples were brought to Florence.

The Fayum portraits were initially studied and documented by various methods, such as visual inspection of material and material decay, photography in natural light as well as in raking light, and in UV-light. Observations and photography in optical microscopy in diffusion light were made when the samples were removed for chemical-technical investigation. The chemical-technical investigations made at the Opificio delle Pietre Dure consisted of the stratigraphic analyses of sections in optic microscopy in diffusion light and under UV radiation for the examination of the fluorescence caused by the materials. The samples selected were enclosed in polyester resin and the surfaces were perpendicularly ground. An optical microscope Zeiss Axioplan equipped with objectives from 5x to 20x and with a UV lamp of mercury vapour was used. Each cross-section was documented with the various techniques mentioned above. The very same sections were utilised also for a SEM investigation, using an electronic scanning microscope Leica Cambridge, and examined by elementary microanalysis EDS, using a system Link-Gem from Oxford. Other samples, in powder form, were selected and their compositions analysed in a spectrophotometer FTIR, using an equipment Perkin Elmer 1725X, adopting the technique of making micropellets (\varnothing 1.5 mm) in Kbr.

The investigation of Roman mural painting further included documentation of the mural fragments, made as drawings in full scale, and photographs. The construction of the fragments, i.e. the numbers of mortar, plaster and stucco layers possible to distinguish with the naked eye, or under a magnifying glass, was documented and noted on forms made for the occasion. The average grain sizes and the general impression of the layers were noted. The paint layers were studied before and during the cleaning of the fragments, and the observations made were noted. After this initial documentary phase, all information concerning each fragment, accompanied the samples to the Opificio. The chemical-technical analyses at the Opificio were made by using the same equipment and methods as described above.

In a third case study, concerning fragments of Roman wall paintings from San Lorenzo in Lucina, the chemical-technical analyses were very limited, and consisted mainly of the determination of one particular pigment, interpreted as cinnabar,

and microscopical studies of some samples, with the aim of answering to a set of specific questions. Simple investigation methods were the same as those mentioned above.

The main aim of the case study concerning Palazzo Calabresi, was to study if there was a firm correlation between theory and actions taken in practice. The method of establishing such possible relationships was by strictly following existing guidelines when documenting the object and planning for the conservation interventions, and finally evaluating the measures taken in practice.

The methods used for the experiments followed ancient descriptions for making mixtures of wax, and testing their application on traditional and more recent kinds of supports. At this first step, the usefulness of the substances was tried, and in a next step the durability during different circumstances was tested. All the methods used are fully described in the case studies.

Contemporaneously with the investigations of materials, relevant issues concerning the cultural context were studied. The objective was to establish *if* the materials investigated were well known and used during Antiquity, as well as establishing *how* and *when* they were used. It was therefore necessary to understand the cultures within which these materials and techniques were developed, but also by defining the materials within their context, either as being the only materials available, or as being some of those possible to choose. If there were possibilities of choice, it was important to understand the circumstances during which these materials were chosen, if it was for their specific qualities or due to a local tradition.

Studies concerning the cultural context

The history of archaeological excavation of Roman contexts was studied, since the situation during excavations may have had an influence on the materials studied. The Roman context i.e. the Roman way of using art, in public or private spaces has been carefully studied. Traditional historic and art historic aspects, such as observations of the stylistic changes, have been considered. Various scholarly interpretations of those symbolic values manifested in Roman art, i.e. studies of pictures as carriers of intangible qualities, have been taken into account. These aspects have not been of immediate importance in this study, since the material aspect of art has been at focus. Art as a communicative system, has been given attention, since this aspect explains the kinds of messages sent from the commissioner of art to the beholder - consciously or not -, and requires a direct link to the substances carrying the art messages.

During the last decades some investigations dealing with the Roman characteristics in art, based upon analyses of the themes and contexts, have been published, to some extent aiming at excluding personal opinion and taste being built into the research method, but rather being presented just as what they are, personal preferences.

The method used by Wallace-Hadrill (1994) for his systematic investigation of the decorations in Pompeian houses, and the corresponding social status of their

owners has, in this sense, been of great importance for my own work, just as the publications by Iacopi (1997, 1999), in which she takes into account the entire cultural context as expressed in the decorations described. The thorough investigation of painted statues, performed by Moorman (1988), has been an inspiring example of how to proceed, just as the publications by Zanker (1988) concerning the power of images in the age of Augustus and, on aspects of public and private life at Pompeii (1998). Likewise important has been the study of portraits of Livia by Bartman (1999) and those by Marvin (1993) and Kleiner (1993), which, like all the publications mentioned above, are characterised by a combination of strictness in the research method, with that of an open mind and a personal intuition. The same is valid for Leander Touati (1998), who has set an example with the thorough investigation and determination of the conceptual framework behind copy, replica, fake and other related terms. Investigations such as those mentioned above, consist of the collection and interpretation of facts, and the methods used are clearly described. These methods, as well as the results achieved, may consequently be approved of or questioned by other scholars. The attitudes towards investigations and of research such as mentioned above, have been an inspiration and a guideline to me, rather than the traditional art historian method of describing and interpreting the stylistic modalities and the subjects represented, often, mythological, while paying comparatively little attention to the total ambience. Even though the art history tradition, and the scholars representing this, indisputably has contributed with important knowledge about ancient art, these research methods, however, have not been applicable in this dissertation.

Terminology

As far as terminology is concerned, a set of terms, and their conceptional dimensions, has been studied with the objective of clarifying their linguistic connotations, and to propose an intelligible vocabulary, possible to be generally agreed upon. Languages change and it is therefore important to be aware of the meanings of important terms such as they were used during the period, which is studied in this context, in order to avoid misapprehensions caused by changes in conceptions. It is therefore an objective to determine some conceptions associated with wax painting and wax as a surface protective, in order to understand the original meaning of the terms. Based upon these studies it might be possible to judge if some existing unclarities linked e.g. to a painting technique, are due to unsatisfactory knowledge about these terms, conceptions and materials. It is a generally accepted approach that by defining the initial meaning of a specific term, combined with the understanding of the technique and its materials, existing unclarities may be indicated and consequently, avoid repetition. In case there is a discrepancy between ancient and modern terminology, and if such a discrepancy has led to ambiguities, this would lead to another issue to consider, i.e. whether modern terminology should, or should not, be changed. In cases of unclarities, these have to be explained, as well as the

possible reasons for their occurrence. Based on such knowledge, there is a possibility of establishing a vocabulary, which may be commonly accepted. The methods used for studying variations in terminology, have been by confronting a carefully considered choice of translations of ancient scripts, and by studying the differences, small or great, between documents. The discrepancies observed during this study, lacking philological explanation, were presented to experts in Latin and Greek, Classical as well as modern, and this collected information was used as a base for further studies.

The reliability of those ancient sources, which are important in this context, was also tested. This was done by comparing some translations, with the objective of seeing if there were, discrepancies or not between translations, and if such existed, these may have been related to initial unclarities, or to later variations in transcriptions of the original texts. In addition, one of the Plinian passages frequently quoted was examined word by word, with the intention of comprehending what he actually had written. Some consideration has consequently been given to the descriptive literary “style” of Plinius, compared to that of Vitruvius.

Theoretical and practical aspects on conservation

The development of conservation methods and ethics in conservation has been studied, to create a basis for the present understanding of the discourse of the concept of conservation. The materials used in conservation, traditionally as well as recently, have been given attention, with the objective of understanding if modern chemicals are more suited for conservation treatments than the ancient materials and methods were – and are. Since this is an enormous field of study, and obviously the topic for more than one dissertation, just some details have been studied more in depth in the “real world”, e.g. some cleaning methods. The issues discussed in this dissertation are primarily ethical, connected to choices of materials in conservation, how and when to conserve an object, and they are of a more general theoretical character, focusing on the necessity of documentation in conservation. Conservation principles discussed have been presented under the heading *Theoretical perspectives*.

MATERIAL TECHNOLOGY AND MATERIALS

Waxes, Natron, Pigments and Binders, Painting Preparations, Roman Wall Painting, Encaustic Painting and Gnosis

Beeswax and natron are the principal materials studied in this dissertation. They constitute, together with some ancient pigments, the components of the paints used in encaustic painting and in the coatings, pigmented or not, which were used on marble statues and wall paintings. Special attention has been given to the properties of beeswax, and how it has been used for artistic purposes. Various analytical methods are presented, since they are commonly used for the identification of waxes and/or pigments. Wax as a material to create sculptural objects, or as a material for bronze casting is not within the limits of this dissertation. Ancient pigments and binders, i.e. paint, and some materials and techniques used for preparations during Antiquity are briefly described.

The intention is to present a general view of ancient materials and of the techniques in which they were, and still are used, with the objective of providing an idea of the possibilities available during Antiquity for the choice of materials in painting and for coating surfaces of art works. By knowing the characteristics of materials and techniques it becomes easier to understand how materials react when used in various combinations and environments, as well as comprehending what is possible and what is impossible to do with them.

Waxes

Man has used natural beeswax for various purposes ever since Antiquity. It has, until present times, been used as paint and as a material for shaping objects. It has been used to create models for bronze casting, votive figures, writing tablets, and for making decorative objects. Beeswax is an ideal modelling material, permitting corrections or additions at any stage, as it does not dry or change during work.

Beeswax was used by the Ancient Egyptians as a modelling material for votive figures, as an adhesive and as a surface coating material.¹ It was used in shipbuilding, and has also been identified as one of the components in an ancient Egyptian wig.² During the Roman era, fruit and flowers made of wax were popular.³ Pigments were added into the fluid wax and pieces of various colours and shapes were connected to each other to form complex objects. This tradition was still in existence during the 17th, 18th and 19th centuries, when impressive flower and fruit decorations of coloured wax were high fashion. Anatomical objects were created in wax and used for medical studies. Such studies still remain in European museums, e.g. at the wax model department at “La Specola” in Florence, which contains a wide range of anatomical studies. Votive figures of wax were popular donations to Italian churches, and in the church Santissima Annunciata in Florence there were about 600 such figures in natural size at the end of the 17th century, some of them donated as early as during the 13th century. Except for the man-sized examples there were a great number of smaller figures as well.⁴

Beeswax has been used as a surface coating on statues and wall paintings but also on tempera and oil paintings, since it has good protective properties. Waxes have the greatest degree of impermeability to atmospheric moisture of any of the commonly used protective materials. Modern technical analyses have revealed that wax impregnation of stone may prevent further need of treatment, and that a surface treated with wax repels most solvents.⁵ Multiple layers of thin coats ensure most complete coverage.⁶ A recent study shows that beeswax is an efficient moisture barrier for several kinds of wood panels, such as mahogany, oak, lime-tree and poplar.⁷ Natural beeswax is virtually insoluble in water, but becomes soluble in water if saponified. It is known that the adhesive strength of beeswax is better than that of paraffin waxes, which depends on the different chemical structures. The resistance to mechanical forces is, however, less than that of resins and oils.⁸ Beeswax was, as indicated above, a common material for making objects and protecting them. Sometimes, some other kind of wax was added to adjust the malleability and the melting point. There are many mixtures of waxes available, and these can be dissolved either in water or in various organic solvents. Most waxes become harder when the solvent has evaporated.

¹ Murrell, 1971, p. 95.

² Mills, 1994, p. 54.

³ Büll, 1963, p. 438.

⁴ *Ibid.*, p. 438.

⁵ Horie, 1987, p. 73.

⁶ *Ibid.*, p. 78.

⁷ Masschelein-Kleiner, 1995, p. 43.

⁸ Mayer, 1981, p. 418.

Crystal growth on the surface of objects of wax is frequently documented. Such growth, or bloom, may be due to polymorph transformations of fats and waxes.⁹ These transformations are due to the migration of fatty acids, caused by continuous changes in the surrounding temperature. On some parts of a fruit decoration investigated, a red pigment had been applied, and on those parts no crystals had formed. The general impression was that the pigment had prevented crystallisation of the wax. A head of a girl, made with a mixture of beeswax, paraffin wax and pine resin, presented similar formations of crystals on the surface.¹⁰ It seems that in most cases when this problem occurs, there has been an addition of stearin wax into the beeswax, and that the objects have been exposed to great variations in the surrounding temperature, which favours the forming of crystals.¹¹ Changes in temperature is the cause of a second problem, namely cracks on the surface or in the structure of wax objects. The fatty acids function as plasticisers, and when they are lost, due to the migration, the wax loses its plasticity and this eventually leads to cracking.

The chemical composition of beeswax

Waxes have a low melting point, generally between 40° and 90° C, beeswax at about 64° C. Oxidation with the atmospheric oxygen may increase the hardness and raise the melting point to about 120°.¹² Beeswax is translucent and solid. It consists mainly of esters of long-chain hydrocarbons, alcohols, carboxylic acids and esters formed by the two latter groups.¹³ The esters are divided into several different groups (table 4.1).¹⁴ The hydrocarbons range from 25 to 35 in carbon number, the major number being 27.

Waxes are lipids, and lipids are esters, i.e. acids combined with an alcohol. The main components of waxes are the cerides, containing long chains of fatty acid combined with normal, i.e. not branched, alcohols of high molecular weight, such as e.g. myricil alcohol, $\text{CH}_3\text{-(CH}_2\text{)}_{28}\text{-CH}_2\text{OH}$ or cerilic alcohol, $\text{CH}_3\text{-(CH}_2\text{)}_{24}\text{-CH}_2\text{OH}$.¹⁵

⁹ Ibid, p. 66.

¹⁰ Ibid, p. 65.

¹¹ Ibid, p. 64.

¹² von Tell, p. 29.

¹³ Frinta, 1963, p. 148.

¹⁴ Mills, 1994, p. 50.

¹⁵ Masschelein-Kleiner, 1995, p. 34.

Table 4.1 Composition of beeswax (after Tulloch³)

Component	Weight (%)
Hydrocarbons	14.0
Monoesters	35.0
Diesters	14.0
Triesters	3.3
Hydroxy monoesters	3.6
Hydroxy polyesters	7.7
Free acids	12.0
Acid monoesters	0.8
Unidentified	8.6

Fig. 7. Table 4:1. After Mills, 1987, p. 50.

Fig. 8. Table 4:2. After Mills, 1987, p. 50.

Table 4.2 Composition of free and total acids of beeswax (after Tulloch³)

Chain length	Whole wax	Free acids
16	59.8	—
18	2.6	—
18:1	4.1	—
20	1.5	—
22	1.3	3.3
24	11.9	46.8
26	4.2	12.3
28	4.3	12.1
30	3.8	8.4
32	3.2	7.8
34	3.1	8.3
36	0.2	1.0

18:1 signifies a chain length of eighteen carbons with one double bond (oleic acid).

Wax esters crystallise in sheet structures, most of them with their hydrocarbon chains in tilted form, some with vertical chains while others give X-ray diffraction data for both forms.¹⁶ After saponification, beeswax yields, in addition to the original hydrocarbons and free acids, further free acids, monoalcohols, hydroxy-acids, and diols (Table 4.2).¹⁷ Saturated hydrocarbons are chemically inactive compounds. Both carbon-carbon bonds and carbon-hydrogen bonds are strong and non-polar and not easily broken. For splitting these bonds, energy, such as high temperature is needed. The hydrocarbons in waxes are heavy, i.e. they can be found in the lower part of carbon atoms. Hydrocarbons with low numbers are gases, those in the middle are liquids and those with higher numbers are solids.

Methods for identification of waxes

Several methods are available for the identification of waxes, e.g. *gas chromatography*, *mass spectrometry* and *infrared spectrometry*. Lately, FTIR (Fourier Transform Infra-Red spectrometry) and SEM/EDS (Scanning Electron Microscopy/Energy Dispersive Spectroscopy) are frequently used in well equipped laboratories. Cross-section and thin section samples can be examined in a number of ways, including observations in diffuse light or ultra-violet fluorescence light.¹⁸ In addition there are traditional methods such as *optical microscopy*, *micro-chemical analyses* and, if a larger sample can be removed, the *determination of the melting point*.¹⁹ When examining paintings and other objects, only milligram or microgram samples can be removed, and in such cases the modern methods are indispensable.

Gas chromatography was often, and still is, used for the identification of waxes. This method makes it possible to identify the composition of different mixtures, for example of one wax mixed into another, or the addition of resins or oils into the

¹⁶ Aleby, 1971, p. 421.

¹⁷ Mills, 1994, p. 50.

¹⁸ Lalli, 1999, p 214.

¹⁹ Kühn, 1960, p. 73.

wax.²⁰ The composition of the wax sample can be observed on the gas chromatogram, although a considerable proportion of the original components consist of compounds of molecular weight too high to pass through the column even at high temperatures.²¹ Paint samples containing saponified wax appear differently compared to natural beeswax on the gas chromatogram, and therefore, saponified wax can be identified by gas chromatography.²² The wax esters are in such cases converted into methyl esters. Saponified beeswax, or Punic wax, has been identified in paintings. In a few cases some oil had been added into the mixture.²³ In other cases there had been an addition of lime as an emulsifying agent.²⁴ Analyses of samples have revealed the addition of non-drying fats and resins into the saponified wax.²⁵

Mass spectrometry can be used for the analysis of organic materials, especially when combined with gas chromatography. For example, analysis of crystal growth on a Victorian fruit decoration of wax revealed that the crystals consisted almost entirely of free palmitic and stearic acids, while the wax areas on which they grew contained no such acids.²⁶

Infrared spectrometry is a useful method for the analysis and identification of waxes, and has, in recent years, been frequently adopted as an analytical method in conservation. As the infrared spectrum of beeswax is a rather reliable and constant characteristic, the method is convenient for unmixed samples of sufficient size. Infrared spectrometry has served to identify materials of appliqué brocade materials in some wooden sculptures, being made either in pure beeswax or in a beeswax/resin mixture.²⁷ Some samples of both types contained small quantities of sand, sometimes with the addition of a drying oil or lead white. The reason for the presence of the sand and the oil or pigment was not clear.²⁸ Infrared spectrometry was successfully used for the identification of pure beeswax in wax sculptures from the 17th, 18th and 19th centuries. Kühn used infrared for analysis of the paint medium of three mummy portraits. Two of the portraits, painted in encaustic, had a spectrum similar to that of recent beeswax, and that of a wax seal dated to AD 1218, which clearly shows that wax does not undergo much change in the course of time.²⁹ Infrared spectrometry has also proved to be adaptable for analysis of samples from mural paintings.³⁰ A sample from a Pompeian wall painting showed an infrared spectrum indicating beeswax, but in so small quantities that it would not have been sufficient as a binding medium. It is therefore possible, according to Kühn, that a mixture of lime and wax was used in the *ganosis* procedure, in which case the heat might have had a reducing influence on the wax.³¹

FTIR can be used for identification of pigments, binders, varnishes and other

²⁰ Mills, 1994, p. 54

²¹ *Ibid.*, p. 50.

²² Hillyer, 1984, p. 2.

²³ Mills, 1994, p. 173.

²⁴ Kühn, 1960, p. 78.

²⁵ Mills, 1994, p. 173.

²⁶ Harley, 1993, pp. 63-66.

²⁷ Frinta, 1963, p. 138

²⁸ *Ibid.*, p. 144.

²⁹ Kühn, 1960, p. 78.

³⁰ Frinta, 1963, p. 138; Kühn, 1960, pp. 71-79.

materials contained in painting preparations.³² Only samples of microscopic size are needed, and the method may, therefore, be characterised as a micro-destructive technique, in comparison with non-destructive methods operated by radiation and with no need of samples. The results of FTIR analyses appear as spectres, where the peaks indicate the materials included in the sample. Organic matters are often not visible since they are usually a low percentage of paint mixtures.³³

SEM/EDS analyses reveal the constituent elements of the samples. The great power of SEM/EDS reduces the necessary size of sample, and it is therefore competitive with non-invasive diagnostic analyses.³⁴ The EDS analyses allow us to obtain a higher magnification as well as an element by elementary analysis.³⁵

Determination of the melting point of paint samples is another method of identification of waxes. The melting point of natural beeswax is rather constant, and does not change with ageing of the material. Wax has proved to melt at about 64° C, normally within the range of 63.4-65° C.³⁶ Analysis of the melting point was frequently used in the past, and it is a rather reliable method in art and conservation, if large samples are available.

Ageing properties of beeswax

Beeswax changes only slightly through oxidation or ageing. The chemical composition is more or less the same for beeswax in different countries, or different periods of time and does not seem to vary in chemical composition due to which period of the year it has been produced. Samples from various sources look much the same, a fact that has been noted by analysis of such different samples as an Egyptian sarcophagus, a Roman candle and a medieval wax seal.³⁷

Changes in wax have, however, been noted by infrared spectrometry in cases where wax had been exposed to ground water. Material analyses from a 17th century ship burial showed reduced ester-group absorption relative to that of free acids.³⁸ Saponified beeswax also remains of the same chemical composition whether it is fresh or old. The chemical difference between natural beeswax and saponified beeswax does not alter in the course of time and each material shows its specific pattern in gas chromatograms.³⁹ Consequently it might be difficult to determine the exact age of wax, at least with the methods described above. Age may sometimes be determined by C¹⁴ analysis of the material supporting the wax application. The analytical programme of a mummy portrait, which was made by a group of conservators at the Getty Conservation Institute, is a good example, illustrating this state-

³¹ Büll, 1963, p. 359.

³² Matteini and Nepoti, 1999, pp. 217-218.

³³ Matteini and Nepoti, 1999, p. 223.

³⁴ Lanterna, 1999, pp. 40-41.

³⁵ Lalli, 1999, p. 215.

³⁶ Mills, 1994, p. 50.

³⁷ Mills, 1994, p. 53.

³⁸ *Ibid.*, p. 53.

³⁹ *Ibid.*, pp. 173, 190.

ment.⁴⁰ Since there were some doubts about the age of the portrait, and FTIR of the paint does not reveal the age of wax, a C¹⁴ test was made. The test revealed that the wood was roughly 250 years old, a result which excluded the possibility that the portrait was an original Fayum portrait.⁴¹

Additions of other materials into the wax

Remaining ancient descriptions give some information on how beeswax was used, as a singular material and as a component in mixtures. The practical knowledge regarding the characteristics of organic materials obviously were discovered in Antiquity, but the possibilities of making exact chemical analyses have not been offered until recent times. The advanced technical equipment nowadays makes it possible to do exact and reliable analytical determinations. Analytical methods have made possible, not only the determination of material compositions, but also to understand the interactions between different materials in mixtures. One such compound is *Punic wax*. Various materials, such as resins, fats, oils and pigments have occasionally been mixed into the beeswax to achieve specific effects.

Experiments have revealed that beeswax can be useful if mixed with modern materials. Such an example is the addition of bleached beeswax into an artificial resin, a polycyclohexanones, AW2. The resin hardened rather rapidly and became almost as insoluble as dammar and mastics. The addition of bleached beeswax improved the resolubility of the resin, and the result was considered to be very successful.⁴² This mixture, in fact, resembles ancient Roman glue used for marble, which principally consisted of a mixture of colophon and beeswax.⁴³

Natron

Nitrum, *nitro*, *natron* are terms referring to a double salt, which may be collected in natural circumstances in salt lakes in desert regions. *Nitro*, a term used by Pliny, is a form of the Latin word *nitrum*. The corresponding Greek word is *natron*, and in the English chemical terminology it is called *Trona*.⁴⁴

Natron exists in a natural form in Egypt, where the salt can be found on the surface of the shores along some salt lakes. One important such lake is situated in the Wadi Natrun, a partially cultivated valley in the Western Delta of River Nile, in the Libyan desert north-west of Cairo. In the middle of the valley, a chain of salt lakes is extended, which collectively are called Wadi Natrun. The name indicates the

⁴⁰ Corzo et al., 1997, p. 82.

⁴¹ Corzo et al., 1997, p. 82.

⁴² Raft, 1985, p. 143.

⁴³ Alessandro Danesi, personal communication, 1999.

⁴⁴ The double salt Natriumsesquicarbonat, Na₃ (HCO₃) (CO₃) · 2H₂O.

finds of *natron*, which has been collected in the area since ancient Egyptian time.⁴⁵ During the Pharaonic era this *Wadi* was considered as one of the seven oases in the Libyan desert, and was called either “The salt field” (*Sechet Hemat*) or “The Lake of Heaven” (*Schet-Pet*), the latter referring to the importance of *natron* for incense, which was used in the daily temple ceremonies. The *Wadi* continued to be an important place during the Graeco-Ptolemaic era, when it formed a district of its own, the “Nitriotes”, under the protection of the god Serapis. Another large salt lake was the Birket Quarun in the Fayum district. The salt from this lake *may* be of the same composition as that from Wadi Natrun, but there are, to my knowledge, no existing reports on this matter. There may also exist other North African desert lakes containing *natron* salt, but this, to my knowledge, has not been established. According to Dr. Nasry Iskander, *natron* for the purposes mentioned above was exclusively taken from Wadi Natrun.⁴⁶ Due to these facts, in this context, *natron* will be understood as *a natural impure salt collected at Wadi Natrun*.

Natron salt was used for different purposes, e.g. for mummification, where it was a drying agent in the desiccation process, since the salt absorbs liquids and is antiseptic. *Natron* was, in addition, used in the fabrication of glass, and for cleaning purposes. It was also one of the components for making the glaze *blue frit*, which could be used as a pigment in a powdered form.⁴⁷

During winter the level of the water becomes more elevated than in summer, and when the water retires and evaporates from the wet ground, the salt crystallises on the ground. It remains as a white layer on the surface and is easily collected at any time of the year. It may be easier to collect great quantities in periods when the layer is thick. Due to the sand on which the salt crystallises it is almost impossible to avoid collecting sand at the same time. The impurities in *natron*, therefore, are mostly sand, and as sand is not soluble in water it is easily distinguished in analysis, and will have no importance for the determination of the composition of the salt.⁴⁸

Natron may, according to Dr. Iskander, be substituted with pure sodium carbonate, sodium bicarbonate plus a small addition of sodium chloride and sodium sulphate for experimental purposes.⁴⁹ The *nitrum*, mentioned by Pliny as an important ingredient for making Punic wax, was most probably natural *natron* salt. This may explain the name *Punic wax* - suggesting either that the wax or the ingredient salt was derived from Northern Africa. Another possibility is, according to Professor Carl Nylander, that this mixture might actually have been Punic, i.e. invented by the Phoenicians, and that the product was inherited by the Greeks, and later by the Romans.⁵⁰

In November 1998 I made a visit to Wadi Natrun in order to collect some samples of salt. The journey to reach the salt lakes went along the desert road between Cairo and Alexandria, and about halfway, at Sadat City, continued on a local road

⁴⁵ Bonniers kulturguide, Egypten (Bonniers Cultural Guide, Egypt), pp. 390-391; Laurie, 1910, p. 40.

⁴⁶ Dr. N. Iskander, Director General of conservation, Egyptian Museum, Cairo. Personal communication, December 1997.

⁴⁷ Forbes, 1965, p. 224.

⁴⁸ Dr. N. Iskander. Personal communication, December 1997.

⁴⁹ *Ibid.*

to the Coptic monasteries, Deir el-Surian and Deir el-Baramous. From there a minor road leads to the salt lakes. The most remarkable and immediate impression of this isolated place was the taste of salt in the air and the extreme quietness of the place. No sound could be heard and salt, sand and water were exposed under the sun and the clear blue sky. The place seemed untouched by man, and the surroundings gave the impression of sterility and desolation.

Salt had crystallised in various systems in the different areas along the shore where the samples were collected. Distant to water it appeared in a rather powdery form just as newly fallen snow when the temperature is very low. Closer to the water it became heavier and in some areas it formed irregular flakes of smaller or larger size. At the edge of the water the salt was slightly wet, forming hard flakes. Six samples of salt were taken at various distances from the water. It was collected in sterilised glass bottles and closed with plastic taps. When examined in FTIR at the Opificio, sodium sulphate was identified. This means that even in an isolated desert region there are signs of air pollution, and the salt collected today is therefore not identical to ancient *natron*.

Two samples, no. 5 and no. 3, were examined by microscopy at CNR in Rome.⁵¹ The samples presented the same characteristics with distinct formations of crystals. The lower side, which had been exposed against the sand, was darker than the upper side, and containing sand. Most remarkable was the transparency and glassy appearance of the material. Some crystals had specific optical properties, transmitting spectral light through prismatic crystal formations. There were red stains indicating residues of a ferrous material, some undefined black grains, some burgundy coloured, and some yellow grains. The lower side seemed more fragile, presenting empty spaces and a more complex structure, consisting of formations of stars, serpents and forms similar to painted skies from the Baroque period. The serpent formations, or vein structures, may have been natural tubes for the disposal of air.⁵²

Finally samples nos. 2 and 3 were brought to the National Heritage Board in Stockholm, where Dr. Runo Löfvendahl examined some grains. The grains were viewed and photographed in an optical microscope, and the same kinds of observations were made, confirming that the *natron* salt contains various crystals, e.g. quartz and other mineral grains. Some red particles were identified as iron oxide.

⁵⁰ Dr. Carl Nylander, personal communication, March 2001.

⁵¹ CNR - Consiglio Nazionale delle Ricerche. Centro di studio sulle cause di deperimento e sui metodi di conservazione delle opere d'arte, Roma. Dr. Sandro Massa kindly instructed and supported the microscopical analysis.

⁵² Dr. S. Massa, personal communication, 1998.



Fig. 9. The Wadi Natrun.

Fig. 10. Natron salt in different forms of crystallisation.

Pigments and Binders

To a great extent our ancient source-based knowledge of ancient art refers to Pliny, who wrote about many subjects, and among them, the origin and development of painting. According to Pliny, the Egyptians claimed to have invented the method of painting 6000 years before it reached Greece, and he also notes that painting initiated with the outlining of a man's shadow while more elaborate methods were invented later.⁵³ Obviously, Pliny had no precise conception of age at that time, since today it is known that painting started already during the Aurignacien period. The old cave painting techniques and materials have survived in the traditional aboriginal art. Recent analyses of aboriginal rock art show that natural earth colours have been continuously used for the paintings, and that no binders were used. This is consistent with traditional cave painting techniques, which include brushing of a water-based dispersion and spraying from the mouth.⁵⁴

Colour had a profoundly important meaning for pre-historic man, and decorating the skin with red, yellow and blue patterns seems to have been practised at a very early date. The earliest pigments that were used for painting were red and yellow ochre's, black from soot or charcoal, and white obtained by clay or lime.⁵⁵ Red ochre was used in grave rites from the Cro Magnon period and onwards, either as layers of pigments encasing the dead body, or placed close to the head of the skeleton, maybe as a symbol for a life-giving substance because of its resemblance to blood.⁵⁶ The archaeological finds in "Grotta delle Felci" on Capri is an example of such a tradition. The cave was found at the end of the 18th century, and it contained grinding stones covered with red ochre, together with remains of human skeletons.⁵⁷

Water or grease were suitable binders on walls that were not directly exposed to water, wind or sun, but did not make a resistant paint. A waterproof paint was achieved by mixing the pigments with a more withstanding substance, e.g. blood, urine or egg. Binders such as these can be diluted with water.

Early wall-paintings at Hieraconpolis, a site in the Nile Valley, show that not only earth pigments but also manufactured green and blue pigments was known before 3000 BC.⁵⁸ Pliny described the pigments used during the Roman period; where to buy them, how to handle them and even what to pay. He also gave his opinion about the difference between the old traditions and the methods used by contemporary painters during his own lifetime. "*When we contemplate the number and*

⁵³ Plinius, NH XXXV, 15. "The origins of painting is obscure, and hardly falls within the scope of this work. The claim of the Egyptians to have discovered the art six thousand years before it reached Greece is obviously an idle boast, while among the Greeks some say that it was first discovered at Sikyon, others at Corinth. All, however, agree that painting began with the outlining of a mans shadow; this was the first stage, in the second a single colour was employed, and after the discovery of more elaborate methods this style, which is still in vogue, received the name of monochrome."

⁵⁴ Ford et al., 1994, p. 59.

⁵⁵ Forbes, 1965, pp. 210-213.

⁵⁶ Ibid, pp. 210, 211.

⁵⁷ Andr n, 1975, p. 14.

⁵⁸ Forbes, 1965, p. 241; Woldering, 1962, p. 22; Lloyd, p. 34.

*the variety of colours known, we are overcome by admiration for the early masters. The greatest artists, Apelles, Aetion, Melanthius and Nichomachus used four colours only for those immortal masterpieces - melinum as a white pigment, Attic sil among the yellows, Pontic sinopsis as a red and the black atramentum - and yet towns lavished their whole resources on a single picture. Today when purple has made its appearance on our walls and India contributes the slime of her rivers, the blood of dragons and elephants, no noble paintings are produced.*⁵⁹

That pigments fell into some rank of order is apparent in the comments of Vitruvius and Pliny. Pigments were valued in proportion to their availability and expense. Most esteemed and most costly were the richest pigments such as cinnabar, which could be excluded from the decorators' contract and charged directly to the customer.⁶⁰

In the Roman tradition the variations in colour were also used for establishing hierarchies of space. Plain white walls were most economical and consequently common in secondary rooms in the houses of the wealthy, and in simple houses used as the overall colour of the walls. Yellow and red ochre's represented the norm for the better rooms of houses, while blue pigments were something of a rarity. Black was normally used in rooms of special scale and grandeur.⁶¹ The pigments used during Antiquity have been subject to various analyses during the last decades, and the results confirm the information given in ancient sources, e.g. by Pliny.⁶²



Fig. 11. Fragments of Roman wall paintings. Small fragments of various red colours. From excavations at San Lorenzo in Lucina, Rome.

⁵⁹ Plinius. NH XXXV, 50. The artists mentioned were well known Greek painters at the time.

⁶⁰ Wallace-Hadrill, 1994, p. 31.

⁶¹ *Ibid.*

⁶² Hillyer, 1984, pp. 7-8; Johnson et. al., 1995, p. 73; Dinsmore and Howard, 1988, p. 63; Barov, 1990, p. 20.

Ancient pigments, commonly used

Pliny described the pigments presented below, and are the pigments most commonly found in modern analyses of ancient paints. Beside these, several other pigments were available.

Black pigments

Black pigments generally contained carbon in some form. *Carbon black* could be prepared from bones, e.g. *ivory black*,⁶³ or wood, i.e. *charcoal*.⁶⁴ Other black pigments were made by *iron oxide*,⁶⁵ and *bitumen*, said to have been invented by Apelles.⁶⁶ Carbonised wine roots made a black pigment with a bluish black hue and ivory made a brownish black.⁶⁷

White pigments

The white pigments used in Egypt were mostly prepared from calcium. Among the white colours were *limestone*, *chalk*, *lime* and *gypsum*. Greeks and Romans continued to use *lime*, *gypsum*, *chalk* and *china clay*, but also produced *ceruse*, which is *lead white*.⁶⁸ *Paraetonium*, was a white calcium pigment, made by crushed seashells.

Red pigments

Red ochre, a natural earth, owing its colour to anhydrous or hydrous iron oxide, was the most common red pigment during Antiquity.⁶⁹ Other natural reds were *natural ferric oxide* and *red lead*. Several artificial red pigments were used, like *cinnabar*, a mercury sulphide,⁷⁰ and *dragon's blood*,⁷¹ an organic product, achieved from plants. *Purpurissum*, an organic *red lake*, was a dye extracted from the madder root. Less expensive madder originated from Greece.⁷² This colour frequently occurs on objects from the Roman period in Egypt.

Yellow pigments

Yellow pigments generally were natural iron oxides like *ochre's* or *limonite*. Pliny considered the *Attic sil*, dug in the silver mines of Athens, to be the best ochre.⁷³ *Orpiment*, an arsenic sulphide, also called King's Yellow, was used in ancient Egypt.⁷⁴

⁶³ Lat. elephantinum.

⁶⁴ Lat. atramentum.

⁶⁵ Black hematite.

⁶⁶ Berger, 1904, p. 262.

⁶⁷ Doxiadis, 1995, p. 99.

⁶⁸ Lat. cerussa.

⁶⁹ Lat. rubrica.

⁷⁰ Lat. minimum.

⁷¹ Lat. Cinnabaris.

⁷² Doxiadis, 1995, p. 99.

⁷³ Lat. sil atticum, a yellow ochre from Attica. Sil, Latin for ochre.

⁷⁴ Lat. auripigmentum, a natural sulphide of arsenic.

Blue pigments

Azurite, a basic copper carbonate, was much appreciated during Antiquity.⁷⁵ It was an expensive natural pigment, which was often substituted by the artificial product called *blue frit* or *Egyptian blue*, made by grinding copper-calcium-tetrasilicate, which produces an ultramarine shade of blue. The blue frit was initially used as a glaze and later in a powdered form as a pigment. It was prepared by melting *silica*, *malachite*, *calcium carbonate* and *natron* for 24 hours at a temperature between 800-900°C.⁷⁶ This colour was known to the Assyrians about 1500 BC, who used it for decorations as well as for shaping small objects. *Indigo*, a natural product made of plants, was another blue, and expensive pigment.⁷⁷

Green pigments

Green earth pigments were known at a very early date.⁷⁸ A vivid green based on copper, was achieved by powdering *malachite* or *chrysocolla*,⁷⁹ and an artificial *green frit* occurred in Egypt at the time of the 6th dynasty. The *blue frit* could be mixed with a *yellow ochre* or *orpiment* to obtain a green colour.

Violet pigments

The only violet pigment was purple, prepared from the Murex mollusc.⁸⁰ Purple was the most expensive pigment during the Roman period.

How to prevent some pigments from altering

Some pigments were - and are - sensitive to light, and tended to alter when exposed to direct sunshine. Among these was *vermilion* or *cinnabar*. Vitruvius and Pliny agree that cinnabar, exposed to light, turns dark. This transformation depends on the ultraviolet rays of the sun, which turns the red mercury sulphide into black. Cinnabar also alters in contact with lime.

Other colours, such as *purple* (Purpurissum), *indigo* (Indicum), *Egyptian blue* (Caeruleum), *Terra Melia* (Melinum), *orpiment* (Auripigmentum), *Appian green earth* (Appianum) and *lead white* (Cerussa) neither remain intact when they are exposed to the ultraviolet rays of sunlight and in contact with lime. In order to avoid such transformation, an application of Punic wax mixed with oil could be spread to the painted wall, when the colour was dry. The wax then formed a protective coat and the colours remained unaltered.

⁷⁵ Lat. Caeruleum.

⁷⁶ Forbes, 1965, p. 215.

⁷⁷ Lat. Indicum Purpurissum.

⁷⁸ Lat. creta viridis.

⁷⁹ Lat. aerugo.

⁸⁰ Lat. Purpurissum.

Colours and pigments

Ancient philosophers formed theoretical systems to describe the nature of, and the connection between, colour and light. The formation of a systematically documented discourse took place in Greece. Aristotle considered that "... all colours are the mixture of three facts, the light, the means through which light is perceived, like water or the air, and in the third place the objects...".⁸¹ According to Plato, vision is caused by light going out of the eye, round the object, and back to the eye. Seen in this way, observation of colour may be described as "a two-way communication, based upon the evolution of the faculty of vision of the observer".⁸² Plato defined colour as "... an effluence of form commensurate with sight and palpable to sense".⁸³ Democritus associated the four primary colours with the four elements in his general atomic theory.⁸⁴

Colour appearing as pigment or paint has also been subject to interest, and more or less systematically analysed and described. Vitruvius divided the colours into *natural* and *artificial*.⁸⁵ Natural colours were those which can be found in the earth, such as yellow and red ochre's, Paraetonium, melian white, and green chalk from Smyrna.⁸⁶ Artificial were those made by man in some kind of a process.⁸⁷ By this definition most colours are artificial, since some chemical process is frequently needed to make a pigment or a dye.

Pliny divided the pigments principally into *the vivid* (*floridi*) and *the subdued* (*austeri*). Vivid pigments were *cinnabar*, *azurite*, *dragon blood resin*, *malachite*, *indigo*, and *Purpurissum* (an earth dyed with Tyrian purple). All other pigments were classified as subdued.⁸⁸ Pliny stated, however, that pigments might be classified differently, for example into the natural and the artificial.⁸⁹

Nowadays there are other ways of classifying pigments. For example, Selim Augusti, who studied the pigments found in Pompeian painting, presents five different ways of classification.⁹⁰ In brief, the different classification principles are according to Augusti:

- A. According to colour. (Red, yellow, green, blue, violet, black and white).
- B. According to nature and origin. (Natural and artificial colours).
- C. According to commercial value. (Vivid and subdued colours).
- D. According to chemical composition.
- E. According to chemical components.

⁸¹ Aristotle, *De Coloribus*, 793, a, b.

⁸² Jensen, 1996, p. 25.

⁸³ Plato, *Meno*, 76, D.

⁸⁴ Lyons, 1996, p. 214.

⁸⁵ Vitruvius, *De architectura*, the ten books on architecture, c. 10 B.C.

⁸⁶ Vitruvius, *De architectura*, VII, 7.

⁸⁷ Vitruvius, *De architectura*, VII, 8-14.

⁸⁸ Plinius, *NH XXXV*, 30.

⁸⁹ Plinius *NH XXXV*, 30.

⁹⁰ Augusti, 1967.

Paint and conservation

Analysis and the successive determination of pigments and media are of great importance in modern conservation. Examinations of the paint have to be made, and microscopic samples may be removed for determination of the paint's chemical composition. Pigments can be identified in various ways: by e.g. chemical analysis, optical investigation, x-ray diffraction, x-ray fluorescence, transmission electron microscopy, and scanning electron microscopy (SEM).⁹¹ The latter can be combined with energy dispersive analysis of X-rays. The identification of the binding medium can be made by infrared spectrometry, gas chromatography, mass spectrometry, nuclear magnetic resonance spectrometry and determination of the melting point.

Metamerism is a problem, which may occur if modern pigments substitute ancient or old pigments or paints.⁹² The problem is caused by differences in reflection and wavelengths between the old pigment and the modern substitute. The colour may be similar in some wavelength intervals, and therefore the colours may seem similar in one kind of light, but if light changes, differences become obvious. This may lead to unexpected effects. The retouched part of an object may be perfectly indistinguishable from the surrounding original paint when exposed to daylight, but not in the artificial light from a lamp, or from the flash when a photo is made. A way of avoiding this problem is by using modern products with similar reflection spectra as the ancient materials.

Painting Preparations

Plastering and painting

Materials such as *clay*, *lime*, *gypsum* and *chalk* were used as preparations for wall paintings in most ancient societies. The materials were mixed with water in order to achieve a suitable consistency, and the mixture obtained was applied to the wall where it was left to set for drying or carbonating as the water evaporated.⁹³ Wall preparations of gypsum plaster, made as early as 3300 BC, have been found in Egypt. Such preparations are known from pre-dynastic wall paintings in Hieraconpolis, and in early-dynastic mastaba tombs at Saqqara.⁹⁴ Egyptian preparations were carefully made. At first a thick coating of straw and mud was applied to the rough-hewn walls and covered with layers of plaster, consisting of very fine sand and clay with calcium carbonate and gypsum.⁹⁵ The finishing coat was a *gesso*, a priming coat to which glue had been added. The resilient straw and mud support preserved the paintings from bad shrinkage and earth tremors, so that many of them have survived in an astonishingly fresh condition, though frequently damaged by

⁹¹ Jensen, 1996, p. 37.

⁹² Staniforth, 1985, p. 101.

⁹³ Aldred, 1994; Aletti, 1951; Forbes, 1965; Ling, 1991; Vitruvius.

⁹⁴ James, 1988, p. 55.

⁹⁵ Rickerby, 1993, p. 45; Stulik et al, 1993, p. 57.

the hand of man.⁹⁶ The painted decoration was made with tempera when the preparation had dried. This kind of plastering and painting remained the common method for the next 3000 years. The gesso primer was also applied to other materials, such as wood or linen. Gesso was used as preparation on several panels for mummy portraits.

Roman wall paintings were not made *a secco* as were Egyptian murals, but rather in the *al fresco* technique. In both traditions, however, the thorough and systematic construction of the wall preparation was characteristic. The Roman wall plaster was basically made of slaked lime, sand and water. When this mixture sets, by taking up carbon dioxide from the air and drying out to form calcium carbonate, it becomes chemically similar to limestone and marble. The preparation of Roman murals from the first layer to the final painting consisted of defined parts of a well-structured process, the painting being part of that structure and not considered as an additive and superficial decoration.⁹⁷ To begin with, a rough layer was applied directly on the wall, continuing with one of finer structure, and proceeding with applications of even finer layers, until the preparation was completed. The ultimate and very fine layer served as a support for the painting. Pliny and Vitruvius provide us with enough information to form an idea about Roman building standards.

The main source in understanding how Roman murals were made is Vitruvius' *De Architectura* from the first century BC. Vitruvius actually lived at the time when Roman mural paintings were at their highest technical standards, and according to him wall preparations should consist in as many as six layers in addition to the render coat.⁹⁸ The first three layers should be made of lime and river sand, while fine marble dust should replace the sand in the ultimate three layers.⁹⁹ His contemporaries followed these recommendations to a certain extent.

The first step in plastering was to ensure good adhesion to the underlying wall construction. If the wall surface was too smooth it had to be prepared by pecking with a hammer or other implement but if it was rough enough the first layer of mortar was applied. If there was any danger of dampness penetrating from the ground, crushed terracotta and *pozzolana*, a volcanic material, could be mixed into the plaster, forming a hydraulic mortar. The fired clay, mixed into the mortar, confers hydraulic properties and through hydration it hardens in damp conditions and subsequently becomes waterproof.¹⁰⁰ A keying pattern could be made in the rendering coat, in order to improve the adherence of the successive plaster layers.¹⁰¹

Roman wall preparations generally gained a considerable thickness, often as much as 7 or 8 cm. The combination of several applications of plaster and stucco layers and the intermediate compacting of these layers, made the walls acquire certain qualities such as being strong, which prevented surface cracking. This considerable thickness favoured a slow drying, which may be among the reasons why the signs of different applications, the *giornate*, are not very apparent on Roman

⁹⁶ Aldred, 1994, p. 28.

⁹⁷ Melucco Vaccaro, 1967, p. 20.

⁹⁸ Vitruvius, VII, 3.

⁹⁹ Borrelli, 1980, p. 82.

¹⁰⁰ Ling, 1991, p. 199.

¹⁰¹ Barbet, 1998, p. 105.

murals, but have been ascertained.¹⁰² The *giornate* are indications of the areas upon which one day's painting was done. Such areas are clearly visible on fresco-paintings from the Renaissance, when the thickness of the preparation was much reduced.¹⁰³ The wall was compacted and smoothed with special plasterer's tools, similar to those used today, the mason's trowel, *trulla*, for applying the material and the float, *liaculum*, for smoothing and polishing it. Many such tools of metal and wood have been found at Pompeii and Herculaneum.¹⁰⁴ Smoothing with hard tools must be done while the plaster is wet, and is done to compact the plaster and harden it. Marks from tools have been identified on the surface of several Roman murals.¹⁰⁵

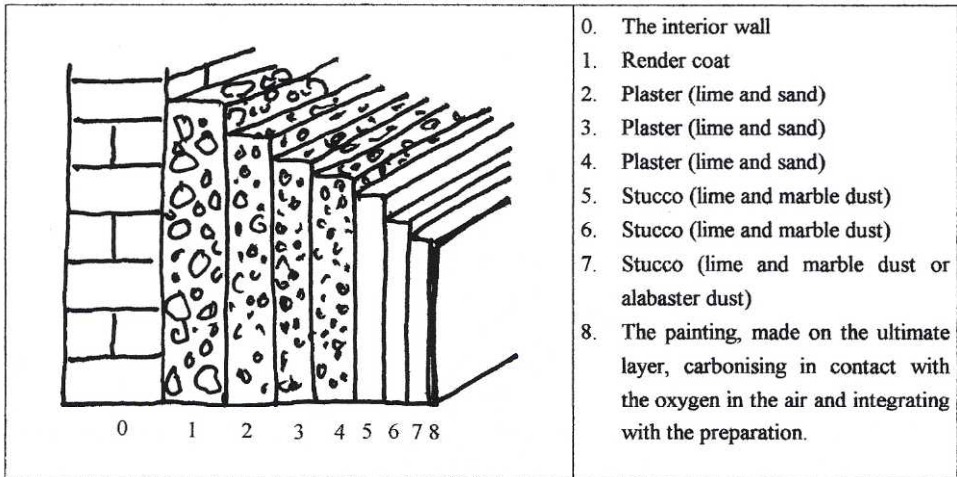


Fig. 12. The preparation of a wall, according to Vitruvius. The evaporation of water makes the calcium hydroxide migrate towards the surface, penetrating through the paint layer. It reacts with the carbon dioxide gas CO_2 in the air developing calcium carbonate, CaCO_3 .

The material constituting these last layers is called *stucco*, a term which refers to the *material* as well as to the *architectural decorations* frequently appearing in Roman architecture.¹⁰⁶ In this context the term *stucco* will be used for the material, and if a stucco relief is intended it will be specifically indicated.

¹⁰² Barbet, 1998; Borrelli, 1980; Iacopi, 1997; Ling 1991.

¹⁰³ Laurie, 1910, pp. 83-85.

¹⁰⁴ Borrelli, 1980, p. 82; Ling, 1991, p. 200.

¹⁰⁵ Borrelli, 1980, p. 82; Ling, 1991, p. 199.

¹⁰⁶ Ling, 1995, p. 1; Bordignon, 2000, p. 39.

In the House of Livia at the Palatine, and at the house presumably belonging to Julia and Agrippa, excavated at the Farnesina Villa in Rome, six preparatory layers have actually been revealed. In the House of Livia the marble dust was substituted by alabaster-dust, a material that must have been extremely costly even at that time.¹⁰⁷ Recent analysis of decorations at Torre di Prima Porta and at the Villa of Livia at Prima Porta show that also in these houses marble dust was substituted by alabaster dust.

The Roman wall painting technique

There have been, and still are, different opinions among scholars concerning the technique used for Pompeian murals.¹⁰⁸ At the time of the early excavations, the lustre of these surfaces was most striking to the persons involved in excavations, and attempts were made to explain the reasons for this shiny appearance. Field studies of excavated murals were made and published. Ancient literature was studied, principally the books of Vitruvius and Pliny, but also by Aristotle, Plutarch and other writers.¹⁰⁹ In general, Roman wall paintings are called “frescoes”, which is not an adequate denomination. During the last centuries it has been debated whether these murals should be considered as paintings *al fresco*,¹¹⁰ *encausto*,¹¹¹ *tempera*,¹¹² or even *painting with polyments*.¹¹³ Other alternatives have been suggested, and among them are *stucco-lustro*, *fresco-secco*, *tempera on fresco ground*, *painting with a mixture of milk and wax*, or with *oil paint with wax application*. It has also been suggested that they were made in *mixed techniques*.¹¹⁴ Lately it has been suggested that the decorations were made with various lime-paints, *al fresco* as well as *a secco*.¹¹⁵

Already Vasari had posed this problem, according to Borrelli.¹¹⁶ In some cases the differences in opinion are not really as far apart as it may seem. In order to understand the conceptions behind the terms, the characteristics of these techniques will be mentioned.

Al fresco means that a painting is made on wet plaster, and pigments traditionally are dispersed in water or limewater. A fresco-painting can be identified by its rather uniform surface, the painted details appearing on the same level as the background colour. This happens because the fluid paint is applied while the lime-plaster is still wet. The lime-based colours integrate with the wall and form a unity with the lime-plaster, forming calcium carbonate (Ca CO₃) as it dries. The surface suc-

¹⁰⁷ Ling, 1991, p. 199.

¹⁰⁸ Aletti, 1948, 1951; Augusti, 1950, 1961; Berger, 1904; Doxiadis, 1995, 1997; Forbes, 1965; Laurie, 1910; Mora, 1967; Schiavi, 1961.

¹⁰⁹ Aristotle, *De coloribus*; Dioscorides, *Materia medica*; Plutarch, *De glor. Ath. 2*; Seneca, *Epist.* 121, Theophrastus, *De Lap.*, Varro, *Rerum rusticarum libri III, XVII*.

¹¹⁰ Suggested by Winckelmann, Mengs, Wiegmann, J.F. John.

¹¹¹ Suggested by Requeno, Donner von Richter, Gros, Henry.

¹¹² Suggested by Carcani, Letronne, Mau, Gusman.

¹¹³ Suggested by P. Mora. Polyments are natural earths, i.e. fine clays of various colours.

¹¹⁴ Suggested by Eastlake, von Raehlmann, Berger, Laurie.

¹¹⁵ Bordignon, 2000, pp. 14-15.

¹¹⁶ Borrelli, 1980, p. 84.

cessively becomes extremely hard, due to the carbonating process. Any addition of paint, which has been applied upon the dry fresco-painting, may be recognised, since those colours do not integrate with the preparation but remain on the top, appearing slightly in relief.

A secco, means that the painting was made on a dry surface, and consequently a binder had to be added to the pigments, to secure the adhesion of the paint. In case the binder was glue or a gum, the paint is commonly called *tempera*. But *tempera* does not explicitly indicate any specific binder, and there are alternative binders existing. *Milk* (casein) has been used as a binder since Antiquity, and mixed with pigments it becomes a tempera paint. Saponified wax can also be used as binder in tempera paint. Consequently any of the binders mentioned above may occur in tempera. More precisely, the different paints could be further defined as casein tempera, egg tempera or wax tempera etc.

Stucco-lustro means lustrous stucco, and the *stucco-lustro* procedure technically is the same as of Roman mural painting, consisting of smoothening the fine plaster layer in order to compact it and make it lustrous. The difference is that *stucco-lustro* is made with a lime-soap paint, while *fresco* is made without such an addition of soap. Another difference is that the metal tool, which is used as a pressing agent in stucco-lustro, has to be hot, not cold. The lime-soap in the paint helps the tool to gently slide over the surface, and the heat spreads the saponified particles uniformly over the surface. About a year after the decoration has been made, an application of beeswax is commonly applied as a surface protective, or to give the painting a finishing coat.

Polyments are fine clays, natural earths, used in traditional gilding on wood. Based on his personal interpretation of Vitruvius VII, 3, Mora suggested that Roman wall paintings were made with such clays.¹¹⁷ Polyments may probably be used as primers for painting as well, but this suggestion has not been mentioned or considered as relevant by other authors in publications on the subject.

Encausto is a term with several significations. One of these indicate the use of Punic wax as a treatment used to protect specific pigments on Roman murals. In this case, as a surface coating, the appropriate term is *ganosis*. Surface coating with Punic wax is compatible to *fresco-paintings* and to *stucco-lustro* and also to *tempera* painting, since the coating may be applied to any of them. Punic wax may also be used as paint, on wet plaster as well as on dry.

Roman wall paintings generally present a smooth and shiny surface. Such a surface is not indicative for a fresco-painting, but rather for the Roman method of plastering and preparing the wall before painting it. A fresco may have a rather rough structure if painted on a rough surface. Two factors are required to make a smooth and shiny surface. One is to use a very fine-grained plaster for the preparation and the second is to smoothen, or burnish, the plaster carefully with a hard tool, which is possible only on a wet plaster. Fresco painting nowadays is made with special brushes, and there is no reason to believe that those used by Roman artists should have been very different. The bristle of such a brush is long and cylindrically shaped at the end of a long wooden stick. The bristle has the capacity to contain a lot of fluid paint, which makes the brush perfect for painting *al fresco*.

¹¹⁷ Mora, 1967.

It has been calculated that the Roman wall-painter had a little more time to his disposal than the painter nowadays. This was due to the superior thickness of the Roman wall, which could contain more water and remain humid for a longer time than a modern wall preparation. A modern painter has roughly one hour per square metre at his disposal for painting before the wall becomes too dry.¹¹⁸ Since painting has to be done in a short time, a full-size draft, i.e. a cartoon, is normally used in order to facilitate the painting process. It has not been ascertained if artists during the Roman period, like those during the Renaissance and later, used such a cartoon, but it has been suggested.¹¹⁹ Cartoons are quite useful for the outlining of the motif in the decoration, as painting must be quickly executed and there is little room for corrections. Rapid sketches were, however, made in the wet plaster, and either incised or designed with *sinopia*, an ochre pigment.¹²⁰ It has been shown that some kind of method was used for repeating a pattern in the Boscoreale *cubiculum* where the right and left walls are painted in mirror reversal.¹²¹ This could easily have been done with a cartoon. It has been suggested that such drafts were kept and re-used.¹²²

A problem, which occurred in fresco-painting was that some pigments were altering during the carbonating process or when in contact with lime and the carbon in the air. Vitruvius described how the public official, Faberius, found his peristyle black only a month after it was painted with *vermilion*, which would not have happened if he had been more cautious and let the painters protect the surface with an application of Punic wax. He stated that “... *a more discerning person, who wants his vermilion decoration to keep its colour, should, when the wall is well polished and dry, lay on with a stiff brush Pontic (Punic) wax melted in the fire and tempered with a little oil, then bringing an iron pan with glowing coals near to the wall, he must heat both it and the wall and make the wax sweat, and thereafter, to make the surface even, he must rub it with a candle and clean linen cloths, as nude marble statues are treated. This process is called ganosis by the Greeks*”.¹²³

Vitruvius mentions the Punic wax application just for these two treatments, for cinnabar on plastered walls and for statues. In both cases it is used as a coating, forming a protective shield upon the colours. Analyses of samples from murals in St-Rémy-de-Provence have revealed that a thin film of wax had been applied to cinnabar pigments during Antiquity.¹²⁴ At the same excavation part of an excavated wall had to be restored, and while working on it some areas of the red surface were left unprotected. The colour turned black, transformed into meta-cinnabar. Whether Punic wax was used upon other sensitive pigments or not cannot be traced in the descriptions by Vitruvius.

¹¹⁸ Andersen, 1985, p. 114.

¹¹⁹ Andersen, 1985, p. 114.

¹²⁰ Barbet, 1998, p. 105; Clarke, 1991, p. 46; Ling, 1991, p. 203.

¹²¹ Clarke, 1991, p. 46.

¹²² Andersen, 1985, p. 125.

¹²³ Vitruvius, *De architectura*, VII, 9, 3. Translation by Laurie. In the Italian translation referred to by Aletti *Pontic* is translated with *Punic*.

¹²⁴ Barbet, 1998, p. 109.

Roman murals often reveal that paint has been applied after the carbonating process. Flaking paint is obvious on many famous paintings, where detached paint reveals the underlying monochrome paint layer. According to Ling the painted decorations on Roman murals were made in *buon fresco*, but if the surface was dry, the colours could be applied in *fresco secco*, which according to him means “*mixed in a specially prepared solution of lime-water, or with an organic medium which would glue them to the surface (the tempera technique)*”.¹²⁵ But the term *fresco secco* is a contradiction, and what in fact is described is a mixed technique, fresco-painting followed by a tempera with a not defined binder.

Recent analyses of samples from Roman murals show that in many cases these are true frescoes, as a thin skin of calcium carbonate was formed upon the surface, and no traces of colours have been identified upon this kind of layer. Analyses have also revealed that different techniques were used for these murals, showing all kinds of intermediates between fresco and tempera. Occasionally it has been possible to individuate two thin layers, one made *al fresco* and the second paint layer applied when the plaster had already started to dry. In many cases it is evident that the painted decorations are made in several layers, one superimposed on another, which makes it impossible to define these paintings as frescoes. In most cases when tempera paint was applied upon underlying frescoes, the tempera binder is difficult to determine, primarily due to the minimal remains of the binder, caused by the passage of time and to the microscopic size of a sample. Roman murals were, however, often made in a *mixed technique*, starting with painting *al fresco* and successively using another technique upon the half-dry or dry surface.

Bordignon has recently stated the existence of terminological problems. He suggests that expressions such as “*buon fresco*”, “*mezzo fresco*”, “*fresco secco*” and “*lime tempera*” should be avoided when speaking about Roman wall paintings. Instead expressions such as “*painted on a wet preparation*”, “*on a humid or a dry preparation covered with a layer of lime water*”, or “*on a dry surface with a paint consisting of pigments and lime*”, would be to prefer, since these would not create any confusion.¹²⁶

¹²⁵ Ling, 1991, p. 204.

¹²⁶ Bordignon, 2000, p. 14.

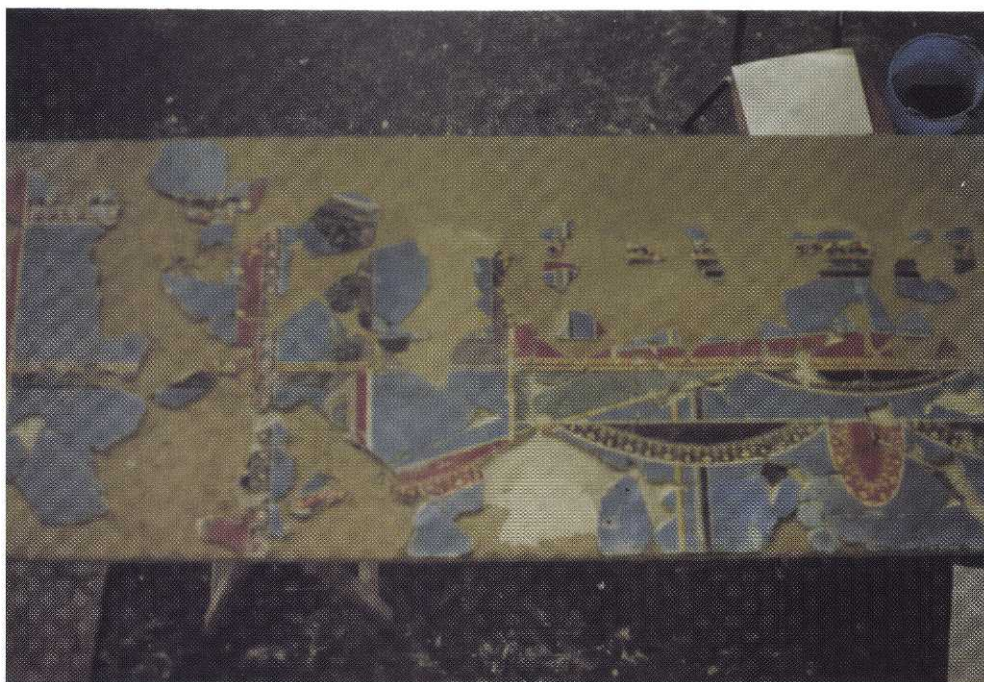


Fig. 13. *Above*: Fragments of a Roman wall painting from the Villa of Livia at Prima Porta. Overlaid paint peeling in some areas.

Fig. 14. *Below*: Fragments of a Roman wall painting. Reassembly and conservation. From the conservation studios at Herculaneum.

Encaustic Painting and Ganosis

In ancient Greece it was a specific profession to be an encaustic painter. This profession is indicated in the payment list from 408 BC at the Erechtheion in Athens, where the sums spent for encaustic paintings were registered.¹²⁷ Building inscriptions in the Temple of Asclepius in Epidaurus reveal that encaustic was used in that building too.¹²⁸ According to Plutarch there were three classes of decorators of marble sculpture; the encaustic painters, the gilders and the tempera painters, also this confirming that encaustic painting was well established in ancient epochs.¹²⁹

According to Pliny, paintings made in encaustic were highly esteemed and consequently paid for with high prices. A painting of Cydias, named *Argonauts*, was paid for with 144.000 sesterzies.¹³⁰ Another painting, made by Timomachus of Bysanz, depicting *Ajax and Medea*, was bought by Caesar for 80 Attic talents, and hung in the Temple of Venus Genitrix in Rome 46 BC. During the period of Augustus, a painting showing a two-horse chariot was inserted into the wall in the Curia at the Forum in Rome. On this painting Nicias had written that he had made it in encaustic.¹³¹ Iaiia of Kyzikos was a famous encaustic painter making portraits, whose paintings were sold at high prices.¹³²

Coloured wax, used for painting, is mentioned not only by Pliny and Vitruvius, but also by Plato,¹³³ Plutarch,¹³⁴ Dioscorides,¹³⁵ and other Graeco-Roman writers.¹³⁶ Seneca described in Epistle 121.5 the working method of an encaustic painter:

“The painter chooses with great speed between his colours which he has placed in front of him in great quantity and variety of hues, in order to portray faithfully the naturalness of a scene, and he goes backwards and forwards with the eyes and with the hands between the waxes and the picture.”¹³⁷

¹²⁷ von Graeve, 1981, p.155; Laurie, 1910, p.56. “...In the inscription from Athens, which records the building of the Erechtheion, occurs the entry of a sum paid to the encaustic painters for having painted the cymation on the epistylum of the interior...”, and further “That the encaustic technique was used at a later date for ceiling decoration seems clear from the statement in Procopius that Justinian, on restoring the Imperial palace, had the ceiling decorated, not with paintings in melted wax, but with mosaic.”

¹²⁸ Büll, 1963, p. 323.

¹²⁹ Aletti, 1951, pp. 5-46.

¹³⁰ Cydias, Greek painter 114-50 BC.

¹³¹ Pollitt, 1995, p. 115.

¹³² Pollitt, 1995, p. 87.

¹³³ Plato, Greek philosopher, 427-347 BC. In *The Republic* he refers to painted statues. See: Aletti 1951, p. 46.

¹³⁴ Plutarch, Greek writer, c. 46-120 AD. Plutarch refers to different statue painters, and writes about the ganosis technique. See: Aletti, p. 46 and Berger p. 239.

¹³⁵ Dioscorides, Greek physician. Writer of a book on medicine.

¹³⁶ Aletti, 1951, pp. 45-46. Aletti presents a long list of ancient authors, among them Sammonico, Varro, Ovidius, Seneca, Stazio and Marziale.

¹³⁷ Doxiadis, 1995, p. 93.

Varro commented on the special metal boxes with compartments for various colours that were used by encaustic painters. A box fitting that description was found in a painter's tomb at the excavations of a Roman villa at S. Médard-des-Prés.¹³⁸

Eusebius, active at the end of the Roman Imperial era, mentioned wax painting in his treatise concerning the life of Emperor Constantine.¹³⁹ Eusebius enjoyed the wax material, and appreciated the variations in light and darkness in the paintings, which he described as rich in colour, and he defined the method as "... a noble one, which will assure an eternal remembrance of the depicted person...". Basilus,¹⁴⁰ made another remark about wax-painting and stated that: "*The wooden panel, the wax and the skill of the artist makes the pictures immortal portraits of mortal beings*".¹⁴¹ One of the last ancient notices about encaustic painting is in the "Mappae Clavicula", a Latin translation of a Greek text.¹⁴² This Medieval written source of painting instructions informs, e.g. that wax paint with or without the addition of fish glue, was used for painting on wood and on parchment, while pure wax was used for paintings on clothe.

Still during the 11th and 12th centuries a wax tempera technique was used, according to information from a handbook in painting by Dionysios from Mount Athos.¹⁴³ Andrea Pisano and other Renaissance artists used a wax mixture called *cera colla* for painted decorations on statues. This was probably a mixture of beeswax, egg and turpentine.¹⁴⁴

Remaining physical evidence of wax-paintings are the Aegypto-Roman Fayum-portraits and some Early Christian icons, most of them dated to between the 6th and 9th centuries AD. At the convent of St. Catherine on Mount Sinai, there was previously a rich collection of such icons, about 2000 items, made of the same size and painted according to the same scheme as the mummy portraits. Other paintings, which may have been painted with wax, were recently discovered at the monastery Deir el-Surian in Wadi Natrun.¹⁴⁵ It has been suggested by the conservators that at least one of these early Coptic wall decorations could have been made in the encaustic technique.¹⁴⁶ The colours appear brilliant and vivid and the surfaces of the paintings have a particular lustre. The paintings stylistically are closer to the Classical tradition than to the Early Christian or Coptic, since the volumes of bodies and movements of figures and cloths are naturalistically painted.

These short notes make evident that encaustic paintings were much appreciated, but also that the wax-painting technique was used for a long period of time.

¹³⁸ Berger, 1904, pp. 211-218, 230-236. According to Berger, Benjamin Fillon described the findings of S. Medard in 1849.

¹³⁹ Eusebius Pamphili, Bishop in Cesarea, 263-339 AD.

¹⁴⁰ Basilus the Great, Bishop in Cesarea, 330-379 AD.

¹⁴¹ Büll, 1963, p. 324.

¹⁴² Ibid, p. 237.

¹⁴³ Dionysios from Mount Athos, 12th century AD. These recipes were written during the 19th century.

¹⁴⁴ Büll, 1963, p. 350.

¹⁴⁵ Deir el-Surian is one of the remaining Coptic monasteries in the Libyan desert.

¹⁴⁶ Innemée, 1996, p. 5.

Three methods of encaustic painting

According to Pliny, there were three methods of encaustic painting.¹⁴⁷ “In ancient times there were two methods of encaustic painting, with wax and on ivory with the *cestrum*, that is with a sharp pointed tool, until it became the custom to paint ships of war. Then the third method was added, that of melting the wax colours with fire and laying them on with a brush.”

This imprecise description of materials and techniques has caused differences in opinion between scholars. Pliny is not concise in the descriptions of materials and tools required for any of the methods, but leaves the door open to speculations. He does not mention the tool used for the first painting method, which he does for the second (*cestrum*) and the third (brush). In another passage, concerning colours which are not suited for lime preparations, he states that “...*Waxes are stained with these same colours for painting encaustic, a kind of painting unsuitable for walls, but commonly used for ships of war, and now also for merchant ships...*”.¹⁴⁸ According to Vitruvius, Punic wax with the addition of a little oil was applied as a surface coating to delicate pigments in order to prevent them from altering.¹⁴⁹ Also Pliny explicitly mentions Punic wax mixed with some oil used for coatings on some colours.¹⁵⁰ These, and other fragmentary descriptions, have been examined as a collection of information, which, related to each other provide an idea about the ancient materials and techniques. Considering the descriptions on the encaustic methods, it seems natural to interpret them as follows: the first method consisted of using coloured and melted wax, the second in the use of coloured and melted wax on ivory which had an incised decoration made with a pointed tool, and the third was Punic wax applied with a brush. It remains, however, to identify the tools used for melted and pigmented wax. Since there is an alternative, the *cauterium*, that tool is in this study considered as the instrument used for melted wax-paint.

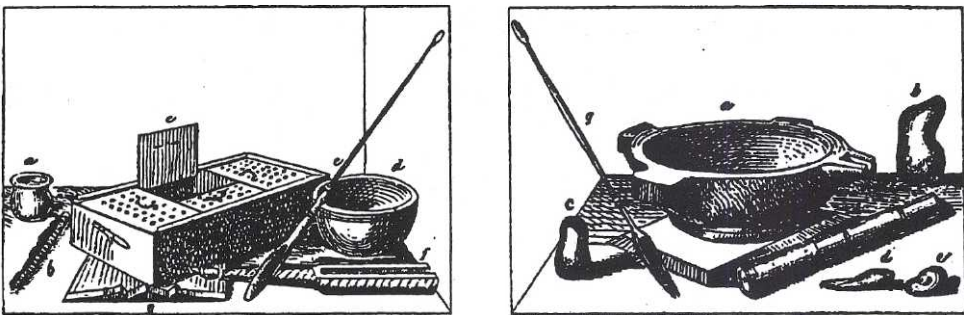


Fig. 15. Tools for encaustic painting. After Berger, 1904.

¹⁴⁷ *Cauterium, cestrum, stylus* are Latin terms for metal tools used for encaustic painting.

¹⁴⁸ Plinius, XXXV, 49.

¹⁴⁹ Vitruvius, VII, 9,3.

¹⁵⁰ Plinius, XXXIII, 40.

The first method signified the use of a *cauterium*, a tool made of metal, probably bronze, shaped as a slender spoon at one end and as a spatula at the other.¹⁵¹ Since tools were handmade in those days, remaining examples are all individually shaped. The spoon-like end of the tool was used for pouring melted wax. Melted wax can be worked for just a short time, as it quickly solidifies. The heated *cauterium* made it possible to pour, work and shape the wax on the painting. It has been assumed that artists generally had at least two tools to work with.¹⁵² Encaustic paintings made this way appear slightly in relief, as can be seen on several Fayum portraits.

The second method was characterised by the use of a *cestrum*, a pointed metal tool used for engraving. Pliny states that the method was used on ivory, and the technique consisted, as far as we can imagine, of engraving patterns on objects of ivory and then filling the lines with melted and coloured wax. This method has been suggested to be the oldest. Homer mentioned an engraving technique used in Asia Minor, which was also used for decorations in Greece.¹⁵³ Fragments of an ivory plate, dated to about 400 BC, have been found in southern Russia. The engraving on that plate was probably made with a *cestrum* and the lines filled with wax.¹⁵⁴ Some plates of bone, or possibly ivory, are shown at the Coptic Museum in Cairo. These small pictures suit very well the descriptions of encaustic painting on ivory. The decorations are engraved and the lines filled with paint, maybe wax paint.

The third method was, according to Pliny, invented for painting ships. He explicitly states that brushes were used.¹⁵⁵ This indicates that the paint was fluid when applied, and remained so during the painting process. It was not so hot as to ruin the brushes. That would necessarily have occurred if melted and hot wax had been applied. The beeswax, consequently, must have been treated in some way in order to remain liquid at a lower temperature. Punic, or saponified, wax can be spread at any normal temperature. In addition, considering the time-consuming work in painting a ship, or even a boat, spreading the paint had to be relatively easy, otherwise such work would not have been done even then. Punic wax, therefore, fits the descriptions as well as the purpose.

The Greek tradition of painting their ships is well documented in art and literature, and was mentioned already by Homer.¹⁵⁶ He refers to ships that had been painted with red or blue colours, and states that such painting was performed in a technique, which had been invented in Asia Minor. Not only were the ships painted, they had decorations as well.

¹⁵¹ Aletti, 1951, pp. 100-101; Berger, 1904, pp. 211-218. By defining the tool "cauterium" both authors are referring to the painter's tomb in St. Médard-des-Près, where such instruments were found. The tomb also contained amphoras with wax, pigments and a box for the encaustic paint.

¹⁵² Büll, 1963, p. 330.

¹⁵³ Ibid, p. 336.

¹⁵⁴ Ibid, p. 384.

¹⁵⁵ Plinius, XXXV, 149.

¹⁵⁶ Büll, 1963, p. 336.



Fig. 16. Portrait of a young girl. Encaustic on wood. NMEg 944. Nationalmuseum, Stockholm.
Fig. 17. Decorated bone plate in the Coptic museum in Cairo. Inv. n. 7065. Encaustic on ivory?

The custom of painting ships with wax must have been in use during the Classic, Hellenistic and Roman periods, since it was still adapted at the end of the Roman Imperial period. Kallixenos recorded the tradition in his book about Alexandria.¹⁵⁷ Kallixenos described how the ship of Ptolemaios Philipator was decorated with wax paintings in many colours. Ships and boats painted in vivid colours are still part of the Mediterranean tradition, although wax colours are probably not used anymore.

Punic wax

Pliny gives a long and quite poetic description about the method of making Punic wax.¹⁵⁸ He describes the yellow beeswax, which changed from solid into liquid through a complex process. It was boiled and bleached and boiled again, and some *nitrum* was added. The product achieved had many qualities, and could be used for medical treatments as well as for the protection of leather or weapons, or for coating white marbles and wall-paintings.

When Punic wax was used as a substance for patination and coating of plastic art, some oil was added. Uncoloured wax was traditionally applied on the unpainted parts of marble statues, partly as a surface protective but also to reduce the striking whiteness of the fresh stone and to give it a warmer hue. The actual painting of the statues was probably made with any tempera.¹⁵⁹ The term *tempera*, as explained above, does not imply that any specific kind of binder is used, but that the pigments are mixed with a binder and the paint is diluted with water.¹⁶⁰ A binder compatible with heat must have been used for the *ganosis* treatment since the final part consisted of heating the surface. The binder, therefore, might have been a gum, a glue or Punic wax.

Just like the term *encaustic*, even *Punic wax* has been a source of disagreements. Some opinions regarding the material aspect are referred to below, while those regarding terms and interpretations are presented in “Terminology”.

The main disagreement concerns the consistency of the product, whether it is hard and solid or if it is a soft emulsion. As mentioned above, some enthusiasts made experiments during the 18th century when Roman wall paintings were discovered at the excavations at Pompeii. Among the encaustic devotees were the French Count de Caylus, who was the first to publish on the subject.¹⁶¹ The Italian abbot, Vincenzo Requeno, was also engaged in the matter and had his “Saggi sul ristabilimento dell’antica arte dei greci e romani pittori” published in 1784. These early experiments were generally quite complex, and a great number of components were often mixed into the beeswax. The main concern seems to have been in trying to discover how to make the substance become and remain fluid and thereby possible to spread without keeping it hot. In one of Requenos descriptions, soap, wax and

¹⁵⁷ Kallixenos, 3rd century AD.

¹⁵⁸ Plinius XXI, 49.

¹⁵⁹ Forbes, 1965; Melucco Vaccaro, 1967; Moorman, 1988; Pratt, 1976; Richter, 1928; von Graeve 1981.

¹⁶⁰ It. *temperare* - mix, *stemperare* - dissolve.

¹⁶¹ Caylus, A.C. Philippe de Tubières, 1692-1765. French art historian who published several volumes on ancient art. The most important is *Mémoires sur la peinture à l’encaustique*, published in 1755.

water are mixed together, and he reported that painting with this emulsion gave excellent results. Very often, however, various resins and solvents were added into the mixtures. The final treatment for many of these early attempts was to heat the painted surface and to rub it when it was cold again, just as described by Vitruvius.

Berger made an emulsion of Punic wax, consisting of beeswax, potash and water.¹⁶² This basic emulsion has been used for various tests by myself, since it was easily made, had a pleasant smell, could be used hot, tepid or cold, and in addition, other components could be mixed into the paste. These tests are described in "Experiments". Schiavi made several tests with the objective of rediscovering the ancient method, which she also claims to have done.¹⁶³ She used *natron* and beeswax in the procedure described by Pliny. When I tested this, it did not work out well. The paint became hard and unusable for painting. Possibly dissolved in some solvent it would function as paint.

The list could be made long, discussing all methods, which have been tested for the purpose of making Punic wax. Some German scholars, among them Eibner and Stois, claimed that Punic wax was not an emulsion but a solid product.¹⁶⁴ They consider it to be an emulsion at one stage, just between the first and the second boiling, but then it becomes hard again, due to the chemicals in seawater. The main achievement of such boiling is, according to them, that the chemical transformation of the wax raises its melting point as it successively becomes harder. Consequently, this wax product must be very hot when spread. A Swedish artist, Göran von Matern, has produced a Punic wax following these guidelines. Since the wax becomes very hard it has to be diluted with turpentine for painting.¹⁶⁵

Lately some experiments have been made by Doxiadis, who divides wax paint into two types - wax to be used hot and wax which can be used cold.¹⁶⁶ Wax to be used cold is defined as Punic wax, which according to Doxiadis, requires emulsification or saponification. A similar definition is made by Kühn, who states that Punic wax is "...a beeswax containing salts of fatty acids (soaps). He refers to the Plinian recommendation of boiling and bleaching the wax with "*some form of soda*", followed by a description of the chemical process which leads to the conversion of the esters and free fatty acids in the beeswax reacting with the soda, converting it to sodium salts, i.e. soaps. The soaps emulsify the beeswax, "*allowing it to mix with water to form a paste*". It seems that the consented opinion in recent research is that Punic wax is an emulsion. Being an emulsion the paint is easily spread with a brush, and can be used for painting as well as for a surface coating, and with final heating, if desired.

¹⁶² Berger, 1904.

¹⁶³ Schiavi, 1961.

¹⁶⁴ Hoppe, 1991, pp. 273-277.

¹⁶⁵ von Matern, personal communication, June 1998.

¹⁶⁶ Doxiadis, 1995, pp. 97-98.

Ganosis and circumlitio

In order to heighten the artistic value, statues were generally painted during Antiquity. Polychrome treatment, *circumlitio*, was the common way of finishing the work on a statue. The famous painter in Classical Greece, Nicias, was employed by Praxiteles to make the *circumlitio* on his statues.¹⁶⁷ Traces of polychromy have been found on several statues, and the pigments identified are primarily carbon black and earth pigments, such as yellow and red ochre's, but blue and green colours, achieved by copper glazes, azurite and malachite, have been identified as well. Bright red generally was cinnabar. Some parts on the statues were particularly accentuated, such as eyes, lips and hair. Plato explained that the works of a stone-carver received their full effect when they were finally painted.¹⁶⁸

Binders are generally difficult to identify, since their original quantity in the paint is very limited. As time passes, they are mostly decomposed and worn off. This fact, combined with the relatively small areas of thin paint, which remain on the objects, makes sampling difficult. Mostly, only samples of microscopical size can be removed, but even if enough paint would be provided, a trustworthy result would not necessarily be achieved, due to the presence of other substances on the painted surface. Such additional materials might consist of dirt or previous surface applications.

If the binder is a wax, its presence is easily determined by FTIR, for example. But also in this case a later surface application of wax may not be excluded, and such an application might be wrongly interpreted as a binder. In order to make an absolutely reliable determination it would be necessary to take samples from objects that have not been cleaned or exposed to any surface protective after excavation.

Pliny described how Greek artists used *Punic wax* to give the marble statues a protective coating, and that this had the double function of being a protective as well as giving a coat of patina. The substance was diluted with some oil and then spread on the marble surface with a stiff brush. When the surface had dried it was heated in order to melt the wax. In this process a shield of wax was formed, which protected the pigments and made them adhere to the stone.

As the surface again was cooled and dry, it was rubbed with a cloth, and the surface of the stone became shiny. According to Pliny, this process was called *ganosis*.¹⁶⁹ Plutarch described the tradition of impregnating statues with wax after they had been gilded or painted.¹⁷⁰ The term *circumlitio* indicates that statues were painted in order to receive their final polychrome appearance. *Circumlitio* also indicates that the statue, after performed treatment, had received a protective shield. It therefore seems natural to assume that *circumlitio* may have been performed with Punic wax in the *ganosis* process.

¹⁶⁷ Büll, p. 56.

¹⁶⁸ Büll, 1963, p. 360.

¹⁶⁹ Plinius, NH XXXV, 49, XXXV, 149.

¹⁷⁰ Büll 1963, p. 360.



Fig. 18. Polychromy on Roman statues.

To the left: Statue of a woman, probably a fountain figure. Traces of a red-brown colour still remain in the hair, yellow and light blue on the dress, with edging in dark red. Inv. 105, Museo delle Terme, Roma.

To the right: Marble head with traces of red-brown paint on the hair, black outlining of the eyes and eyebrows, bright red on her lips. The head may be a portrait of a Ptolemaean queen. Inv. 3908, Graeco-Roman Museum, Alexandria.

Discussion

Building constructions and objects of art and handicraft, which have remained since Antiquity, provide us with observable evidence of ancient technology. By studying these objects, we may identify the materials, which they were made of, and define the techniques, which were used for their production. Paint, and its components pigments and binders, was described by ancient writers, just as were painting preparations and coatings, applied to protect the painted surfaces from a rapid decay. In modern publications on the conservation of ancient materials and the corresponding techniques, often consisting of research reports, these ancient descriptions are generally confirmed. Pigments have been given a particular interest as research objects, and the list of publications concerning the identification of pigments might be made very long.

Nowadays there is a considerable knowledge of the materials and techniques used by the ancients. Some artists' materials, such as beeswax, can be traced back to Dynastic times in Ancient Egypt, while earth pigments were used earlier than 3000 BC. Painting preparations made of lime or gypsum is dated to the same early periods.

Beeswax, as paint and as a surface coating, has been at focus in this dissertation. Issues concerning the composition of such materials, the necessity of heat, the tools required and the sizes of encaustic paintings have been examined, just as the characteristics of Punic wax and its connection to *ganosis*, applied on marble statues as well as on plastered walls, which leads to the issues of the paints and coatings used on Roman wall paintings. The conclusions regarding the material aspects are presented below, at first considering the encaustic techniques and then Roman wall painting.

Literary evidence as well as remaining objects and chemical-technical analyses proves that encaustic painting was one of the painting techniques used during Antiquity. Wax paints were either made of melted and pigmented natural beeswax or by saponified beeswax, i.e. Punic wax. Both kinds of mixtures are paints, but the differences are striking, not least of all regarding the applicability and solubility. For the sake of simplicity, below they are called wax paint and Punic wax paint. The latter could just as well be named wax tempera, since the paint is dissolved in water, but becomes hard when the paint has dried. Wax paint was used to fill the decorations engraved on ivory, to paint *pinakes*, e.g. the Fayum portraits, and for architectural decorations. Punic wax was mainly used for surface coatings on statues and on plastered walls, but also for painting.

Undisputed remaining evidence of these materials and techniques consist of engraved decorations on ivory or bone and the Fayum portraits, which are excellent examples of portraits painted with wax paint as well as with Punic wax paint. Beeswax, probably Punic wax, has also been identified on Roman wall paintings, as a coating and as paint. In addition, there are tombstones, e.g. the stelae of Demetrias, which have been regarded as encaustic paintings.

Heat

Several opinions have been expressed on the subject regarding the necessity of heat in connection to encaustic. Questions such as if the supporting material should be heated before, during and/or after painting have been ventilated. Another set of questions regard the paint, whether heat was needed to melt the beeswax when making the paint, if the paint should be kept hot during application, and/or if the paint should be heated when the painting was finished. These questions in particular concern Punic wax, and its characteristics. Minor issues are e.g. encaustic painting being a slow technique. In my opinion, no craftsman wants to complicate things more than necessary, and consequently the materials are used in the most suitable manner, considering their nature.

Wax paint is fluid only when it is hot, and therefore heat was used to melt the wax when the pigments were added, just as it had to be melted and hot when the engraved lines on ivory were filled. The ivory would preferably have been warm too, in order to facilitate the perfect penetration of the wax paint into the lines. The object could, if desired, be heated as a final procedure, to remove any superfluous paint, surrounding the decoration, but that would not be necessary, since the wax on the surface could easily be scraped or rubbed off, just leaving the coloured decorations in the incised lines.

It was stated by Pliny that encaustic was a slow technique, used for small paintings. This engraving technique was, of course, time-consuming and used only for small-sized objects. Portraits, and other decorations made on wooden panels, could obviously not be painted in the same way as the ivory decorations were, even though the same kind of paint was used. Paint was used for filling lines in the first case, while in the second case the paint was intended to remain upon the surface of the panel. It would, consequently, not have been advisable to heat the finished painting, since such treatment would most certainly result in a melted painting and heating would probably, in addition, provoke changes within the wood. Some scholars have believed, however, that encaustic paintings should be heated as a final treatment. Wax paint on Fayum portraits in many cases was heated to consolidate the material at the time of excavation, and effects of overheating have frequently been noted. This, unfortunately, shows that final heating is not compatible to encaustic paintings made with wax paint on panels.

Encaustic paintings such as the Fayum portraits were made with hot, and consequently fluid paint, which was worked with hard tools to finish the painting. Such tools were made of metal, and could be used to scrape off superfluous paint, or used to pour additional hot paint on the painting. The same tools could, in addition, be heated and used to shape the paint already applied. Marks upon the surfaces of the encaustic Fayum portraits suggest such a procedure.

Punic wax was used for painting and as a surface coating on mural paintings and marble. It was applied with a brush and, therefore, a rather fluid substance, otherwise the application would have been complicated. Some scholars claim that Punic wax was solid and should be applied in a very hot state. These scholars refer to the same ancient sources as this author, but interpret the texts in a different way. There are some problems with a solid product, especially if this product is harder than natural beeswax, and its melting point is higher. Extreme heat would be needed to melt

the paint. The process of keeping the substance hot and the supporting material warm enough not to cause a rapid solidification would be extremely time-consuming and difficult. One possible alternative to heating is a solvent, e.g. turpentine, which might soften the hard wax and make it spreadable with a brush. Such a method is not mentioned in any ancient sources. Solvents evaporate and do not show when examined in chemical-technical analyses, and therefore it is not possible to prove if solvents were used.

Saponified wax, or Punic wax, may be diluted in water and applied whether it is hot or cold, which is convenient when large areas have to be painted. When applied on a wall or on a statue, it could easily be heated as described by Vitruvius. This final heating would not burn the marble or the plaster preparation, it would simply “burn it in”, i.e. melt the thin layer of wax and make it, to some extent, penetrate the surface.

Consequently, there was not one method only, but three, as mentioned by Pliny. Wax paint was heated when it was made and when it was used. Supporting materials such as bone or metal might have been heated, if the decoration was incised, and probably were warm but not hot, when used for painting. Wooden panels were not heated. Encaustic paintings made with wax paint were not heated when the colour had dried. Punic wax was heated when it was boiled, and the painting, or coating was sometimes heated when the surface was dry.

Dimensions

Encaustic paintings made with wax paint and a *cauterium* must necessarily have their limits in dimensions, depending on the properties of wax. The reasons for such limits are at least two. First of all, the melted and hot wax has to be used on a more or less horizontal surface, or there would be difficulties in controlling the fluid substance, which, by nature, would slip downwards, especially if the support was warm. If, on the other hand the supporting material was cold, the wax would solidify quickly. Therefore, the supporting material should at least have a temperature of 20-30° C. Wax quickly returns to its normal, solid state, and the paint can be worked with hot or cold tools on small size horizontally kept encaustic paintings. The size could not be more extended than the area possible to reach with human arms, which, on a painting put in a horizontal position is definitely much smaller than the space within reach on a vertical area. Therefore, this technique must be considered as a slow one, and only used for small-sized paintings, just as described by Pliny.

Punic wax, on the other hand, might be used on horizontal as well as on vertical areas, and without any limitation of the size, since the substance was applied with a brush, and the temperature of the paint and of the support was of minor importance. According to Pliny, the third encaustic method was invented for painting ships, and such work would be possible with saponified wax. The conclusion must be that the first two encaustic methods were slow methods, used for small paintings, while the third method was not necessarily slow and might be used on small as well as on large areas.

Ganosis

The *ganosis* procedure may be briefly described as an application of Punic wax on wall-paintings or statues, a treatment concluded with a final heating of the surface. Some oil was mixed into the Punic wax, probably to make it more fluid and to harden the coating, thereby making it form a protective shield upon the supporting material. Surplus oil on the surface was disposed of by heating it and making it "sweat", penetrating into the marble. Heat might also have had the effect of accelerating the chemical process, thus making the wax harden, and lose its rather sticky nature, more rapidly. Wax, which has been applied to a surface and thereafter heated, reaches a higher melting point than raw beeswax. The oil, which was used for this purpose, is not mentioned by Pliny or by Vitruvius, but it may have been olive oil, since that was used for many purposes. Heating was, in ancient times, made by bringing a box containing glowing charcoal close to the surface, but today there are other heating methods available, e.g. by using a hairdryer or a hot-air pistol.

Ganosis on wall-paintings

Some pigments have to be encapsulated in wax in order to remain unaltered when they are used for painting on wet lime-plaster. Already during Antiquity, some of these pigments were known to alter, e.g. *vermilion*, *caeruleum* and *cerussa*. They were not suitable for fresco-paintings, since they became dark by oxidation in the carbonisation process. Vitruvius, to avoid such a transformation, suggested an application of Punic wax. He described what happened in the house of Faberius at the Palatine, when all the walls of the peristyle had been decorated with *vermilion*. Faberius saw them change and darken, and that would not have happened if they had been coated with wax, according to Vitruvius.

Beeswax protects some delicate pigments, and in addition the surface becomes quite resistant to water, as wax has excellent water repellent properties and closes out humidity. This quality makes wax suitable to use for paintings in humid rooms, where the vapour will remain on the surface. Even though wax is water repellent it permits the painted material to breathe, and does not close its pores.

Ganosis on marble

The *ganosis* process as a surface coating on marble has been studied and discussed by some scholars. Experiments following the descriptions given by Pliny and Vitruvius were the starting-point for experiments made by Richter and a group of co-workers. The results documented were considered as satisfactory or even excellent. Since the *ganosis* method is well documented in ancient scripts, there is no need to question its existence. Wax mixtures were used as coatings on statues not only during Antiquity, but also through the Medieval and the Renaissance periods, until quite recently, when modern chemicals have substituted these ancient materials.

Ganosis and circumlitio

Polychromy on three-dimensional art was part of the classical tradition. In ancient literature there are some remarks concerning the painting of statues. Polychrome treatment, *circumlitio*, was the common way of concluding the work on a statue, and it was made in order to heighten the artistic value. Some parts of the statues were particularly accentuated, such as eyes, lips and hair.

Traces of polychromy have been found on several objects, and consequently the pigments are well known. The binders used are hardly known at all, and the issues concerning binders are still under debate. It is generally assumed that tempera paint was the usual medium for plastic art. The term *tempera*, as explained before, does not imply that any specific kind of binder is used, but that the pigments are mixed with a binder and the paint diluted with water. Since the colours disappear easily if exposed to rain, wind and sunshine, the problem with fading colour was solved by a protective application of *Punic wax*.

The coating made with Punic wax, was also a means for patination. The substance was spread on the marble, and when the surface had dried, it was heated in order to melt the wax. In this process a shield of wax was formed, which protected the pigments and fixed them to the stone. As the surface again was cooled and dry, it was rubbed with a cloth, resulting in a shiny appearance.

The term *tempera* does not reveal the binder, and the term *circumlitio* is equally indistinct. It seems solely to indicate that statues were painted in order to receive their final polychrome appearance, and that the statue, after this treatment, had received a protective shield. It therefore seems natural to assume that *circumlitio* was performed in the *ganosis* process. Punic wax was used as a surface coating to maintain the painted details, and it may have been used as binder in the paint as well. Just by mixing the desired pigments into the Punic wax, a mixture suited for patination as well as for painting could be achieved. In addition, this substance did not need any additive protective coating, at least not for an initial period of time.

TERMINOLOGY

Terms, Translations and Interpretations, Pliny on Punic Wax and Comments Discussion

Terms and conceptions regarding *encausto*, *ganosis* and *Punic wax* are briefly examined in this chapter. The important passages by Pliny¹ and Vitruvius² concerning encaustic painting, *ganosis* and how to prepare a wall for painting have been studied. Plinian texts on the subject in Latin and the translations in Italian, English and German were studied.³ Vitruvius VII, 3, on how to prepare a wall for painting; the Latin texts and English, Italian and German translations respectively have been compared.⁴ Vitruvius VII, 9, 3, on how to prevent vermilion from altering; Laurie (1910), Aletti (1951) and Fensterbusch (1964). Pliny's description of the method of making Punic wax is related, and commented on.⁵

Personal reflections of the author upon the interaction between the actual use and meaning of terms and techniques are described, since those constitute the basis for this argument. Already at the beginning of this study, existing unclarities concerning terms and conceptions related to *encausto* became apparent. Consequently, one of the initial concerns was to search for the reasons for such obscurities. One initial assumption was that the existing disparity in definitions of materials or techniques might be terminological unclarities due to some ancient and later authors' lacking knowledge about materials. The intention in this chapter, therefore, is primarily to discuss relevant terms and conceptions in order to see which are the relevant factors that define the encaustic techniques and *ganosis*, and to make a suggestion on what might have been intended with Punic wax, as well as making some proposals for an adequate vocabulary.

It is reasonable to assume that these linguistic and terminological problems are caused by a) incoherences in translations and transcriptions from Latin, b) various successive interpretations of these translations, and c) a general lack of knowledge about materials among translators and interpreters. By identifying these problems, it was possible to create a systematic working-plan, which allowed looking into the background and development of each specific problem. No problem is an isolated issue since there are, of course, interactions between these perspectives, making a linguistic problem also part of the technical sphere. The quality of original scripts and of later transcriptions has to be considered. From there originates, not only our theoretical knowledge but also the uncertainties and questions regarding ancient polychrome art and painting in general, and encaustic painting in particular. Most often, only a few lines are quoted from the documents mentioned above, and this

¹ NH XXXV, 149, NH XXXV, 122, NH XXXV, 49, and NH XXXIII, 40.

² De architectura VII, 9, 3, and De architectura VII, 3.

³ Ferri, 1960, Laurie, 1910, Berger, 1904.

⁴ Laurie, 1910, pp. 72-77; Aletti, 1951, pp. 55-56; Mora, 1967, pp. 73-84; Fensterbusch, 1964, pp. 322-326.

⁵ The English version by Laurie.

absence of more complete information can, at times, be rather unsatisfactory, at least for a non-expert in Classical Greek and Latin as this author.⁶ Somehow problems seem easier to understand and react to, if they are presented as a whole, and not only in minor details. When examining each of the main problems, it becomes apparent that there are obscurities connected with the original documents, either in the form of inadequate transcriptions,⁷ or as a result of inaccurate translations.⁸ The fact that there are variations in transcriptions and translations often leaves the door open to speculation.⁹ Consequently, it seems even more important to read, not just a sentence but also an entire passage, since possible unclarities in the sentence may be satisfactorily explained later on.

It has not been my intention to give a full presentation of these problems, but merely to point them out. Most problems of terminological nature are connected to the very vital terms in this context, *encausto*, *kausis*, *ganosis*, and *cera punica* (Punic wax), but also the terms *politionibus* and *politiones* used by Vitruvius are not clearly defined. Existing obscurities have at times led to some amazing assumptions and conclusions.¹⁰ To begin with, *encausto* and some of its ordinary forms will be given some attention, continuing with *ganosis*, *cera punica* and various forms of *politio*, concluding some comments on *natron*. Pliny's description of Punic wax is then related and commented upon.

⁶ In order to have an expert opinion on Classical Greek terminology, Ove Strid, Ph. D. in Greek, at the Institution of Classical languages, Stockholm University, was consulted for advice. The Greek writer living in Sweden, Theodor Kallifatides, was asked about the conceptions behind some Greek terms. For help with interpretations of Latin terms, Hans Aili, Ph. D. in Latin at the Institution for Classical languages at Stockholm University and Göran Bäärnhielm Ph. D. at the Royal Library in Stockholm were contacted. All parties kindly gave their opinions on the questions asked.

⁷ There are many examples of errors in transcriptions. In later surviving Pliny manuscripts one of the transcriptions that caused much confusion is the one speaking of "nudo" (bare) instead of "udo" (damp). Forbes, p. 253. Pliny has been accused by many authors of not being correct, either in citing Vitruvius or just by not being precise. One example of the first kind is the following: "Pliny evidently copied some of his facts from Vitruvius, and in many cases copied inaccurately." Laurie, p. 17. Another example concerns the passage where Pliny describes how to make Punic wax, where he uses the word "nitrum", which according to some scholars should be replaced by "natron", a product suitable for many purposes including making Punic wax.

⁸ Translations differ to some degree, and when the basic Latin manuscripts vary, the translations must obviously vary too. In some cases it has been suggested that a specific word at some specific time has been changed into another. For example the word "cauterium" in Plinius description of the three methods of encaustic painting has, by somebody's mistake been changed to the word "cera", according to some scholars.

⁹ One example of bad communication can be observed in Pliny's explanation of the three methods of encaustic painting. He does not connect any tool with the first method as he does with the second (stylus) and the third (brush). It has been suggested that the tool connected with the first method should be "cauterium", since he refers to it as a tool for encaustic painting in the Index for book XXXV. The inconsistency has caused polemics, but most authors seem to be of the opinion that the cauterium, stylus and brush are the tools for the three different techniques of encaustic painting.

¹⁰ Much has been said about the technique of the Pompeian wall-paintings, and it has been suggested that they are encaustic (Schiavi, 1961), that they are in stucco lustro (Berger, 1904), the result of a specific polymer-lime technique (Mora, 1967) and that they could have been painted with a mixture of Punic wax and lime (Augusti, 1950). The same kind of chemical analyses are presented as evidences for these different theories.

Terms, translations and interpretations

Encausto

The meaning of *encausto* is philologically very simple and clear. The term in its different forms, concerns the “burning in” or heating the paint, which has been applied to a surface, creating encaustic paintings. This signifies that the only paintings which should be correctly defined as encaustic, based on a linguistic judgement, are those which actually have been “burned in”, i.e. heated by glowing charcoal or any other kind of heat, intense enough to melt the wax upon the surface.

In some 19th and 20th century publications the term *encausto* was often followed by a translation in Greek, in any grammatical form, and of course, written with Greek letters. For a person lacking knowledge in Classical Greek, it seemed rather strange that one word could have so many ways of appearing in Greek, until it became clear that the Latin word was not always translated with the corresponding Greek word. In summary, the following translations and interpretations are generally accepted nowadays:

Encausto is a Latinized form of the Greek term *enkaustos*, meaning “burned in”.

Enkausis is the substantive form, meaning “burning in”.

Enkaustai and *enkaustes* are plural and singular forms of the word, signifying “someone who is burning in (something)”, or a “creator of encaustic paintings”.

Enkaio, *enekaen*, *enekaiein*, are different forms of the same verb, meaning, “I am burning in”, “to burn in”, or “to paint with colours which are burned into the surface”.

Enkaumasi, *enkauma*, means “that which has been burned in”, “brand mark”, or a “painting, which has been burned in”.

Kausis is a feminine substantive form, meaning “burning” (of something).

Ganosis

Ganosis comes from a Greek verb, signifying “making lustrous”, “polishing”, or “glazing”. It can also signify “to tin”. Generally it is used to describe the process of surface coating on marble statues with Punic wax, but occasionally this treatment is, as stated above, called *encausto*. To add some more confusion there have been suggestions that *ganosis* should be used exclusively in referring to the treatment of marble statues and not be used for the same kind of protective treatment on murals.¹¹ Vitruvius, on the other hand, uses the word when describing how to treat certain pigments on plastered walls, followed by the remark “as nude marble statues are treat-

¹¹ Cagianio de Azevedo (1952) proposes a terminology for mural painting that one could agree on, or at least discuss, and one of the proposals is that *ganosis* should be used when referring to sculpture and *kausis* would be the correct word for the same treatment on murals.

ed. This process is called *ganosis* by the Greeks".¹² As far as I can understand the term refers to the treatment as such, not to the underlying material. In order to have an additional view on the meaning of *encausto*, *kausis* and *ganosis*, Theodor Kallifatides was asked to give his opinion, and his answers to my questions were the following:

Encausto is the adjective, indicating that something is "burned" or "burned in".

Kausis indicates, generally, that something is "burned in".

Ganosis is the method, the technical process that is possible to control.

According to Kallifatides, the terms *ganosis* and *kausis* cannot be used in place of each other, since they refer to different things. As mentioned before, Michelangelo Cagiano de Azevedo has proposed a commonly accepted terminology for painting techniques, as he finds the existing one very unsatisfactory.¹³ In that context his own definition of what characterises *encausto*, *kausis* and *ganosis* is the following:

Encausto is the definition of a painting, which has been made with a paint consisting of pigments mixed into beeswax. The term *encausto* may not be used if the wax is spread upon some previously applied paint, then functioning instead like a varnish.

Kausis is the correct word for the protective treatment or varnishing with wax when the procedure is made on any kind of painting, including on architectural elements.

Ganosis is the same protective treatment upon statues of marble.

There is a great difference between the philological facts and the statements by de Azevedo. This becomes important since he aimed at a correct vocabulary, and suggested an adequate use of terms. de Azevedo's idea of *encausto* is not based on the ancient conception, meaning the "burning in" of paint, but refers to a technique, which ought to be called *wax painting*. On the other hand, terms are given new significance as time passes, and in modern terminology *encausto* is generally understood as synonymous to *wax-painting*. We, therefore, have to consider that the initial concept of the term is not equal to later and recent conceptions.

The suggestion that *kausis* and *ganosis* should be used on different occasions for the same treatment is a personal opinion of de Azevedo. There are no philological or technical reasons to make such a differentiation, as can be seen from the previous discussion. If such a division was accorded, terminology would not be clearer, but rather more confused. The word *encausto* signifies that something has been "burned in", and since the word, traditionally, has been connected to wax paintings, one might claim that the word simply means paintings on which paint or wax has been burned into the surface. To be correct, from a linguistic point of view, the main focus is "burned in", not wax. If one accepts this argument it would be natural to claim that paintings made of heated and melted wax are not encaustic, but simply

¹² De Architectura VII. 9.3.

¹³ Cagiano de Azevedo, 1952, pp. 145-153.

wax paintings, unless the paint has become “burned into” the surface. This implies that a group of the famous Fayum portraits, constantly referred to as *encaustic* portraits, should rather be called *wax-paintings*. Nothing would really be won by making a demand for a change of terms, and therefore the present use of *encausto* signifying painting made with wax paint should be accepted, even though it is not correct, philologically speaking. The important aspect is to be aware of the actual meaning of terms, and when needed, to be able to explain exactly what is meant. Spoken languages are constantly changing, and that has to be kept in mind.

On a terminological basis, a much later mural technique, the *stucco lustro*, could be considered as (ancient) *encausto*, according to the initial definition, “burning in”, since the colours are really “burned into” the surface with hot iron tools. This comment is not, however, a proposal to rename *stucco lustro*, a well-defined painting method, which for technical reasons, appears to be closer to the Classical Greek conception of *encausto* than are the encaustic Fayum portraits made during the Roman Imperial period.

Punic wax

Punic wax is a concept that does not present any difficulty in understanding from a philological point of view. It means wax of Punic origin. One might presume that either the wax, or any important component of the mixture, originated from explicitly Carthage or, maybe, any country along the Mediterranean south coast. Traditionally the *natron* salt, one of the constituents in Punic wax, was collected at the salt lakes in Egypt.¹⁴ The question if *punica* specifically signified Punic Carthage or if the word indicated any country along the Mediterranean south coast is not mentioned by Pliny or any other ancient writer, and therefore an explicit answer is not possible to provide.

The only terminological confusion about Punic wax is connected to the description in Lauries translation of Book VII by Vitruvius, where he calls it Pontic wax. This has, however, not had any vital influence on the discussions, but is occasionally mentioned. In the later translation by Fensterbusch, the term is Punic, and Punic wax is the accepted denomination. The term *ganosis*, therefore, is the proper word for any surface coating with Punic wax.

Politiones

A few more words of vital interest in this context have to be explained, and those are *politiones*, *politionem*, *politionibus*, *expolitiones*, *expolitionem* and *expolitionibus*. Vitruvius in *De Architectura* uses these different forms of the Latin word *politio*. The reason why interest is given to these terms in this study is due to the sug-

¹⁴ Natron, trona. $\text{Na}_3 (\text{HCO}_3) (\text{CO}_3) \cdot 2 \text{H}_2\text{O}$.

gestion made by Paolo Mora, that the final layer on Roman murals was made of a polyment.¹⁵ He has also claimed that Roman mural paintings were entirely made by such polyments. As an argument Mora refers to Vitruvius, who uses the Latin words *politionibus* or *politiones* when describing the preparation of the last coating for mural painting.¹⁶ The interpretation by Mora seems to be unique. In all other documents studied, those words have, in their different grammatical forms, been translated and interpreted as connected to the plastering process. Most frequently, *politiones* is translated with the word *smoothing*, while other terms are *lustrous* and *shiny*. Vitruvius uses the term *politiones* when describing the plastering of walls, explaining how to beat and rub the walls to make them hard and shiny. Professor Mora and his students have performed experiments with this polyment technique at the ICR, and the results show, according to information I have received from a former student, a great resemblance to ancient Roman wall paintings.¹⁷

Politionibus, politiones etc. signifies *smoothing*. The words are used 15 times by Vitruvius in *De Architectura*, and appear, not only to signify smoothing or polishing, but also plastering. Only in one case is the word *politionem* used in a way, which is not quite clear.¹⁸ In this passage Vitruvius describes the natural pigments that are taken from the earth, and he tells how the Greeks happened to find a yellow ochre in the silver mines in Athens, a pigment which they valued as much as if it had been silver. But even in this passage it is not possible to claim that he distinctly means that these earth pigments were *polyments*. They might have been, as we know that *polyments* are natural earths. According to Bäärnhelm nothing in the Vitruvian text indicates that a specific type of preparation was intended, but the words are used in general terms, signifying smooth, smoothing and referring in general to the plastering process.

The clay, called *polyment*, in Italian *bolo*, in Swedish and some other languages called *polyment*, is a very fine natural clay, which is commonly used by gilders as a preparation for gilding with gold foils. The clays exist in different hues, like yellow, red, green, brown and black. Used in an adequate way, they are easily polished by using a piece of agate or marble, which makes the surface become very smooth, hard and lustrous. The distinction between earth, ochre, polyment and clay is rather subtle. Red ochre is a red earth. A red earth may be a clay called polyment. All clays are not polyments, and neither are all red ochre's polyments. Polyments and ochres are natural earths of various compositions and pigmented by various minerals. Polyments are not equal to pigments or vice versa. A polyment may be used as a foundation colour in a wall painting, just as suggested by Mora. It may also be used for the same purpose on a wooden panel.

¹⁵ Mora, 1967, pp. 63-68.

¹⁶ The terms are used 15 times; 14 of them in book VII, once in book VI.

¹⁷ Conservator Cecilia Malm. Personal communication, Rome 1995.

¹⁸ Vitruvius, VII.7.2.

Natron

The term *natron* is, as mentioned above, another term with great significance in this context. Pliny states that Punic wax was made of beeswax and water from the sea, i.e. salt water with the addition of some *nitro*. *Nitro* is a form of the Latin word *Nitrum*, in Greek called *Natron*, and in English chemical terminology it is called *Trona*.¹⁹ Many speculations have been made in trying to explain the word *nitro* in the Plinian text. It has been translated to “nitro and soda” by Ferri in his Italian translation with comments. This translation has created some problems, regarding the nature of *nitro*. It should be sprayed upon the wax while it is boiling in water, a comment that seems rather strange.²⁰ It has also been suggested by Elena Schiavi that *nitro* was a poor translation of the word *natron*.²¹ She claims to have identified, with the assistance of a chemist, the originally intended chemical, which is not an improper claim to make, since the terms refer to the same salt. Terminologically both words mean soda. Chemically there is a difference between the impure double salt, *natron* and the purified product, *soda*.

Schiavi describes how Punic wax became a perfect paint when *natron*, which she had brought from Egypt, was used instead of ordinary sodium carbonate.²² This might lead to the assumption that the natural salt *natron* contains impurities, which could be of great importance in this case. *Natron* is a double salt, which can be found in salt lakes, for example in Wadi Natrun in the Libyan desert, a lake named after the *natron* salt. This district had a well-established trade of salt already during the Pharaonic dynasties. Therefore it may be assumed that the salt used for making Punic wax came from Wadi Natrun. There are, however, other salt lakes in Egypt, and maybe also in Tunisia and other North African countries. Whether or not these lakes or other possibly existing lakes contain the same kind of *natron* salt as that found in Wadi Natrun has not been investigated, as far as I know.

¹⁹ The double salt Natriumsesqvicarbonate, $\text{Na}_3 (\text{HCO}_3) (\text{CO}_3) \cdot 2\text{H}_2\text{O}$.

²⁰ Piva, 1964, p. 104.

²¹ Schiavi, 1961, pp. 155-158.

²² Schiavi, *Il sale della terra*.

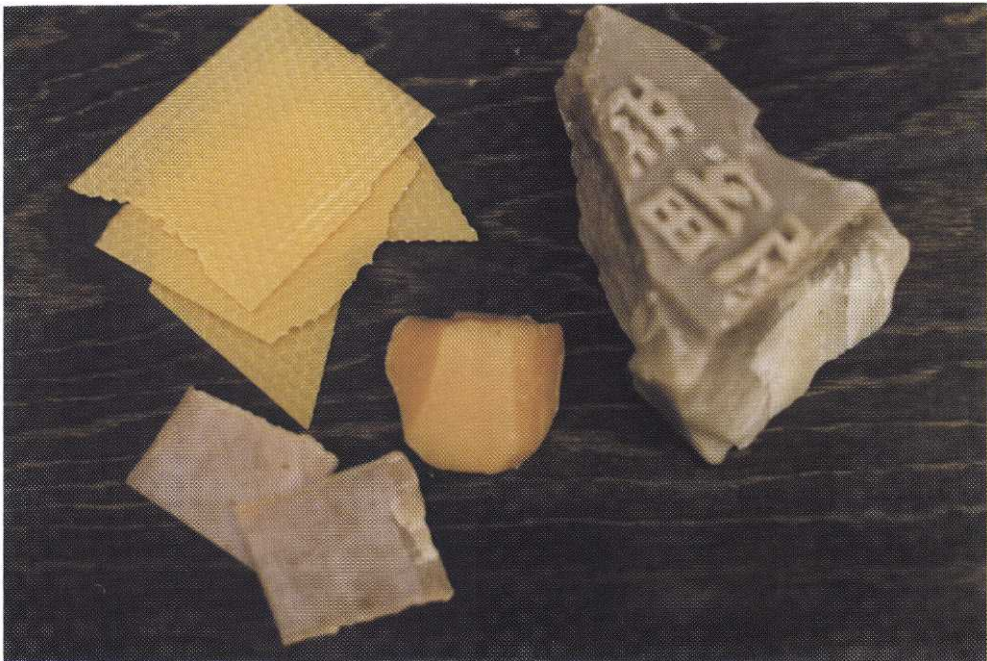


Fig. 19. Honeycombs.

Fig. 20. Beeswax from different manufacturers.

Pliny on Punic wax, with Comments

PLINIUS, NH XXI, 49

Punica fit hoc modo: ventilatur sub diu saepis cera fulva, dein fervet in aqua marina ex alto petita, addito nitro. Inde lingulis hauriunt florem, id est candidissima quaeque, transfunduntque in vas, quod exiguum frigidae habeat, et rursus marina decocunt separatim, dein vas ipsum aut aquam refrigerant. Et cum hoc ter fecere, iunceae crate sub diu siccant sole lunaque. Haec enim candorem facit, sol siccatur, et, ne liquefaciat, protegunt tenui linteo. Candidissima vero fit post insolationem etiamnum recocta. Punica medicinis utilissima. Nigrescit cera addito chartarum cinere, sicut anchusa admixta rubet, variosque in in colores pigmentis trahitur ad reddendas similitudines, et innumeros mortalium usus parietunque etiam et armorum tutelam. Cetera de melle apibusque in natura earum dicta sunt.

*“Punic wax is prepared as follows: Yellow wax is exposed to the outside air for some time, then boiled in sea-water taken from the open sea, with nitrum added. Then the flower, that is, the whitest part, is skimmed off and poured into a vessel containing a little cold water. Again it is boiled in seawater by itself, then the vessel, or at least the water, cooled. When this has been done three times the wax is dried in the open air on a mat of rushes in the light of the sun and of the moon. For the latter makes it white, the sun dries it, and lest it should melt it is covered with a thin linen cloth. It will become exceedingly white if it is boiled again after the exposure to the sun. Punic wax is the most useful for medicines. Wax becomes black when papyrus ash is added to it. It becomes red when mixed with alkanet; With pigments it is made to assume various colours in order to represent true likeness of objects. It is useful to men in numberless ways, even serving as protection for walls and weapons”*²³

The wax:

“Yellow wax is exposed to the outside air for some time...”

This phrase indicates a natural beeswax, yellow, because it was not bleached. It seems probable that beeswax in those days was delivered uncleaned, and consequently containing waste products from the bees, otherwise there would be no reason to start with leaving it in the open air for some time. A cleaned wax left outside would become dirty from dust, falling leaves etc, but an uncleaned wax would probably lose some unwanted remains from the bee's production, and in addition become whiter.

The sea water:

“...boiled in sea water...”

This can only be understood as *in salt water* (water containing different chemicals, mainly sodium chloride (NaCl), sodium sulphate (Na₂SO₄·10H₂O), sodium bicarbonate (NaHCO₃), potassium chlorate (KClO₃), magnesium chloride (MgCl₂·6H₂O) and gypsum (CaSO₄·2H₂O).

²³ Laurie, 1910, p. 39. From the edition of Pliny's Natural History edited by Carl Mayhoff in 1906.

“...*Taken from the open sea...*”

This expression may signify salt water without the inclusion of sand or sea fauna. The natural chemical composition of the seawater must be rather the same over large distances, but sand, sea fauna or soil water may be additions to the water in closer contact to the shores. *Taken from the open sea*, therefore, must be interpreted as clean seawater. The seawater intended by Pliny probably was the Mediterranean water, which is rather salt. In seawater there are several chemicals, such as those mentioned above. In laboratory-made, medium salt seawater, the quantities of the most important chemicals are as follows: sodium chloride (table salt) in major quantity (24 g/litre), followed by magnesium chloride (11 g/litre) sodium sulphate (4 g/litre) and calcium sulphate (1.47g/litre). Other chemicals are less than 1 g/litre. Sodium bicarbonate is a minor part, only 0.17 g/litre.²⁴ We do not know if all the chemicals in seawater were important for making the Punic wax, or just the sodium chloride. To verify the importance or non-importance of the different chemicals, experiments have to be made.

Nitrum:

“...*with the addition of some nitrum...*”

The word *nitrum* (Lat.), *natron* (Gr.) and *trona* (Eng.) are referring to the same salt, $\text{Na}_3(\text{HCO}_3)_2 \cdot 2\text{H}_2\text{O}$, a natural double salt containing impurities. *Natron* exists in a natural form in salt lakes. This salt may have been the *nitrum* suggested by Pliny. If, on the other hand, Pliny used the word *nitrum* just to indicate *soda*, then the question is what kind of *soda* he intended. It could mean *natron* but also signify any *saponifying agent*, which might be *soda* or *potash*, as they both are alkaline salts, which react with the beeswax in similar ways. The wax mixture could still be called Punic wax, connecting the product with some kind of North African origin. In order to establish whether or not *natron* was necessary for making Punic wax, experiments need to be performed. It is only in that way the importance of *natron* (*nitrum*) and *nitrum* (*soda*) can be determined.

The boiling:

“*When this has been done three times...*”

This phrase may be interpreted as a double process of cleaning and of transforming the wax. The question is which was the most important factor when boiling the wax. By using seawater a double effect may have been achieved: boiling to clean the natural beeswax and in addition exposing it to a chemical process. Natural beeswax is contaminated when it is collected, containing remains from the bees' production, and it must be boiled before it can be used. This is the way cleaning is still executed by beekeepers. By boiling it three times with *soda* it definitely becomes clean, and in addition rather white, since *soda* also has a bleaching property. By boiling the wax as described, and at repeated times, the chemicals may have accumulated in the beeswax. If that was the intention, the question is whether it was necessary to repeat the boiling treatment, or if a higher concentration of chemicals in only one water would have had the same effect. In order to understand the effect/effects of repeatedly boiling the bees wax in salt-water experiments have to be made. Only in that way can it be determined what is happening and why.

²⁴ Dr. Stig Aleby, personal communication.

The drying and the sunshine:

“*The wax is dried on a mat of rushes in the light of the sun and the moon...*”. This sentence is definitely describing a combined drying and bleaching process, which is further pronounced by the following lines: “*...for the latter makes it white, the sun dries it*”.

Of course Pliny makes a mistake about the moon’s capacity of bleaching the wax, and the quoted line may just be regarded as a poetic description of a real process. The important information is that the boiled wax should be left outdoors, day and night, for some time in order to bleach and dry. By being exposed to the heat in the sun, water will evaporate, leaving dried beeswax, containing only a little water. This process led to the production of a white wax, especially if the wax contained bleaching salts. As water evaporated wax probably achieved quite a solid nature as well.

The cloth:

“*And lest it should melt it is covered by a thin cloth...*”

The content of this statement indicates that wax, even though transformed, and in a more or less solid state, caused by the evaporation of water, might still melt in the sunshine. This means that the melting point of the wax had not changed very much by the previous boilings, but remained approximately the same as the melting point for natural beeswax (about 64° C), or had become lower.

The last boiling:

“*... it will become exceedingly white if you boil it again after exposure to the sun*”

This assertion is further proof for the bleaching of the wax being an important factor. No statement is made about the water for the ultimate boiling, if seawater is still intended or if ordinary drinking water might be used as well. It is not clear either if these words are meant just as a statement or if it is a suggestion. The last lines of the quoted part concern pigments, which could be added for making a paint and also some other ways of using Punic wax, and are, therefore, not commented upon in this context, in which focus is placed on the process of making the white substance called *Punic wax*. The product was consequently achieved by boiling the yellow beeswax in salt water. The exact composition of the water can only be determined by testing the different possibilities and comparing the results with the product described.

Discussion

In modern publications concerning ancient Greek and Roman polychrome art, the *ganosis* method, as described by Pliny and Vitruvius, is commonly referred to as the *encaustic painting technique*, which seems to be an expression both right and wrong at the same time. *Encausto* indicating the process of “burning in”, is an adequate term for the *ganosis* procedure, and so far the concepts are linked together. *Ganosis* however, was not principally a painting method but a technique for surface coating. Furthermore, the encaustic painting techniques were considered to have been three already during the Roman era. Consequently, encaustic is not one, but several, techniques. At least one of these, the first method, was not compatible with heat. Examples of paintings made in that technique are some of the Fayum portraits, which have a surface appearing slightly in relief. Such relief texture would not remain if the painting had been heated. Nowadays the term *encaustic* is commonly used to define the pictorial material of these mummy portraits.

It is evident that there is no total reliability as far as the ancient sources are concerned. This is partially due to the existing inconsistencies of those transcriptions and to the various translations of these ancient scripts. There are later translations than those studied in this context. These have not been related, since the issue was not to make any comparison between, and evaluation of, translations, but just to illustrate the problem. Any presentation of further, updated translations would not eliminate the problem, but probably just add some more examples.

It must be pointed out that Pliny is not quite reliable when discussing the encaustic methods and how to make Punic wax, but he seems to have been reliable as a narrator of events and opinions of his time. This can be inferred from comparisons with other documents of more or less contemporary authors. In some cases he was obviously mistaken, and in such cases he was either relying on ancient beliefs or he did not have accurate information. This may be exemplified by his statements about painting being invented 6000 years before it was introduced in Greece, and bleaching the wax by the sun and the moon.

In the first case, a) we have a more correct calculation of time today, based on additional knowledge and more refined methods of determination. In the second case, b) our understanding of the planets and their impact is different today.

Therefore, Pliny can be regarded as a reliable source as long as he made general observations and descriptions, and in this respect as a sufficiently reliable source for precise information. In some cases he was mistaken about specific facts, and those cases may have consisted of facts of a very precise character, of which he was unaware, or that were not known at all at that time. As far as his descriptions of the methods investigated in this study, one cause of his vagueness may have been, that he had no personal experience of these matters, but narrated them in the way he had understood. Consequently, he must not be understood literally, but rather be accepted as a narrator of facts, as interpreted by himself.

Vitruvius, on the other hand, obviously had a personal, practical knowledge, about how to plaster a wall for painting, and therefore there is no discrepancy

between his description and remaining physical evidence, i.e. Roman wall constructions and preparations. This difference between Pliny and Vitruvius is most probably related to their different professions. Vitruvius, as an architect, had to be aware of building construction, while Pliny, the historian, had a more vague conception about practical details. This does not, however, make Pliny unreliable, since he obviously had a great knowledge of the practices of previous periods as well as of his own time.

Based on the studies, which have led to the considerations mentioned above, and confirmed by the terminological investigation, I have come to some conclusions about the three encaustic methods. The first method consisted of the use of melted beeswax, which was applied, and worked with a hard metal tool, the *cauterium*. For the second method, the same kind of paint was used to fill the engraved lines on hard materials such as ivory. A stylus, or *cestrum*, was used for the engraving. The third method was painting with Punic wax, and for this kind of painting a brush was used. Punic wax was chemically transformed beeswax, which by repeated boilings was cleaned, bleached and saponified.

As far as the terminological issues are concerned, it is obvious that terminology has changed, and that the original conception behind the word *encausto* is not equal to the modern use of the word. Since such evolution is normal and has to be accepted, there is no use in suggesting a return to the ancient conception, and neither to introduce new words, such as *kausis*, which only would bring confusion to terminology. It is therefore suggested that encaustic today should be accepted as a conclusive term, indicating paintings made with wax as the binder. When defining the specific encaustic technique of any object, this definition may be either *painted with melted and pigmented wax*, or *painted with Punic wax*. *Wax tempera* is another adequate word for paintings made with Punic wax, since this kind of paint is diluted with water.

The issue regarding the heating of the paint, or of the painting, is, in my opinion, easily resolved. Paintings made according to the first technique were not, for obvious reasons, heated, since they would melt and be ruined. Paintings made according to the second technique, were probably heated, since one of the objectives was to fill the lines with colour. Paintings made with Punic wax were probably heated, if made on walls, but probably not if they were made on wooden panels, since there would not be any feasible reason for this procedure. This issue is, however, difficult to determine, and the suggestions made are based on personal experiences of paints and preparations.

The terms *natron*, *nitrum* and *nitro* indicate the same impure salt, and consequently these terms are interchangeable. This product is often called soda. There may be chemical differences between *natron* and *soda*, and therefore these words may not substitute one other. In this context, *natron* indicates a natural salt from the Wadi Natrun.

Mora presented the hypothesis that Roman mural paintings were made with natural fine clays. According to him he based this conviction on the statements made by Vitruvius, which have been explained above. Such hypothesis must be rejected, on the following grounds:

- a) the word *politionibus* means smoothing as well as lustre. The word is not equal to later, similar words in other languages, further that
- b) there is a connection between *politionibus* – smoothing, and lustre, which is the effect of smoothing (the Roman wall plaster preparations, but also polyments), and that
- c) *polymēt* is a fine clay used by gilders. Polyments might have been used for Roman wall-painting, but there is no ground for claiming that Vitruvius intended that Roman wall paintings were made with polyments.

ROMAN PAINTING AND POLYCHROME PLASTIC ART

Roman Art in Context

In order to better understand the consciously formulated intentions and intangible image conceptions as well as underlying conventions in Roman plastic art and painting, a brief summary of the cultural, social and political background will be presented. The general architectural scheme and decorative system is briefly described in order to outline the designed context into which the paintings were inserted. Private buildings, situated in Rome, Ostia and Pompeii, and belonging either to the Imperial family or to middle class families, have been at focus in this study. Public buildings, such as baths, temples and basilicas have not been taken into consideration, since it seemed natural to confine this limited study to either public or private buildings. Stylistic changes in arts are reflected in decorations in either category of building. The period investigated, is roughly between the Late Republic and the third century AD, a period of great changes in Roman society.

The social context

Several scholars have pointed out the utilitarian aspect of Roman art.¹ Such a statement necessarily leads to the forming of two important questions, which have to be answered; utilitarian for whom and for what purpose. The answers to these questions are quite complex, but will be briefly indicated.

Art in Roman society, as in any other, was essentially commissioned by members of the ruling class, who possessed the economical means necessary to invest in architectural structures and art. The purpose of such investment was to manifest economic and social power, but also to create a personal or public environment of culture and refinement. Power could be shown in official spaces as well as in the private sphere by exposing impressive, suitable and commonly understood topics and objects of art, which furthermore were aimed at underlining the rituals taking place in each specific milieu.² Art contributed to offer each setting its distinctive identity.

Roman society was highly stratified.³ During the Republic, its ruling class consisted of the old aristocracy, the *patricians*.⁴ This small group of families, approximately thirty, ruled on basis of the wealth and prestige of their bloodlines.⁵ Below the *patricians* in Roman hierarchy were the equestrians, *equites*, who could advance

¹ Bartman 1994, Clarke 1991, 1994, Dwyer 1994, Hamberg 1945, Kellum 1993, Leach 1993, Marta 1986, Marvin 1993, Nodelman 1993, Poulsen 1978, Richter 1955, Seagliarini Corlàita 1998, Wallace-Hadrill 1994.

² Marvin, 1993, p. 166.

³ Goodman, 1997, p. 16.

⁴ Wells, 1984, p. 94.

⁵ D'Ambra, 1998, p. 17.

in their political career after military training.⁶ The military recruitment system changed during this period and even men without property could enlist, resulting in the possibility for male persons of different origins to rise from simple backgrounds to become rich and influential citizens of Rome, as was the case for several African soldiers.⁷ Although there was a possibility of transition from a lower to an upper class for a competent man, especially if wealthy, such a transition was slow, and not possible in a single generation.⁸

A wealthy upper class was gradually developing during the 2nd century BC, which did not only include the old families, but also successful persons from other social backgrounds. With the reign of Augustus the circle was enlarged. As a result of the contact with the Hellenistic world, there was a gradual change in the self-definition of the elite class. Augustus, aiming at peace and personal security for the Roman people, formed new ideals.⁹ The Augustan political programme, its background, its aims and the visual evidences, have been thoroughly described by Zanker.¹⁰ In official art the potency of the emperors and other important public persons was expressed, e.g. in the iconographic schemes and in the size of the statues.

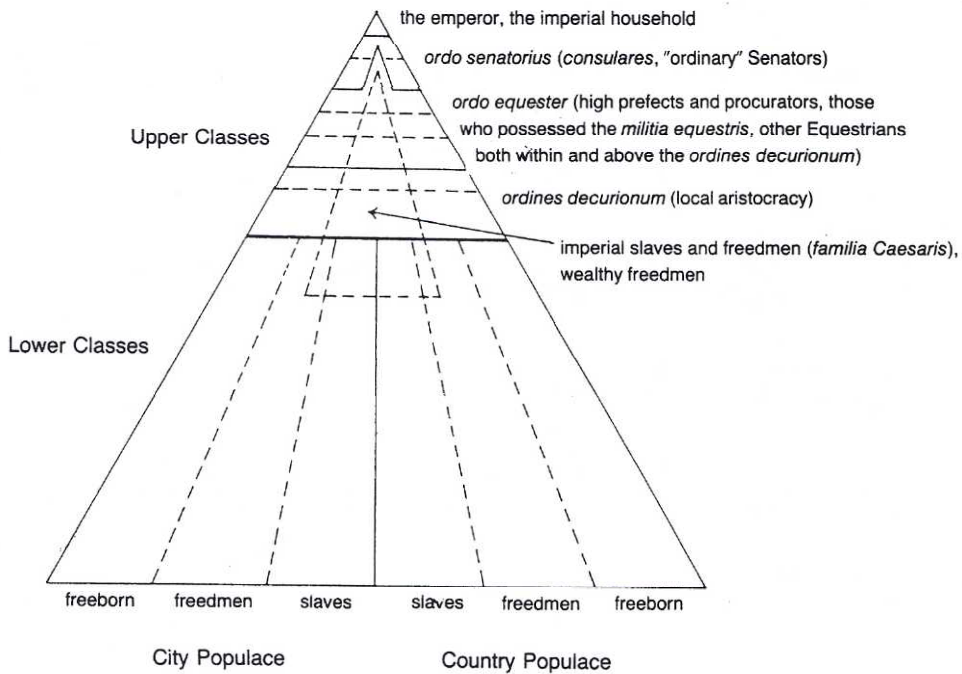


Fig. 21. The pyramidal structure of Roman society in the Imperial Age. After Zanker, 1988.

⁶ Ibid.

⁷ Goodman, 1997, pp. 22-23; Wells, 1984, pp. 250-251.

⁸ Zanker, 1988, p. 151.

⁹ Ibid, p. 78.

¹⁰ Zanker, 1988.

In the private sphere, the size and decoration of the *domus* was a measure of the owner's wealth.¹¹ Ancestral portraits were exhibited in the reception rooms and used as further details to underline the social background of the family. At first sight these portraits seem to depict individuals, but the portraits rather represent a type or a character than different individuals.¹² This can be observed in the veristic portraits from the Republic which generally show middle-aged or old men and women with their faces marked by wrinkles, severe persons engaged in public life and politics, men to respect. During the Augustan period a novel tendency in the official portraiture appeared, expressing the ideals for identification with the new, Golden age, but also linking the present to the honourable past. This transformation can be noted in the official portraits of Augustus, which show him in different symbolic functions, such as the chief priest, the military general, the orator or the godlike hero.¹³ Portraits of the young Augustus show a man with a sensitive expression, maybe somewhat tense and nervous. Such representations later were replaced by portraits based on Classical sculpture, the expression of the face calm, decisive and controlled. A similar iconographical transformation may be noted in statuary.¹⁴ Portraits with propagandistic messages were disposed in public places in Rome and in the provinces, representing the various functions of the emperor and expressing the ideals about him as a ruler. The official portraits of the ever young and active Augustus became the model for many successive rulers, just as the portraits of the women within the Imperial family, their hairstyles and general appearance were imitated by women of the Empire.

The Roman villa

Traditionally a Roman villa or *domus* was built according to principles suitable for the rituals performed within its walls.¹⁵ It was not just the sphere of domestic life but also the place of official duties, where the *pater familias* every morning received his clients, and other persons connected to the family. Since professional activities were taken care of in the house, it was built and decorated to underline the position of the owner, a fact recognized in ancient sources as well as in modern scholarly literature.¹⁶ Some characteristics were individuated independently of the actual size of the building and these remained constant through the centuries.¹⁷ According to Wallace-Hadrill, the Romans were, in their architecture, obsessively concerned with distinctions of social rank.¹⁸

¹¹ Dwyer, 1994, p. 34.

¹² D' Ambra, 1988, p. 28.

¹³ Ibid, p. 31.

¹⁴ Zanker, 1988, p. 239.

¹⁵ Clarke, 1991, pp. 2-6.

¹⁶ D' Ambra, 1988, p. 40; Dwyer, 1994, p. 28; Wallace-Hadrill, 1994.

¹⁷ Dwyer, 1994, p. 39.

¹⁸ Wallace-Hadrill, 1994, p. 10.

The size of a house was related to the social status of its family, a fact stated by Cicero as well as Vitruvius. Both agree that some men must have larger houses in order to fulfil their social obligations.¹⁹

The Roman house, contrary to the Greek, had no division of zones between male and female life, but rather between public and private areas, within which all family members moved freely.²⁰ Privacy, as understood by modern people, was unknown to the Romans, since the Roman house was a constant focus for public life. The interior parts of the house were accessible only for the family. It has been pointed out that early Roman houses had various degrees of privacy, and that the depth to which a guest penetrated the building emphasised his degree of intimacy with the owner.²¹

From the 3rd century BC and onwards, the Roman house generally was strictly axial and symmetric and built with the main entrance facing the street, from where the visitor, by passing a small hall, *fauces*, entered the main room of the building, the *atrium*.²²

The atrium-house, with the rooms symmetrically grouped around a central courtyard, was not a Greek, but an Etrusco-Roman invention.²³ This was recognised by Vitruvius who pointed out that some features in Roman architecture are Italic and others are Greek.²⁴ The *atrium*, *peristyle* and the dining room, *triclinium*, in the centre of the building were used as locations for the owner, with respect to his role in religious and other social rituals.²⁵ From this central position he had a good view over movements within the house. Wax masks of the family's ancestors, *imagines*, disposed in cupboards, were exhibited in the atrium.²⁶ Such images were, as mentioned above, important exponents of the family's origin and consequently of social importance, since the right of keeping ancestral pictures belonged exclusively to the heads of patrician families. Other representations that made part of this setting were the family tree or portraits made in more durable materials. During the late Republic and early Empire it was the undistinguished ambition of *novi homines*, i.e. men elevated to patrician status, to have such pictures.²⁷ The connection between *imagines* and the power of the aristocratic families has been investigated by Flower.²⁸ In the *atrium* was also the *lararium*, a shrine for daily offerings, with the picture of the two *lares*, the household gods, usually represented as two young men in country style clothes.²⁹

¹⁹ Swyer, 1994, p. 33.

²⁰ D'Ambra, 1988, p. 41; Wallace-Hadrill, 1994, p. 8.

²¹ Ellis, 1994, p. 123.

²² *Ibid.*, pp. 152-153.

²³ Sears, 1988, p. 12.

²⁴ Boëthius, 1970, p. 116.

²⁵ Dwyer, 1994, p. 27; Wallace-Hadrill, 1994, p. 12.

²⁶ Wheeler, 1969, p. 162; Richter, 1948, p. 1.

²⁷ Dwyer, 1994, p. 26.

²⁸ Marta, 1986, p. 166.

²⁹ Clarke, 1991, p. 9.

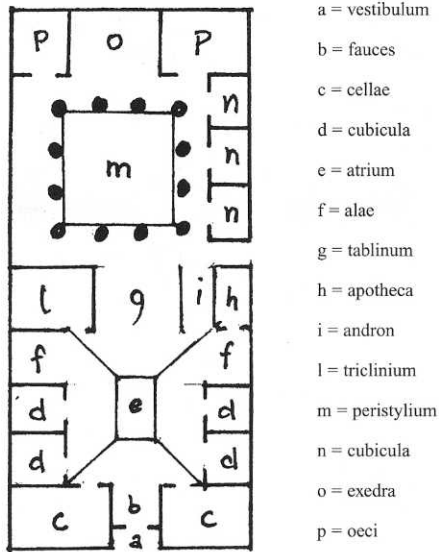


Fig. 22. Schematical plan over a Pompeian house. After Maiuri, 1931.

Nature was part of the urban house in the form of the small garden situated in the peristyle or beyond the back of the house. At Pompeii, terrace houses with splendid views over the landscape appeared during the 1st century BC.³⁰ Other private places for wealthy Romans, representing nature, were the *horti*, pleasure gardens within the city walls, created for resting and pleasure as a contrast to public life at the Forum. According to Pliny the elder, Epicurus was the inventor of such gardens, and Epicurean ideals were important in planning the garden as a place of retreat from the politic life in public in favour of tranquillity and spiritual preoccupations.³¹ Paintings representing gardens were often part of the setting, made on the garden walls as imaginary enlargements of the real garden.³²

As the population in Rome increased during the 1st century AD, a new structure of buildings, the *insulae*, developed. These were multi-storey apartment houses, built of kiln-fired bricks, containing flats, which were let out.³³ In Ostia some *insulae* had simple apartments, probably inhabited by poor people, while patrician families seem to have lived at the ground floor level in larger and more comfortable apartments, at least during the 2nd and 3rd centuries AD.³⁴ The average size seems to have been between three and five rooms, generally built around a central courtyard, the *medianum*.³⁵ At the ground floor a row of tabernae often faced the streetside.³⁶

³⁰ Zanker, 1998, pp. 158-159.

³¹ Wallace-Hadrill, 1995, p. 6.

³² D'Ambra, 1988, p. 137.

³³ Goodman, 1997, p. 185; Sears, 1988, p. 33.

³⁴ Pohl, 1983, pp. 33-35.

³⁵ Marta, 1986, p. 173.

³⁶ Boëthius, 1960, p. 140; Pohl, 1983, p. 12.



Fig. 23. The house of Paquius Proculus, Pompeii. View from the streetside to the peristyle garden, through *fauces*, *atrium* and *tablinum*.

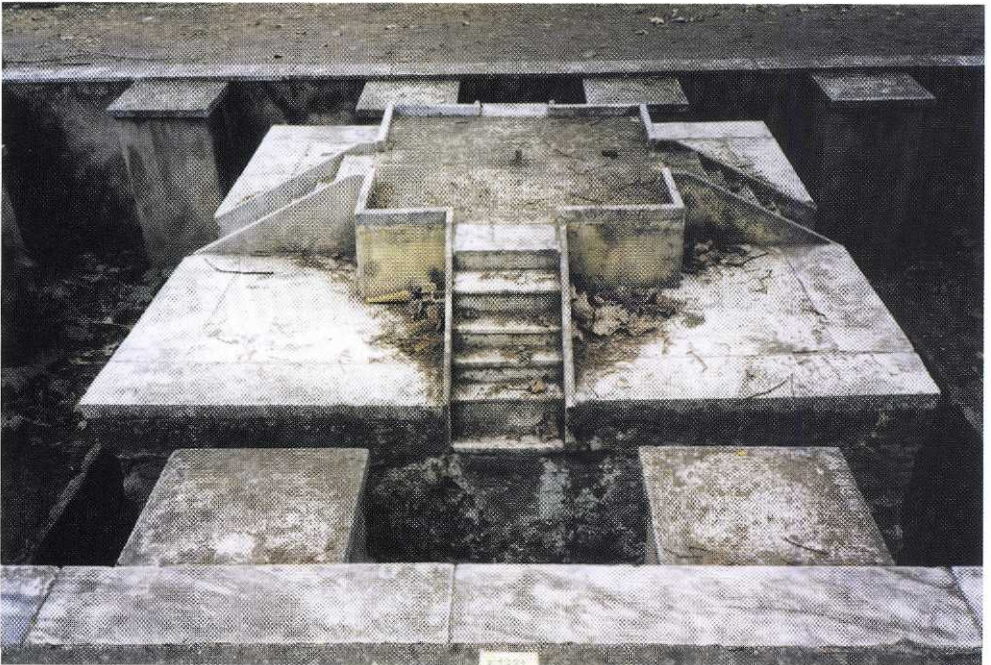


Fig. 24. Above: Casa di Venere in conchiglia, Pompeii. Garden painting.

Fig. 25. The house of Loreius Tiburtinus. Garden with nymphaeum.

The building materials

The architectural scheme of a Roman house did not undergo much change through the centuries, since the functions of private and public spheres were important and the utility of its protected and open areas had to be regarded. The development of materials used in buildings can be followed through time, and observations of the wall construction technique are studied for the dating of a Roman villa. All Roman wall constructions but one, the *opus quadratum*, were made of concrete. The nucleus, *opus caementicium*, was made with stone chips, *caementa*, mixed with mortar of lime and sand, contained between forms of, e.g. tufa wedges or terracotta bricks.³⁷ By the 2nd century BC Romans had developed the *opus caementicium* into an all-important material in architecture.³⁸ The concrete was made by sand from deposits in the volcanic areas of central Italy, making an extremely durable mortar, which combined with *pozzolana*, could be used even for constructions under water. This material, with its great strength and versatility made possible the huge vaulted interiors of the Imperial baths and the arch structures in various types of buildings.³⁹

Walls in buildings from the Hellenistic and Republican periods were made in *opus quadratum*, rectangular blocks dry jointed, i.e. fit together without cement. This building technique was known already from the Archaic age in the Etruscan area.⁴⁰ Stone-coatings were used in Roman architecture already from Hellenistic times, but for revetment, not for the wall structure.⁴¹ *Opus reticulatum*, consisting of square tufa wedges set in cement with the larger base in the façade, forming a diagonal net-pattern, was the most common technique from the Augustan to the Antonine age.⁴² This system was improved by delimiting frames of rectangular terracotta bricks, *opus mixtum*, which strengthened the wall construction. *Opus mixtum* was common during the Hadrianic period, but known from the first half of the 1st century to the beginning of the 3rd AD. Beside these easily recognisable standardised wall constructions, there were various intermediate stages.

According to Suetonius, Augustus claimed to have transformed the city of Rome, and “left in marble that which he found made in brick”.⁴³ Sears states that Augustus, in his building programme, used only the best materials, and that Rome was rapidly transformed when white marble buildings took place of the old tufa ones. Tufa and peperino were later used only for the subsidiary parts of the buildings.⁴⁴ Not only white marble was used but also various kinds of coloured stones were brought to Rome from throughout the Empire. This highly developed trade also included ready-made statues and architectural elements.

Marble was occasionally used as revetment of the external walls of a building. Even when these panels are lost, such revetment may be identified by remaining

³⁷ Ling, 1991, p. 25; Marta, 1986, p. 15.

³⁸ Boëthius, 1970, p. 30.

³⁹ Carter, 1989, p. 37.

⁴⁰ Marta, 1986, p. 11.

⁴¹ Clarke, 1991, p. 27.

⁴² Marta, 1986, p. 22.

⁴³ Suetonius, *The divine Augustus* XXVIII, 3 ff.

⁴⁴ Sears, 1988, pp. 49-51.

small pieces of terracotta or marble which were inserted into the plaster before the surface was covered with thin marble panels. In other cases the walls were covered with several layers of plaster and successively painted.

The formal architectural scheme was the unity into which details were set. Many materials were available to achieve a pleasant and functional house decoration, and these were used in various combinations. Marble, mosaics, terracotta, stucco and lime plaster were the basic artistic materials in a Roman house. Various marbles were imported, and used for columns, architectural elements and statues. Marble cut into rather large pieces and composed in elaborate patterns to form a geometric pattern or a figurative design, *opus sectile marmoreum*, was a luxurious floor-cover, which was only used in the most dignified buildings.⁴⁵

Mosaics were, however, the most common material for floor decorations in the houses of wealthy families. The tradition of mosaic floor decoration can be traced back to the 5th century in Greece, when decorations made of conic mosaic pieces were introduced in public spaces.⁴⁶ Mosaics laid with *tesserae* appear during the 3rd century BC.⁴⁷ It is possible to date the floors by the size of the *tesserae*, e.g. the extremely small-sized *tesserae*, belonging to the Second style, which are dated from around 100 BC, while larger pieces of black and white *tesserae* are typical of the Hadrianic period, AD 117-138. Mosaics could be complex decorations with a central picture, *emblemata*, made with extremely small pieces of mosaics, *opus vermiculatum*, or they could be laid as simple black-and-white compositions. Simple floors, e.g. in courtyards, terraces and warehouses, were made of small bricks of terracotta, placed diagonally in a herringbone pattern, *opus spicatum*.⁴⁸ Such floors were common during the Pompeian Second style.⁴⁹

Ceilings and vaults made in *stucco* relief were generally kept white. First style stuccoes are mostly made in geometric patterns, representing cassette ceilings. These decorations gradually developed into elaborate patterns containing floral and figurative motifs. In order to ascertain a good adherence of the stucco to the underlying structure, canes were nailed to vaults and ceilings.⁵⁰ There are examples of painted stuccoes, sometimes with inserted pieces of marbles or with partial gilding, as well.⁵¹ Examples of such multi-coloured stuccoes are plenty in the Domus Aurea, e.g. the rich and complex decorations of the golden ceiling, *la volta dorata*, in room 80 or the precious stucco decorations in room 129, also called the room with the stuccoes or of Hector and Andromace.⁵²

⁴⁵ Marta, 1986, p. 50.

⁴⁶ Baldassare, 1985, p. 205.

⁴⁷ *Ibid.*, p. 211.

⁴⁸ Marta, 1986, p. 24.

⁴⁹ Dr. Lars Karlsson, lecture at the Forum, September 29, 1998.

⁵⁰ Barbet, 1998, p. 105.

⁵¹ Salvetti, 1998, p. 87.

⁵² Iacopi, 1999, pp. 41-46, 73.



Fig. 26. Stucco decoration. From the Forum baths, Pompeii.

The decorative system

The sense of *decor*, i.e. the selection of a style for each setting, was characteristic for the Romans, and rooms were decorated thematically according to their use. Mythological motifs were, however, preferred in public as well as in private spaces.⁵³ Official persons such as magistrates, politicians and lawyers, who received their clients in the public part of their home, had their rooms for receptions painted with heroic motifs to manifest the official, public and severe character of the room.⁵⁴ Simple decorations were made for spaces where people were just passing through, and complex decorations were made for rooms where people stayed, and had time to look at the paintings.⁵⁵

In private rooms there was less need for public manifestations, and the motifs often were of a more intimate character, such as garden paintings on walls close to the peristyle and erotic motifs in bedrooms, *cubicula*.⁵⁶ Still lifes or masks frequently occur in the dining-room, illustrating the Roman habit of combining dining with music and other forms of entertainment. The emperor Augustus was, according to Suetonius, known for giving very formal dinner parties, which were enlivened by musicians, actors or even men who gave turns at the circus, but more often by professional story tellers.⁵⁷ When the dining-room eventually became a room for receptions, decorations became more official. Petronius, who lived, and died, during the reign of Nero, has narrated the dining rituals in the house of a wealthy freedman.⁵⁸ Even though the scenes he describes in *Satyricon* are maybe a little exaggerated, the story gives a glimpse of what could be comprised in a Roman dinner party.

The manner of combining materials and motifs within the decorative system varied between the Pompeian periods. During the Republic, the Pompeian First style painting was combined with geometrical stucco decorations and dominating floor decorations, often with the insertion of a central *emblemata*. Successively attention was deliberately drawn to the wall decoration and the floor design became less elaborate. A study of the distribution of mythological motifs and mosaics in Pompeian houses has been made by Wallace-Hadrill, who states as a fact that such features strongly correspond with the size of the house, and therefore are mainly found in the larger houses.⁵⁹

Statues of marble or bronze often appeared as motifs integrated in garden paintings.⁶⁰ Mural paintings representing statues have been studied by Moorman, who used these pictures as a source for understanding the development in Roman statuary.⁶¹

⁵³ Ling, 1999, XII, p. 247.

⁵⁴ Scagliarini Corlàita, 1998, p. 57.

⁵⁵ Clarke, 1991, p. 16

⁵⁶ Scagliarini Corlàita, 1998, p. 59.

⁵⁷ Suetonius, Aug. LXXIV.

⁵⁸ Petronius was a friend of Nero, and by him forced to commit suicide in AD 66.

⁵⁹ Wallace-Hadrill, 1994, p. 154.

⁶⁰ Reuterswärd, 1966, pp. 181-183.

⁶¹ Moorman, 1988, p. 64.

Pinakes and Fayum portraits

Small picture panels, *pinakes*, inserted into the walls and integrated in the pictorial scheme, were another reflection of the Graeco-Roman tradition. Such easel-paintings appeared in Greece towards the end of the 5th century BC, and during the following century they became a popular kind of decoration. In fact *pinakes* were considered by the Greek to be an art form superior to wall-painting. These small size paintings were much appreciated also in Rome, where many *pinakes* were brought between the 5th and the 1st centuries BC.⁶²

Early Roman *pinakes* from the Second style were principally framed wooden panels with wooden shutters, like those of later triptychs. Such paintings, including Greek originals, were exposed in large collections, *pinakothecae*.⁶³ On special occasions these collections were open to the public, to show the wealth of its owners.⁶⁴ Wallpaintings made to imitate picture galleries became a fashion in Rome at the very end of the Republic.⁶⁵ These decorations were not necessarily substitutes for real galleries, since they are also found even in the most luxurious houses.⁶⁶ Rather they create a symbolic system in which luxury articles actually present in many villas are combined with imagined spaces and objects.

The motifs were mostly human figures or still lifes, a genre known since the Greek-Hellenistic period. Vitruvius speaks about the *xenia*, guest gifts, which were a class of paintings depicting the provisions made by the hosts to their guests, given as self-supports while being visitors.⁶⁷ Within the Second style the *pinakes* were more often set directly into the wall, and the real shutters gradually disappeared in favour of painted ones. Painted landscapes with human figures and mythological motifs were new kinds of sceneries, surrounded by illusory painted frames made to resemble real wooden or stucco frames. The pictures, occasionally, were painted as if standing on an easel, to give the impression of being presented in a picture gallery.⁶⁸

The Fayum portraits represent a type of Roman painting which appeared in Egypt during the Imperial period. Stylistically these portraits resemble painted portraits found at Pompeii. The personalities depicted wear tunics and mantles of Roman style, and their hairstyles follow the fashion set in Rome. These portraits are painted on wooden panels, superimposed on the face of the mummy and inserted into the mummy bandages. Many were painted in encaustic, other in tempera or with Punic wax. My studies on this painting tradition was planned as a case study within this dissertation, but since the study became more extended, the material has been presented in two separate publications.⁶⁹

⁶² Bianchi Bandinelli, 1980, p. 36; table at pp. 228-231.

⁶³ Zanker, 1998, p. 22.

⁶⁴ Moorman, 1998, p. 21.

⁶⁵ Wallace-Hadrill, 1994, p. 30.

⁶⁶ Zanker, 1998, p. 22.

⁶⁷ Bianchi Bandinelli, 1980, p. 78, Curtius, 1929, p. 151; Ling, 1991, p. 154.

⁶⁸ Ling, 1991, p. 135.

⁶⁹ Freccero, 2000, I and II.

Originals and copies

Subjects presented in Roman art were to a great extent of Greek origin, and there are surprisingly few paintings with genuinely Roman motifs. In fact the figures repeat familiar Greek types from the 4th to the 2nd centuries in painting as well as in three-dimensional art. The painted figures remained the same within the four Pompeian styles even though the painted architecture changed.⁷⁰ Several copies of the same subject have been identified, and the existence of some kind of common source, such as albums or pattern-books, has been suggested.⁷¹

According to Ling the evidence of the existence of artists' pattern-books must be considered as overwhelming.⁷² Andersen, on the other hand, has questioned the existence of such pattern-books, but admits that there might have existed artists' personal sketchbooks, containing a collection of stock figures and a fairly large repertoire of iconographical schemes as well as details for different settings.⁷³ This seems very likely, since artists' sketchbooks usually contain elaborate pictures as well as rapid sketches and studies of details. In my own opinion, the term pattern-book may be just another word for sketchbook, since the drawings collected, or made by the artist, were used as models for the subjects in the painted decoration. The painters did not generally copy the drawings exactly, but rather adapted and altered them just as much as was needed to fit Roman taste and the spaces given them to fill.⁷⁴

How copying was done is guesswork, according to Richter. Making copies of famous paintings was a practice established during Antiquity, according to e.g. Pliny the younger and Lucian.⁷⁵ This leads to the issue of copying as such.

The repetition of popular motifs resulted in a large number of copies and replicas of paintings as well as statues. From the reign of Augustus until the middle of the 3rd century AD there was an intense activity in producing copies of Greek sculpture.⁷⁶ For several centuries, generations of sculptors were mainly occupied in repeating or slightly varying Greek motifs.⁷⁷ Vast numbers of replicas of official statues representing the Emperor and his family were made to celebrate important events and sent to the provinces. Such statues were made as replicas of well-known statues with the attachment of different portrait heads. There were changes in gestures, rearrangements of folds of the drapery or additions of details.⁷⁸ Freely executed copies exist in different forms, some of these reduced in size in contrast to the original.

Accurate, mechanically produced copies in marble were made by use of the copying machine, which had been invented about 100 BC.⁷⁹ This process, still in use today, consists in the transference of measures from a statue to a block of marble, which then is cut according to the measures indicated by the little dots marked on the marble block. It has been possible to reconstruct missing parts of copies by

⁷⁰ Richter, 1955, p. 77.

⁷¹ Moorman, 1998, p. 21.

⁷² Ling, 1991, p. 218.

⁷³ Andersen, 1985, p. 123-124.

⁷⁴ Leach, 1993, p. 149; Ling, 1991, p. 221.

⁷⁵ Richter, 1955, p. 76.

⁷⁶ Poulsen, 1949, p. 89.

⁷⁷ Leander Touati, 1998, p. 82; Brunnsäker, 1971.

⁷⁸ Richter, 1955, pp. 41-43.

⁷⁹ Richter, 1955, p. 37.

using a cast from Greek originals. The pieces, when brought together, did match without difficulty.⁸⁰

Like in other sectors of life, Romans had a utilitarian approach towards art. Not only public buildings but also private houses were enriched with statues, works whose associations were immediately recognisable by everyone.⁸¹ The use of art as a means of propagandistic messages during the Augustan period has been indicated by, e.g. Kellum, Nodelman and Zanker.⁸² Kleiner has acknowledged this aspect in her study of the connection between the Augustan family programme and the family groups represented on the reliefs on the Ara Pacis Augustae.⁸³ The political role of Livia, as envisioned in her portraits has been thoroughly studied by Bartman.⁸⁴

The motif had to suit the intentional frames set by surrounding milieu, and this aspect was more important than the beauty of the singular object or the name of the artist who had made it.⁸⁵ Sculpture contributed to offer each setting its distinctive identity. Consequently there was a great need for replicas, and numerous variations on some themes were endlessly repeated.

Painters and workshops

The uniformity in mural decorations has been discussed by de Vos, who has pointed out that decorators from different workshops, *botteghe*, at Pompeii used the same motifs, subjects and colours, all based on models, which might have consisted of iconographic cartoons for the paintings and wooden stamps for the stuccoes.⁸⁶

In Greek tradition painters were wall-painters or *pinake*-painters, the last indicating painters of small size pictures, either made in tempera or encaustic. The Roman tradition was, as mentioned above, quite different. The wall-painter was in Greek tradition not as highly valued as the *pinake*-painter. It has been supposed that such professional differentiation did not exist in Roman culture, where painters commonly painted directly on the wall. The distinction was rather between the *pictor colorator*, who painted the wall, the *pictor parietarius*, who decorated the walls, and the *pictor imaginarius* who was the motif and figure painter.⁸⁷ These terms are commonly used in scholarly publications concerning Pompeian painting, but objections to these distinctions have been raised, since there are no indications that the

⁸⁰ Richter, 1955, p. 38; Brunnsåker, 1971.

⁸¹ Marvin, 1993, p. 169.

⁸² Kellum, 1993; Nodelman, 1993; Zanker, 1998.

⁸³ Kleiner, 1993, pp. 27-52.

⁸⁴ Bartman, 1999.

⁸⁵ Marvin, 1993, p. 166.

⁸⁶ de Vos, 1985, p. 119.

⁸⁷ Borda, 1958, p. 381; Iacopi, 1999, p. 51.

terms were used before the Edict of Diocletian VII.⁸⁸ This edict has been quoted by Barbet as the source for this professional classification, and she and other scholars commonly use the terms today.⁸⁹ According to Andersen integrated painted architectural and figural motifs had gone out of fashion during the time of Diocletian, and he, therefore, suggests that the term *parietarius* indicated a wall-painter while *imaginarius* indicated a portrait painter. According to Andersen the terms *painter* and *decorator* thus are more adequate, which seems reasonable, since a *painter* of the Roman period, in contemporary inscriptions was referred to just as *pictor*.⁹⁰ Iacopi states that the decorative programme in the room of Acilles at Scyros in Domus Aurea was an artistic unity, where the simplest decorations were made by the *parietarii* and that the *pictor imaginarius* made the figure scenes.⁹¹

Disregarding these terminological disputes, it has been observed that more than one painter worked on large size murals. That this was the case becomes obvious, when studying the so-called “room of the painters” in Casa degli Casti Amanti at Pompeii. The room was being re-decorated at the time of the Vesuvian eruption, and one can see that work progressed at different phases contemporaneously. It seems therefore quite correct to assume that some painters, maybe assistants or pupils, were applying the background colours, others painted the general setting and the master painted the figure motif. In such case, and applying the Anderson terminology the master may be identified with the *painter (pictor imaginarius)* while the background decorator was the *decorator (pictor parietarius)* who might or might not have had some help from an assistant. The *painter* may have created portraits or figures of any kind, while the *decorator* contributed with the painted environmental setting.

Remains from the Vesuvian towns of Antiquity, provide evidence that one and the same figure painter, *pictor imaginarius*, could have been employed by several workshops, and also that a singular workshop could have employed more than one figure painter.⁹²

⁸⁸ Andersen, 1985, p. 113.

⁸⁹ Barbet, 1998, p. 104.

⁹⁰ Andersen, 1985, p. 113.

⁹¹ Iacopi, 1999, p. 51.

⁹² de Vos, 1985, p. 121.

Wall Paintings

The development of the four Pompeian styles and their main characteristics will be briefly delineated. Technical aspects such as how Roman walls were plastered, what materials were used and how the paintings were made will be presented.

Wall decoration

It is generally accepted that the Roman custom of painting interiors was established with the First Pompeian style, but fragments of painted plaster from Archaic houses on the Via Sacra in Rome indicate that the tradition of mural decoration is even older.⁹³

Evolution in mural painting can be followed from the early geometric patterns, imitating the marble coatings of Hellenistic palaces from the beginning of the 2nd century BC, and up to the mature state of the Pompeian Fourth style paintings at the end of the Julio-Claudian period.⁹⁴ Observations such as these are, mainly, possible due to the discoveries in the Vesuvian region, where large areas of land were covered with a thick layer of volcanic ash, lava and mud, by the eruption of Vesuvius in AD 79. This marked the end of life in several small Campanian towns. From an archaeological point of view this has been most fortunate since there is a limited period within which all activities of the sites can be dated. The sites remained almost completely untouched by man from AD 79 until the excavations in the area started in 1738 and 1748. Also in the city of Rome, and its surroundings, several buildings have been found having paintings preserved from the different, so-called, Pompeian styles, and those paintings are by some scholars considered to be of a higher quality than those from the Vesuvian area.⁹⁵ It is generally supposed that the paintings in Pompeii were stylistically influenced by those made in the city of Rome and not the other way around.⁹⁶ One reason, indicating such a development, is that the loots of Greek art from the Imperialistic war campaigns that arrived in Rome were shown there and consequently first became known to the inhabitants of the capital. As Greek art rapidly became popular in the ruling classes, they spread it, not only to the Vesuvian area but also within the entire Roman Empire. As far as the Second style paintings are concerned, decorations in this style appeared at Pompeii during the early 1st century BC, while paintings from the Casa dei Grifi in Rome are dated to the same period or a little earlier.⁹⁷

The Greeks had considered easel painting as the superior art form, which the Romans did not. In Roman art the architectural scheme and the decorative system were of major importance, and into this context the decorative details were set. The

⁹³ Leach, 1993, p. 135.

⁹⁴ Barbet, 1985; Bianchi Bandinelli, 1980; Bragantini and Badoni, 1985; Clarke, 1991; Curtius, 1929; De Vos, 1985; Ling, 1991; Maiuri, 1931, 1961; Mau, 1908; Moorman, 1998; Wallace-Hadrill, 1994.

⁹⁵ Paris, 1998, p. 73.

⁹⁶ Iacopi, 1997; Ling, 1991.

⁹⁷ Ling, 1991, p. 23.

iconographical programme of a certain room has in many cases proved to be a unity.⁹⁸ Therefore the decorations and inserted paintings must be viewed in their context, as an integral part of architecture.⁹⁹ There were great varieties in the performance of wall decorations, but the architectural scheme was followed rather strictly. The main characteristic was the division of the walls in three horizontal fields, the socle, the main field and the upper field, sometimes with the addition or reduction of one field.¹⁰⁰ The upper field often presented a frieze, either painted or in stucco relief. The main field successively developed into the pictorial field with figure paintings or landscapes inserted into the architectural setting. The insertion of a central painting in the main field is traceable from the second phase of the Second style. In some houses on the Palatine in Rome, such paintings are still *in situ*.¹⁰¹ The socle was generally kept monochrome, or simply decorated, e.g. with floral motifs. Verticals intersected the horizontal areas, such as by stucco semi-pilasters in relief, thus dividing the wall into sections.



Fig. 27. The division of the wall, Third style. After Nicholas Wood, *Sotto i lapilli*, 1998, p.35.

The four Pompeian styles

Pompeian mural decorations are divided into four styles, which have been thoroughly defined and described ever since Mau made this classification in 1882.¹⁰² Mau based his style identification on Vitruvius' written descriptions of the successive changes in Roman painting. Vitruvius had pointed out (7.5.1-3), that a development and transformation in painting had taken place, from the ancient, *antiqui*, i.e. the Etrusco-Roman and Graeco-Hellenistic decorations imitating marble, to the degenerate style of his own period.¹⁰³ These phases roughly correspond with the First, Second and Third styles defined by Mau, who also identified a following Fourth style. This classification system is still followed today, even though there are different opinions on exactly how to define the styles and date them. Barbet for example have defined them into rather complex categories. She divides, e.g. each of the Second and the Third styles into three major phases, and in addition the transitional phases in between the styles.¹⁰⁴ In this context just the general lines will be indicated, and the dating by Ling is principally followed.

The First style

First style decorations are stylistically homogeneous and were used during a long period.¹⁰⁵ Such decorations in Pompeii and Herculaneum may be dated approximately between the 2nd and 1st centuries BC.¹⁰⁶ The First style, also called the incrustation style, derived from the Hellenistic tradition, where marble-coated walls seem to have been used since they were first recorded at the Palace of Mausollos in Halicarnassos, in the middle of the 4th century BC.¹⁰⁷ Rather than being a painting style it is a plaster cast of architectural forms.¹⁰⁸ This style basically consisted of geometric decorations, with the walls divided in stucco relief blocks and painted as imitations of marble and masonry.¹⁰⁹

Even though the First style was inspired by Hellenistic tradition it was in some aspects different to its precursors already from the beginning. One distinction is that the Roman socle became much higher, from about 30 cm to 100 cm. The Greek base, consisting of standing orthostates, had an architectonic function, while the high Roman base generally was flat, and successively became decorated. These factors led to the Roman socle losing its architectonic function and becoming just a part of the decoration.¹¹⁰ Another difference is that polychromy became richer.¹¹¹

For the families who could afford to pay for decorations with real marble, the possibilities of choice were many. A vast selection of coloured marble was import-

¹⁰² August Mau, German scholar.

¹⁰³ Leach, 1993, p. 136; Borda, 1958, p. 5.

¹⁰⁴ Barbet 1985, pp. 36-42, 96-127.

¹⁰⁵ *Ibid.*, p. 12.

¹⁰⁶ Ling, 1991, p. 13.

¹⁰⁷ Ortolani, 1989, p. 31.

¹⁰⁸ Clarke, 1991, p. 39.

¹⁰⁹ Mau, 1908, p. 39; Borda, 1958, pp. 5-7.

¹¹¹ Schefold, 1962, p. 21.

ed to Rome during the 2nd century BC, and during the Augustan period marbles arrived from all over the Empire.¹¹² This material was, of course, extremely expensive and consequently could only be afforded by wealthy families.¹¹³ Painted imitations on the other hand provided a similar impression, and were available at a lower cost. Examples of wall decorations in the First style appear across the former Hellenistic world, and in particular on the island of Delos in Greece. The painted marble blocks could either imitate real marbles, or they could be pure decorative inventions. Above the marble blocks in the main field in the, so-called, upper field, were often paintings of ornamental decorations or with figural motifs.¹¹⁴ The figural motifs were generally monochrome, painted on the basis of imitating marble.¹¹⁵ First style decorations occur in the Casa del Fauno at Pompeii, where also the famous mosaic floor decoration, representing the battle between Alexander and Darius was found. This large size mosaic decoration, 2.17 x 5.12 m, was made in *opus vermiculatum* and signed by Philoxenos from Eretria. The picture, mentioned by Pliny, was a copy of a painting, which was brought to Rome where it was much admired.¹¹⁶ Mosaics made with extremely small tesserae such as these are typical for the late phase of the First style about 100-80 BC. Often the size of the tesserae were just between 1 and 5 mm. Mosaics from the early period were mainly simple cement pavements, decorated with rows of tesserae, either in black (*lava pesto*) or red (*coccio pesto*), forming geometric patterns.¹¹⁷

The Second style

The following Second style is also called the architectonic style.¹¹⁸ As Schefold says, in the First style the details in the decorative system are treated as singular units, while in the Second style, the optical unity of these elements are the aim.¹¹⁹ This style may be divided into two major phases, and dated roughly between 80 and 40 BC, and from 40 to 15 BC respectively, i.e. during the years from Sulla to Caesar

¹¹² Gnoli, 1989, p. 13.

¹¹³ Among the marbles imported were, e.g. *pavonazzo* from Phrygia, *cippolino* from Greece, *giallo antico* from Numibia, and from Turkey arrived red and green *africano*. Red and grey *granite*, various kinds of *alabaster* and red and black *porphyry* were imported from Egypt. Green *porphyry* was imported from Sparta. White *marble* arrived from Greece, and also from the Luna quarry at Carrarra in Italy, opened by Julius Caesar.

¹¹⁴ Moorman, 1998, p. 23.

¹¹⁵ Barbet, 1985, p. 27.

¹¹⁶ Salvetti, 1998, p. 90.

¹¹⁷ Clarke, 1991, p. 40.

¹¹⁸ Curtius, 1929 pp. 51, 80; Mau, 1908, p. 41.

¹¹⁹ Schefold, 1962, p. 27.

¹²⁰ Ling, 1991, p. 23. According to Moorman, 1988, p. 37, the second phase of the Second Style is dated to between 30 or 20 to 10 BC.

and from the Second Triumvirate to the early years of the reign of Augustus.¹²⁰ This style was preferred by Vitruvius, who described the development from the First to the Second style as follows:

*“Then they proceeded to imitate the contours of buildings, the outstanding projections of columns and gables; in open spaces, like exedrae, they designed scenery on a large scale in tragic, comic or satyric style.”*¹²¹

Early motifs in the transition between the First and Second styles are cubes seen in perspective and the motif of painted closed doors, a well-known motif also in Egyptian and Macedonian tombs.¹²² The Second style is characterised by illusionistic environments, combined with real architectural structures. The architectonic interior setting was complex, since there were real doors and openings, real columns and pillars, but also three-dimensional insertions of architectonic elements made in stucco relief. Illusionistic apertures were painted, through which an imaginary architectonic milieu, sometimes with human figures, could be seen. Also floral or garden motifs were common in these painted openings. Compositions with mythic, heroic, or religious motifs appear during this period, painted in the main field of the wall.¹²³ At the introduction of such motifs, the *emblemata* decorations in the centre of the mosaic floors tend to disappear.¹²⁴ These picture mosaics were mostly prefabricated and portable and could therefore be removed from one floor and laid in another environment if the owner desired.¹²⁵ An additive complexity during the Second style consisted of paintings inserted into the walls, which could be real *pinakes* or otherwise decorations painted to look like *pinakes*. In brief, the Second style developed from massive architectural forms in the early phase into light and elegant decorations at the end of the period.

The transition of the Second into the Third style is indicated by the end of realism in the representation of architectonic details such as columns and pillars, which tended to become linear decorations without any illusive supporting function. Motifs from Ptolemean Egypt appear already during the Second style, and symbols, such as the lotus blossom and the snake, connected with the Isis cult became frequent.¹²⁶ Other Egyptian motifs were sacral landscapes with crocodiles, Amor as a scorpion, waterbirds, etc. A representative example of the early Second style is the Casa dei Grifi in Rome, dated to about 80 BC, and the earliest known example of this style.¹²⁷ The massive architectural forms are new inventions, combined with imitations of marble and alabaster, which are remains of the previous period.¹²⁸ In addition there is a cubic pattern appearing on the socle in Room II and between orthostates in the middle zone in a decoration in Room IV. Such patterns were known from *opus sectile* pavings, but in Casa dei Grifi they appear on the walls, painted in red, black and white.¹²⁹ Another characteristic of this early period is the

¹²² Vitruvius, VII.5.2.

¹²³ Barbet, 1985, p. 29.

¹²⁴ Maiuri, 1931, p. 12.

¹²⁵ Bragantini and Badoni, 1985, p. 257.

¹²⁶ Clarke, 1991, p. 41.

¹²⁷ Schefold, 1962, p. 29.

¹²⁸ Clarke, 1991, p. 41.

¹²⁹ Borda, 1958, p. 23.

asymmetrical perspective characterised by the lack of a vanishing point, towards which orthogonals can converge in the middle of the right or left walls.¹³⁰ A good example of the late phase Second style is the painting cycles of the House of Augustus – House of Livia on the Palatine and Villa della Farnesina, dated to about 30-20 BC.¹³¹ The paintings in Aula Isiaca may also be related to the cycle of paintings mentioned above and dated to the end of the period, about 20 BC, in the transitional period between the Second and Third style.¹³² Rizzo interprets this space as a cult-room, and based on this opinion he dates the paintings to a much later period, the reign of Caligula (AD 37-41). Since the Isis cult had been forbidden by Augustus in 20 BC, the room could not, according to Rizzo, have been decorated during this period, but must have been made during the reign of Caligula, who officially re-established the cult.¹³³ According to Barbet this dating, based on the assumption that the Aula was a cult-room, is too late, and archaeological evidences confirm a dating of about 20 BC.¹³⁴

The houses of Livia and of Augustus on the Palatine reveal rooms, which are preserved with first class paintings from the second phase of the Second style. The House of Augustus was found at the beginning of the 1960s on the southeast side of the Palatine, and excavations have shown that a ramp connected the house directly to the forecourt of the temple of Apollo. According to Suetonius, the temple was built on that part of his house which the soothsayers declared was desired by the god since it had been hit by lightning.¹³⁵ The house consists of a group of private and public rooms situated along the peristyle connected to the House of Livia. In the upper bedroom, for the first time, a fully integrated composition of painting and stucco relief occurs.¹³⁶ Augustus was known by his contemporaries, not to be addicted to luxury, but to have chosen to live in modesty. Suetonius describes with evident surprise that Augustus had only one bedroom, which he, during forty years, used in both summer and winter.¹³⁷ This is confirmed by the remains of a rather modest building, but since the temple of Apollo was erected in close proximity, the various buildings became parts of a whole complex. Costly materials were, however, used for the pavements in *opus sectile*, and the wall decorations were made by first class painters. The public part of the building is decorated with traditional motifs, possi-

¹²⁹ Barbet, 1985, p. 29; Ling, 1991, p. 24.

¹³⁰ Clarke, 1991, p. 43.

¹³¹ Iacopi, 1997, p. 5.

¹³² Barbet, 1985, p. 97.

¹³³ Iacopi, 1997, p. 5.

¹³⁴ Barbet, 1985, p. 97.

¹³⁵ Suetonius, *The divine Augustus*, XXVIII, 3ff.

¹³⁶ Ling, 1991, p. 45.

¹³⁷ Suetonius, *Aug.* LXXII.

bly dated to the middle of the 1st century BC, while the private rooms are decorated in a less strict manner.¹³⁸ Lately, some of the large amounts of fragments of wall paintings, excavated about three decades ago, have been given new attention, and conservators are presently working with the material, which I have had the possibility of looking at. My impression is, that these beautiful fragments will give important additional knowledge of the decorations in the House of Augustus.

The origin of the Second style has been debated, and the two main alternatives are related to contemporary stage scenery and actual contemporary architecture. The decorations in the *Stanza delle Maschere* in the House of Augustus are unmistakable allusions to stage decoration.¹³⁹ The remains of a Roman villa which probably belonged to Giulia, the daughter of Augustus, and her husband Agrippa, have been found and excavated at the Villa della Farnesina in Rome, considered to be from the transitional phase of the Second style into the Third style.¹⁴⁰ The paintings, made in the four buildings mentioned above, are similar in style, and it has been suggested that one main workshop was charged with commissions by Augustus and Agrippa.¹⁴¹ Floral patterns and mythological motifs as well as a preference for animals and figures growing from tendrils are common, and the delicate and elegant drawing is significant for those mural decorations.¹⁴² Barbet states that the decorations in the *Stanza delle Maschere* must have been painted by the same artist who worked in the House of Livia.¹⁴³

Art of the Augustan period was inspired by the Classical Greek tradition, and adapted to Roman taste. The classicising tendency of the period depended on the intimate contact with the Hellenistic culture, after the Roman conquest of Greece.¹⁴⁴ This is evident in sculpture but also in the elegant and linear wall decorations. Initially favoured by the emperors and noble classes, the classic style was soon adopted by the bourgeois patrons, which led to the popularisation of aristocratic taste.¹⁴⁵ A different kind of Second style decoration is seen in the *megalographiae*, an expression used by Vitruvius, which actually means paintings of large dimensions.¹⁴⁶ These paintings were compositions with figures of natural size, often depicting initiation rites, such as in the Villa of the Mysteries.¹⁴⁷ The motifs painted on these walls have been interpreted as rites of marriage, of fertility or as Dionysiac rites.¹⁴⁸

¹³⁸ Moorman, 1998, p. 29.

¹³⁹ Wallace-Hadrill, 1994, pp. 26-27.

¹⁴⁰ Clarke, 1991, p. 52.

¹⁴¹ Clarke, 1991, p. 56.

¹⁴² Ling, 1991, p. 216.

¹⁴³ Barbet, 1985, p. 42.

¹⁴⁴ Borda, 1958, p. 187.

¹⁴⁵ Goodman, 1997, p. 186.

¹⁴⁶ Vitruvius, VII, 5.

¹⁴⁷ Scagliarini Corlàita, 1998, p. 53.

¹⁴⁸ Barbet, 1985, p. 52.



Fig. 28. First style decoration at the Casa del Fauno, Pompeii.

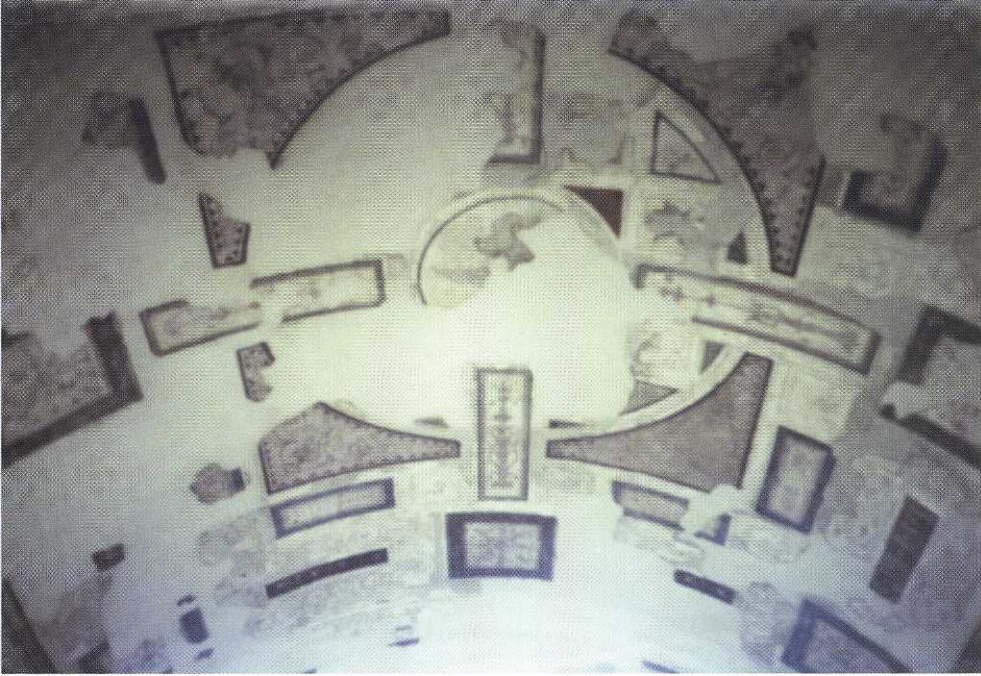


Fig 29. The House of Augustus, decorations in the upstairs cubiculum, c. 30-20 BC.
Above. Vault in the upstairs *cubiculum*, c. 30-20 BC. *Below:* *La stanza dei pini*, c. 30-20 BC.

Philosophical or historical allegories were other grand Second style motifs as were also entire rooms painted as gardens, such as the garden paintings in the Villa of Livia at Prima Porta, now exposed at the Museo Nazionale in Palazzo Massimo in Rome. These paintings contain a lot of information regarding plants and birds. There are indications that this is the country estate at Prima Porta, which Livia inherited. According to Pliny, Livia was on one occasion seated in this house when she was engaged to Octavianus, later to become Augustus, when an eagle, passing in the sky, dropped an unhurt, white hen into her lap.¹⁴⁹ Another miracle was that the hen, in its beak, held a laurel branch bearing its berries. Since this was interpreted as a good omen, the augurs ordered that the hen should be protected and that the laurel branch should be planted. The house thereafter was called *ad gallinas albas* referring to the white hen. Also Suetonius tells a similar story.

Wall constructions, wall paintings, and floors with mosaic decorations or in *opus sectile* have been found, dateable from between the Augustan to the Hadrian periods.¹⁵⁰ Excavations at the villa are still in progress, and fragments of wall paintings dateable to the Augustan period have been found quite recently. Among them is a narrow Third style fragment with elegant decorations on a black background, close to a foundation in the atrium. The position and the size of this base have raised the idea that it may have been the place of the famous statue of Augustus, found during the last century at an undefined spot at the villa. On the other hand, such a foundation could have been the base for the chest containing the family treasury.

The most well-known painter of the Augustan period was Ludius (or Studius), suggested as the painter who made the decorations at the House of Livia on the Palatine, the Villa of Livia at Prima Porta, the house excavated underneath the Villa Farnesina, and the Villa at Boscotrecase just north of Pompeii. Bianchi Bandinelli states that Ludius made either the paintings at Prima Porta or those at Villa della Farnesina, as he could not have been the master of both.¹⁵¹ Gabriel, on the other hand, indicates the probability that the garden paintings are decorations made by several artists, since she is certain to have identified the hand of the master, a second painter and two minor painters.¹⁵² Ling has convincingly argued that Ludius was probably active during the first 30 years of the Augustan period, i.e. working at the time of the Second and early Third Styles.¹⁵³ Ludius was highly esteemed for his beautiful landscapes, views of beaches and harbours, seaside villages, small woods, and other idyllic motifs, and it seems reasonable to assume that the most famous artist during that period worked for the circle close to the Imperial family.

It is, however, probable that wall paintings covering large areas were made by teams of craftsmen from a workshop rather than by a single master. It has not yet been established who was the master or masters working at these specific houses. Neither is it known if the master worked with one team of collaborators, belonging to his studio, or if a team of painters was selected for each commission. It is a well-known general fact that each artist has an individual touch, by which it is normally possible to determine works by his or her hand, a comparative work much used for

¹⁴⁹ Gabriel, 1955, pp. 1-3.

¹⁵⁰ Dr. Peter Liljenstolpe. Lecture at the Swedish excavations at Prima Porta, October 3, 1998.

¹⁵¹ Bianchi Bandinelli, 1980, p. 22.

¹⁵² Gabriel, 1955, pp. 28-31.

¹⁵³ Ling, 1999, VIII.

example in the analysis of pottery painters. To determine the painter of one or more specific decorations is comparatively more difficult, since the painter is not just an artisan, but also an inventive person, which means that he probably discovers new solutions in painting while working. Due to this, early and later paintings by any artist are of necessity different in appearance, an important fact to keep in mind when analysing ancient material. The Augustan political and cultural programme evidently had an impact on the stylistic changes, as the Second style was succeeded by the Third in a relatively short period of time. Such a change indicates a personal progress for any painter active during the period, either by being an inventor of new motifs and presenting new solutions of pictorial problems, or by just adapting to the demands of the commissioners.



Fig. 30. Villa of Oplontis. Second style marble imitations.



Fig. 31. Villa of Oplontis. Wall decorations in the service quarters.

The Third style

The candelabrum style may be regarded as an independent style contemporary with the late Second and the early Third styles.¹⁵⁴ It is characterised by decorative patterns, in particular floral motifs and slender candelabra. Vitruvius objected to the paintings of this period, which he considered as outbreaks of bad taste, since the naturalistic reality had been abandoned in favour of monsters and fantastic creatures.¹⁵⁵ During his lifetime motifs such as herms, centaurs and arabesques were commonly used.¹⁵⁶



Fig. 32. Decoration made in the Candelabrum style. Caserma degli Gladiatori, Pompeii.

¹⁵⁴ Dr. Staub Gierow, personal communication, October 2000.

¹⁵⁵ Vitruvius, VII, 5.

¹⁵⁶ Borda, 1958, p. 51.

The Third style, referred to by Maiuri as the Egyptizing style, developed during the reigns of Augustus and Tiberius, and may be described as a two-dimensional and ornamental style, based purely on colour as the forming modality.¹⁵⁷ Even though painted architectural structures were still part of the decorative system, there was evidently no attempt at achieving any illusion of depth. Exotic motifs appear, such as representations of impressions of countries far away, in particular from Egypt. There were also an increasing number of paintings with mythical figures represented in idyllic and unrealistic landscapes. This style has been described as the classicism of the ruling classes.¹⁵⁸ The decorations became simpler, and the architectural motifs disappeared in favour of large monochrome areas and a clear delineation of socle, wall, ornament and picture field. The classicistic and restrained structures and forms, combined with a quiet colour scheme in the individual rooms, express a longing for calm, order and clarity.¹⁵⁹ During this period the central painting in the main field was expanding, and its figural motif became the dominant painting of the room. The first known examples of the Third style are located inside the Pyramid of Cestius in Rome, dated about AD 12. Third style paintings were made, e.g. in the Casa di Lucius Fronto at Pompeii. In mosaic art polychromy disappears in favour of black and white motifs, and become floors to be walked on, not to be looked at.¹⁶⁰

The Fourth style

The Fourth style has been defined as eclectic, and may be described as a combination of Second style architecture with the decorative patterns of the Third style. The period is roughly from between the reigns of Claudius and Nero, until the Vespasianic period, i.e. from AD 45 until 79 at the eruption of Vesuvius. There is no longer any attempt at creating a realistic visual structure in the paintings, which are merely ornamental.¹⁶¹ Various repetitive patterns occur as subdivisions of the walls. This is often referred to as the *tapestry manner*, due to the resemblance of modern wallpaper.¹⁶² The introduction of such repetitive patterns, *embroidery borders*, which appear as if stencilled to the background, is characteristic of the Fourth style.¹⁶³ Clarke refers to these patterns, sometimes called filigree patterns, as *carpet borders*.¹⁶⁴ Such borders derive from textiles and constitute a diagnostic trait for all Fourth style walls.¹⁶⁵ Flying figures or pictures decorate the centres of these imagi-

¹⁵⁷ Maiuri, 1931, p. 12.

¹⁵⁸ Moorman, 1998, p. 23.

¹⁵⁹ Zanker, 1988, p. 283.

¹⁶⁰ Clarke, 1991, p. 61-63.

¹⁶¹ Maiuri, 1931, p. 10.

¹⁶² Clarke, 1991, pp. 167-168.

¹⁶³ Ling, 1991, p. 71.

¹⁶⁴ Clarke, 1991, p. 168.

¹⁶⁵ *Ibid.*, p. 66.

nary tapestries. *Embroidery border* is not an appropriate term, according to Barbet, instead suggesting the introduction of an adequate terminology to identify motifs in Roman wall decoration.¹⁶⁶ And indeed, what is the difference between embroidery border, carpet border and filigree pattern?

One reason for the appearance of repetitive motifs during this period may have been a consequence of the earthquake in Pompeii in AD 62. It has been pointed out by Clarke that the disastrous effects of the earthquake brought about a collapse of the Pompeian economy.¹⁶⁷ According to him, the wealthy left and those who remained were left with the long lasting task of rebuilding houses and public monuments. Severe damages were caused by the disaster. Many walls were partially destroyed and had to be repaired, a situation favouring rapidly made decorations.¹⁶⁸

The Fourth style appeared in Rome during the reign of Nero, or maybe a little earlier. Intense building activities took place also in Rome, especially after the great fire in AD 64, when large areas of central Rome and the Neronian palace Domus Transitoria, had been completely or partially destroyed. After the fire the construction of Domus Aurea, the Golden House of Nero, was started, integrating parts of the Domus Transitoria.¹⁶⁹ This large building complex was constructed according to the agricultural functions of a Roman villa.¹⁷⁰ The palace was extended from the temple of Claudius on the Caelian hill to the area of the present Via Merulana, where the gardens of Mecenas were set out.¹⁷¹ It was completed in its essential parts before the death of Nero in 68, and was called Domus Aurea because the façade of the main building was gilded.¹⁷² The complex was used until 104, and the major part of the decorations were made during the Neronian period.¹⁷³ Since the period is well determined and the paintings were mainly made in a homogeneous style, it has been suggested that the style was created or developed for this huge monument.¹⁷⁴ According to Iacopi there is actually no unity of style in the Domus Aurea.¹⁷⁵ Even though the major part of the decorations has been made in the Fourth style, some paintings chronologically-stylistically belong to the Third style. This enormous building complex was discovered at the end of the 15th century, and its paintings, the so-called *grottesche*, inspired Renaissance artists such as Raphael, Giovanni da Udine and Zuccari.¹⁷⁶

¹⁶⁶ Barbet, 1981, p. 917.

¹⁶⁷ Clarke, 1991, p. 165.

¹⁶⁸ Ling, 1991, p. 72.

¹⁶⁹ Boethius, 1960, p. 107.

¹⁷⁰ Boethius, 1960, p. 95, 112; Ward Perkins, 1970, p. 214.

¹⁷¹ Boethius, 1960, pp. 107-108.

¹⁷² *Ibid.*, p. 103.

¹⁷³ Ling, 1991, p. 72.

¹⁷⁴ Moorman, 1988, p. 5.

¹⁷⁵ Iacopi, 1999, p. 19.

¹⁷⁶ Borda, 1958, p. 71; Ward Perkins, 1970, p. 216.



Fig. 33. Fourth style decoration in the Casa degli Casti Amanti, Pompeii.



Fig. 34. Fourth style decoration from the Villa of Arianna.

New innovations from this period are the figures placed into niches or doorways, represented as living beings and in a few cases as statues. Gilded stucco decorations became common, sometimes with glass beads set into the centre of the flowers.¹⁷⁷ Statues representing popular figures from Greek tragedies were inserted into the pictorial context, in the *scaenae frons*, stage fronts, and also used as Fourth style decorations in, e.g. the Domus Aurea.¹⁷⁸

Fabullus (or Famulus) was the most famous painter during the Neronian period. He was known to have painted on panels as well as on walls, a rarity during the Roman period.¹⁷⁹ He was particularly fond of using brilliant background colours such as red and blue.¹⁸⁰ It has been suggested that he was inventor of the Fourth style, since he spent many years of his life decorating walls, at first in Domus Transitoria and later in the Domus Aurea, which according to Pliny became the “*prison of his art*”.¹⁸¹ He was, however, not the only artist engaged in these decorations. Investigations of the decorations, in connection with the conservation project in the late 1990s presented by Iacopi, have shown that the differences in artistic style and quality are too diversified to have been the work of just one person.¹⁸²

A simplified version of the Fourth style continued to be used in Rome and throughout the Roman Empire at least during the following two centuries. The later period, after Vespasian, is not as well documented as the earlier periods. As far as we know, there are only a few well-preserved houses or walls after that period.

Wall decorations at Pompeii may be dated fairly well in the period from the first century BC to AD 79. One event, convenient for dating, is the earthquake at Pompeii, which took place on February 5, AD 62. Several evidences of repairs or unrepaired cracks in the walls are still evident. Paintings presenting such damages were definitely made before the earthquake, while those made upon repairs after the disaster were made later.¹⁸³ Undamaged walls were either saved from damage at the earthquake, or made later. There are indications of more than one earthquake in the years between 62 and 79, preceding the eruption of Vesuvius.

¹⁷⁷ Ling, 1991, p. 87.

¹⁷⁸ Moorman, 1998, p. 25; Clarke, 1991, p. 71.

¹⁷⁹ Iacopi, 1999, p. 25.

¹⁸⁰ *Ibid.*, p. 49.

¹⁸¹ Plinius, NH XXXV, 120.

¹⁸² Iacopi, 1999, p. 9.

¹⁸³ Clarke, 1991, p. 73.

¹⁸⁴ *Ibid.*, p. 74.

¹⁸⁵ Ling, 1991, p. 72.

Discussion

Roman culture was, in earlier publications, principally focused on art and architecture, and being so, they were mainly descriptive. Architects observed and measured the surviving parts of sacred and profane buildings, and identified their interior spaces and structures. Roman town planning was part of these studies, and has been given constant interest through the years, just as the monuments representing the urban structure, i.e. its streets, places, bridges and town walls.

Art historians were principally interested in stylistic interpretations of statues, paintings and various kinds of handicraft. Based on principles, referable to stylistic analyses, their suggestions on dating, and assumptions regarding the artistic tradition, were presented. Such analyses are traditionally made according to analytical schemes and value systems, into which the different objects are classified, according to their formal appearance, but also described with regard to some more subtle values, such as their supposed beauty, the technical quality, or the objects as being part of any specific tradition. These, later, aspects of criteria are not generally mentioned, but still exist as unspoken preferences, or as undeclared expressions of the common taste during any specific period. Preferences change at intervals, but some principles seem to be constant. Among these constant values are, e.g. the unmentioned conviction, that some art forms have greater value than others, such as well-executed painted portraits as being superior to well made pottery decorations, or original Greek statues being of higher value than Roman copies of Greek statues. Since there are such latent personal preferences and prejudices among all people, descriptions of art are necessarily, personal opinions. Opinions are formed, expressed and may be related to any specific period, and are therefore mirroring also the value systems of the period in which the descriptions are made. Having a personal opinion, and expressing it, simply means that human beings are subjective in their feelings, but not necessarily, in their research methods.

Statues from the Hellenistic-Roman cultures have traditionally been classified primarily as Greek originals or Roman copies, the prior considered to be of superior quality than the later, much due to the theoretical impact and personal taste of Winckelmann. Romans did copy, and they made replica series of Greek statues. These copies constitute the main source for our knowledge of Greek art today. Copies have for a long period been regarded as objects of inferior value than originals, and therefore the word *copy* has become closely associated with general conceptions of inferiority and low artistic value. Nowadays, the phenomenon of copying, or reproducing, is investigated as such, and the statues are studied as part of the decorative system, i.e. as readable signs, which have significance within their context.

The attitude towards plastic art has changed in more than one way during the centuries. Until quite recently, remaining polychromy on ancient statues was cleaned off, since marble statues were supposed to have been white. Today the remains of original polychromy, which occasionally are found, are very much appreciated. Along with this new conception of art, the attitude towards cleaning has changed, and is made with more delicate methods than those used before. Another change in opinion has led to reconstructions of missing pieces not being made any-

more, while such interventions, previously, were part of the maintenance programme of the statue.

In earlier descriptions, much attention was given to the stories depicted, mainly mythological motifs, which were represented in visual art. Among scholars who paid great attention to the interpretation of mythological motifs were Curtius and Maiuri, later followed by Schefold. Investigations of mythological motifs are still performed, such as in the study of the Pompeian paintings representing the abandoned Ariadne, made by Gallo, or the study of *Aula Isiaca* by Iacopi. Iacopi, however, is not principally interested in describing the myths, but rather to put them into a context, with the objective of dating the *Aula* and determining the original use of the space. This approach towards art and art history is representative for present scholarly investigations.

Enormous amounts of statues, paintings, and other works of art were found at the discovery of Pompeii and the other Campanian towns, which had become buried in ash and lava, at the eruption of Vesuvius in AD 79. The paintings discovered at Pompeii were systematically studied and classified by Mau at the beginning of this century, and divided into Four styles. The Roman wall construction techniques, and the various covering materials traditionally used for aesthetic reasons, and their decorative elements were studied, and dated. The decorative motifs, i.e. the pictures on floors, ceilings and walls were given particular interest, but always with regard to the indisputable inheritance of Greek art.

It seems only natural that the aspect of classification of styles and buildings was important in earlier research, since these issues provide the basic information for understanding the standing structures. The classification systems have been defined and stylistic problems have been thoroughly discussed, just as the Greek influence on Roman art. In recent research focus is set on somewhat different issues, such as the characteristics of the Roman tradition and how it has been expressed in various fields. Instead of stating the superiority of Greek artists in painting and sculpture, Roman art is studied for its own sake. The indebtedness to Greek tradition is so well accepted that there is no challenge in pointing it out. Instead the Roman way of transforming and adapting Greek models for their own needs has been investigated by several scholars and from various aspects. Earlier as well as later scholars have pointed out the utilitarian aspect of Roman art as a very important characteristic, and it has been stated that art to a great extent was used to manifest the political or economic power and also the social influence of the owner. Other topics investigated have been the social context of the Roman house, as well as the private spheres of the buildings. In connection to such issues, much interest has been devoted to the ethics and moral of the Romans, aspects that, maybe, could be defined as studies of the Roman spirit. Studies of Roman culture, therefore, has changed from principally having a function of descriptions of art objects, to becoming studies concerning the social and private lives of the Romans, values and preferences which were visualised as images, in the form of building constructions and in the appearance of their art. Instead of mainly concentrating on the pictures with figural motifs in painting, and focusing on stylistic questions, the pictures are rather viewed and explained as parts of the decorative schemes, and the decoration is interpreted as such. The materials used within the decorative system have been carefully studied and described,

often as a result of conservation interventions performed. In connection to such studies, some regard has been given to the artists, and some attempts have been made to identify works made by specific workshops, to establish how they prepared and proceeded their work, as well as how they were contracted.

Roman art and architecture, consequently, were signals, used to announce the social status of its owner. In the house of a public person, his power and importance was manifested by impressive decorations, not only on the walls, but also on the floors and ceilings, which means that the milieu was covered with decorations, distinctly chosen for the place. Studies have revealed that each environment required its own theme, constructed by a setting of motifs, with understandable signs for each person entering the space, and underlining the intentional message of the place.

Due to this utilitarian approach to art, the setting as such was of higher importance than were the single details, which may explain the repetition of motifs. A copy, or a replica of a work of art was given a similar value as an original, the importance was the motif and its capacity of underlining the theme of the ambience into which it was placed. The single piece of art was a symbol, and as such it had a message, which was emphasised by that of the space within which it was placed. Seen from this perspective, a copy, or the repetition of a type, was suitable, because a well-known motif was not misunderstood, but had the immediate function of signalling a message. This is not very different from the way people manifest themselves through art today, whether it is by showing a row of ancestors portraits or by possessing a painting by Rembrandt or Picasso. Social inheritance or wealth are still powers presented to the public through art.

The materials used within the Roman building, and observable as the surface, was also of highest importance. The ceilings, walls and floors of the Roman house were decorated, and a vast selection of materials was used. Architectural details were made of white or coloured marble, or of painted stucco. The floors were made in mosaic or marble, often laid in impressive decorations, i.e. in the houses of the wealthy, otherwise the floors were made of simple materials, such as terracotta. The decoration on walls and ceilings appeared in relief as well as in a symphony of vivid colours. This variety in forms and colours, softened by the relative darkness in the rooms, was part of the manifestive programme, just as the variety of materials, real or fake, which were used. Much attention was given to the structures of the walls. Their smoothness and silky lustre were, along with the painted decorations, signals of wealth, in contrast to the simple walls in the home of a poor family. Real or fake, original or copy, were issues of less importance than was the social manifestation.

The Fayum portraits appear in Egypt during the Roman period, and therefore they are part of the Roman tradition and the Roman value system. These pictures may, therefore, be studied and interpreted according to the Roman value and aspect of art, as aesthetical objects for manifestation or propaganda. Also these portraits appear as signals of the owner's position. Consequently, the material and the artistic quality of the portrait are measures, which show the social status of the commissioner. The families, who could afford to pay a first class portrait painter, did so, and those who could not, had to be satisfied with a less well-made representation of the subject, or maybe a rapid sketch from an artist's workshop. This may explain the fact that there are different, contemporary artistic styles, represented among the

Fayum portraits. Some pictures are naturalistic and expressive portraits of individuals, often manifesting their wealth or social status by wearing beautiful jewels, a uniform or a golden wreath. These portraits were probably seen by the public, including painters from various workshops, and served as models for other portrait painters. There are several examples of repetitions of characters, which cannot be explained otherwise. Finally, there is a group of portraits, which artistically represent the opposite of the naturalistic tradition in portraiture. Those pictures are schematical representations of persons, often appearing more like a symbolic sign for a person, than as an actual portrait of an individual.

At present, the scholars studying Roman art and architecture seem to take most perspectives into consideration. It is, in my opinion, difficult to make any indubitable determinations about issues such as the Roman spirit, or ethics and moral in Ancient Rome. Neither is it possible to determine the social standard of a family on the basis of the decorations and the size of a house. It seems reasonable to presume that the owner of a large property with vast decorations was a wealthy person, but modern standards are not equal to those during the Roman period. Taking into consideration all information available, it is adequate to formulate a reasonably valid hypothesis about Roman society and some of its individuals. But even if we feel affinity to, or are inspired by the Roman world as expressed in its art, times have changed and we can only imagine the spirit of the past.

APPLICATIVE IMPLICATIONS IN CONSERVATION

Conservation of Plastic Art

Stone is expected to be an everlasting material but, nevertheless, it is exposed to various forms of decay. The majority of stones are subject to a gradual deterioration.¹ In open-air environments deterioration is normally very slow, and in protected milieus almost ignorable. Deterioration may be caused by various factors, and the three most common are physical, chemical and biological factors, acting and interacting on the artefact in a complex manner, thereby modifying the structure as well as the composition.² Some kinds of environments cause a rapid deterioration of stone, such as air pollution in modern cities, or the biological growth in environments situated close to the sea, where factors such as exposure to changes in temperature, and to wind, dampness and salt in the air also contribute to the deterioration of stone objects.³ Thermal shocks in hot and dry climates are another factor causing deterioration.⁴ The degradation of stone may also be due to capillary suction, frost and salt crystallisation.⁵

The effects of air pollution have been given much attention during the last decades, but even though awareness about the reasons and the effects has increased, the problems are still unsolved.⁶ Biological attacks through the physical and chemical influence of vegetation and bacteria is another natural cause of decay. The negative effects of biological growth upon works of art has been known and studied for a long time. Most of modern research has been focused on algae, lichens and bacteria.⁷ Secreted lichen acids attack the stone and extract nutrients necessary for lichen growth.⁸

Due to these circumstances, which cannot be avoided, a systematic maintenance of the objects should be performed to keep the objects well preserved and to prolong their lifetime. Such caretaking of works of art seems to have been accepted as a natural and inevitable procedure by the Greeks and Romans. Apparently the regular maintenance of statues consisted of cleaning, followed by renewed application of Punic wax, in the *ganosis* process. Damaged or lost parts of statues were reconstructed, a fact mentioned by several ancient authors.⁹ Maintenance in the form of cleaning, surface protections, repair and reconstructions made works of art survive in a natural ageing process, respecting their symbolic, artistic, aesthetic and historic values. Lack of maintenance must be regarded as disrespect for such values, nowadays as well as during Antiquity.

¹ Lazzarini and Laurenzo Tabasso, 1988, pp. 16-17; Löfvendahl, 1991, pp. 15-16; Price, 1987, p. 4.

² Tiano, 1991, p. 56; Price, 1987, p. 9.

³ Löfvendahl, 1991, p. 17; Lazzarini and Laurenzi Tabasso, 1988, p. 24.

⁴ Lazzarini and Laurenzo Tabasso, 1988, p. 24.

⁵ Torracca, 1988, pp. 8, 31-33; Lindqvist et.al, 1989, p. 302.

⁶ Price, 1987, p. 9; Rosvall, 1988, p. 33; Rosvall and Lagerqvist, 1992, p. 2.

⁷ Price, 1987, p. 10.

⁸ Löfvendahl, 1991, p. 17; Lazzarini and Laurenzi Tabasso, 1988, p. 39.

⁹ Cagianò de Azevedo, 1952, p. 57.

Today, as stated above, works of art become continuously impregnated with chemicals in order to make them resist the effects of air pollution and biological attacks. Since we have not been able to solve the problem of air pollution and do not spend enough time and money on maintenance, other solutions must be looked for, otherwise part of our cultural heritage will disappear. One way of saving important works of art is by disposing of them in museums and letting copies be exposed in the open-air environment.



Fig. 35. Stone decay. Black crusts on white marble. The Protestant cemetery, Rome.

Conservation of Roman Wall Paintings

The aspects of restoration, copy and fake, are slightly different when paintings are concerned, since paintings are mostly protected, while statues in many cases are not. Issues concerning the conservation of paintings consist mainly of if and how to confront losses of the painted surface. In Antiquity copies of famous paintings were made, as is evident, e.g. at Pompeii and Herculaneum. Copies of paintings seem to have had a slightly different history than sculpture, since there are indications that corrections of common motifs were constantly made to suit the place and the taste of the commissioner.¹⁰ Issues of authenticity do not seem to have been a problem.

The formerly common practice of repainting lost areas on a painting, normally made in the same style and material or as to look like the original, is today considered as falsifications, since they are later interpretations of an original artistic image. *“The restoration must aim at the re-establishment of the potential unity of the work of art, provided that it is possible without committing artistic and historic falsifications, and without cancelling any traces of the objects’ passage in time...”*¹¹ In order to avoid misinterpretations or misapprehensions, the re-painted area should be made with different materials and in a different manner, in order to make possible the distinguishment between the “integration” and the original. Furthermore the materials used for integrations are requested to be “reversible”, or, rather “re-treatable”. This means, e.g., that an integration made on a painting is made with water-colour paint, whether the painting was made on a plastered wall or with oil or tempera on a prepared cloth or panel. Aquarelle paint has a different structure and is not opaque, and is therefore possible to distinguish from existing original materials, and also possible to remove. In practice, however, such adequate integration is often treated with an application of Paraloid B72, frequently diluted in Diluente Nitro, with the intent of making the surface of the integrated area more durable. It has to be emphasised that in reality this kind of application is not reversible.

Roman wall paintings have been described and investigated by scholars and chemists in numerous publications, often presenting contradicting results.¹² There are no diverging ideas about how the carrying structure, i.e. the plaster preparations, were made since they, more or less, strictly follow the recommendations expressed by Vitruvius in *De Architectura* VII.¹³ An unsolved problem, still, is an uncertainty concerning the techniques and materials used for the paint layers, in spite of the fact that methods for scientific analysis have gradually become more refined.¹⁴ Roman murals have also been successively exposed to the most various kinds of conservation treatments. One of the most devastating substances used on Pompeian wall decorations was the protective composed by Morriconi, and adapted as a surface protective for many years. This remarkable substance consisted of turpentine, alco-

¹⁰ Ling, 1991, p. 21.

¹¹ Brandi, 1977, p. 8. (“...il restauro deve mirare al ristabilimento della unità potenziale dell’opera d’arte, purché ciò sia possibile senza commettere un falso artistico o un falso storico, e senza cancellare ogni traccia del passaggio dell’opera d’arte nel tempo...”).

¹² Augusti, 1961, p. 189.

¹³ Augusti, 1961, p. 189.

¹⁴ Brandi, 1977, p. 82.

hol, amber, copal varnish, rubber and sandarac, but had the disadvantage of turning yellow and sometimes it even provoked the detachment of the colours.¹⁵

When studying the history of some wall decorations, it is remarkable that the paintings still exist. The paintings in the Casa di Livia on the Palatine were unearthed in 1875, and they suffered successively from continuous restoration interventions until 1915 when they were detached from the walls and transferred to a panel of Portland cement with the objective of saving them. In contact with Portland cement the original problems did not disappear. On the contrary the problems increased, due to the flourishing of salts on the surface of the paintings, which derived from the wet and slowly drying cement.¹⁶ At an intervention in 1949, the cement as well as the various surface coatings was removed.

The list could be made very long indeed, with reference to all known examples of conservation methods on Roman wall paintings, considering such objects within the areas of Rome and of Naples. Much space would also be required in order to refer to all the different treatments which these paintings have been exposed to during the roughly two centuries since they were first discovered. The conservation problems and successive treatments can be followed, e.g. in many annual reports from the excavation sites.

Paintings have deteriorated successively or even disappeared due to badly performed conservation but mainly due to a lack of maintenance. Wall paintings that were registered and copied a century ago or earlier can in many cases hardly be identified anymore, since there are not enough remains of the decorations.¹⁷ Knowing that this has been the situation from the start of experimentation with conservation methods, the present situation will be described by examining a few examples.

One example is the decorated room with garden paintings from the Villa of Livia at Prima Porta, just outside Rome, which has been exposed to an incredible amount of interventions. The villa was found and partially excavated in 1863, the most important art objects successively removed and the site filled up and abandoned. The restoration history of the garden paintings is astonishing. They were exposed to a great number of interventions, until 1951, when they were finally detached and moved to Museo Nazionale Romano.¹⁸ Among the different surface treatments made on these paintings can be mentioned cleaning with bread, with alcohol and various solvents, various applications of fluid wax and paraffin diluted in turpentine. It is a wonder that anything of the paintings remains. Quite recently these paintings have been (finally?) re-restored and moved to a permanent exhibition at Palazzo Massimo. It must be said, however, that on every occasion, the methods used were

¹⁵ Borrelli, 1980, p. 81.

¹⁶ Cagianò de Azevedo, 1949, pp. 145-146.

¹⁷ Dr. Staub Gierow, unpublished paper presented at *Il settecento romano*, at Istituto Svedese di Studi Classici a Roma 21-23 September 1998.

¹⁸ Cagianò de Azevedo, 1953, pp. 13-16.

accepted by those persons responsible, i.e. thought to be adequate and, hopefully, harmless interventions. Time has shown they were not.

At the Palatine Hill, in close connection to House of Livia and the temples of Apollo and Magna Mater, is the, so called, House of Augustus. These buildings are all constructed during the Roman era and date to the last decades BC. The House of Augustus is situated on a relatively elevated level of the hill with good ventilation and limited problems of humidity, and there is no car traffic in the vicinity. This means that the building is not exposed to some of the most common modern conservation problems, such as penetration of water and exposure to hydrocarbons from the combustion of petroleum etc. The remaining two-floor building is roofed, and thereby its paintings, stuccoes and mosaic floors are protected from rain as well as from sunshine, and sheltered from direct airborne pollution. In this complex of rooms, close to the Temple of Apollo, there are several Second style paintings preserved.

Conservation treatments have been performed and at this moment (Autumn 1998) are still in progress. Where conservation is terminated the rooms have been closed by the insertion of Plexiglas sheets into the door-openings, making it possible to look into the rooms, but not to enter. The Plexiglas sheets are slightly smaller in size than the door-openings, thus allowing some circulation of air. The conservation of painted surfaces has been made in roughly the following way; stuccoing of lacunae, painted integrations of the stuccoing with watercolour paint in the *tratteggio* technique, and a final protection with Paraloid B72 diluted in Diluente Nitro. Two rooms will be described, situated close to each other on the ground floor. One is the so-called *Stanza delle maschere* and the other the *Stanza dei pini*.

Stanza delle maschere has received its name from some painted theatrical masks, which are part of the architectural decoration. The conservation of this room is more or less complete, and there were just a few details that still had to be filled in at my visit in October 1998. The immediate impression of the room is that too many conservation treatments seem to have been executed, since the colours appear too brilliant and the outlining of details is hard and not authentic. The total impression is that of standing in front of a fake. I made some photos and those were later compared to rather recent photos found in the publication by Ling, "Roman art" and there was an obvious difference. The retouching of the paintings have not been made just on limited areas, where stuccoing demanded some intervention, but also on perfectly legible areas, where the painting previously had a worn surface.

In *Stanza dei pini*, the conservation is not yet finished, though stuccoing and some pictorial integrations have been made. The immediate impression of the decorations was quite different to the impressions of the prior room, since the decorations in *Stanza dei pini* seem authentic, as the surface was not too lustrous, and the colours not too brilliant, i.e. not over-restored. When asking some questions to the conservation technician, I was informed that further interventions were planned, including retouches of some painted areas, in order to "strengthen the design", and finally that the walls were going to be protected with the application of Paraloid B 72, dissolved in Diluente Nitro.¹⁹

Standing before these paintings some issues concerning conservation methods automatically arise. We must consider that the environmental quality of the sur-

roundings are quite good, seen from the conservation point of view, including the protection of the paintings. Since the decorations are not exposed to strong variations in temperature and are protected from man, from rain and winds etc, there would possibly be no need to use a surface protective such as Paraloid. Comparing the results presented in the *Stanza delle maschere* to that of *Stanza dei pini*, the difference in appearance is very notable, and not in favour of the first mentioned.

Returning to the issues of authenticity and the ideal of minimum intervention, the interventions here can be judged by the means presented in conservation theory. In *Stanza delle maschere* conservation did not stop at minimum intervention, since work continued with retouches, even on the surface of the paintings, treatments, which are absolutely contradictory to established guidelines, since such retouches are falsifications.²⁰ According to Brandi, the objective is not to refresh the colours on paintings, nor to bring them back to a hypothetical original state.²¹ Since the *Stanza delle Maschere* has already been impregnated with Paraloid, and this application cannot be reversed, it would be convenient to stop interventions at the intermediate phase, represented by *Stanza dei pini* and let some time pass in order to observe the long term effects in the two rooms. Maybe it will be discovered that application of Paraloid is not necessary, due to the preventive measures taken.

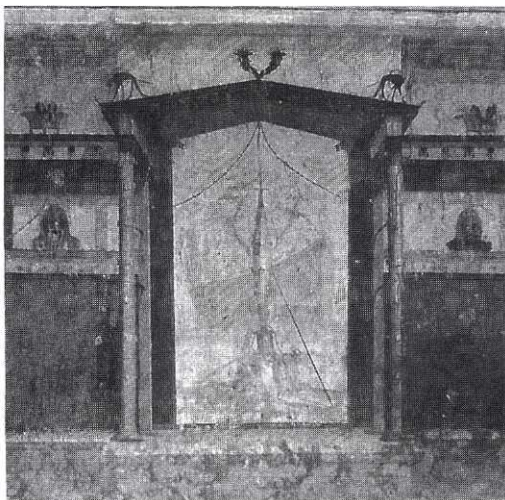


Fig. 36. To the left: The House of Augustus, detail. *Stanza delle maschere*, after Ling 1991.

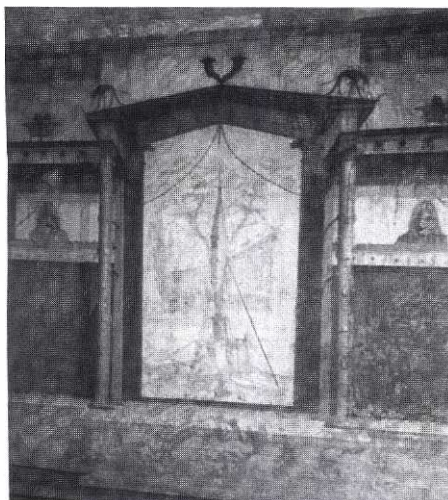


Fig. 37. To the right: The House of Augustus, detail. *Stanza delle maschere*, Autumn 1998.

¹⁹ Marina Cavalieri, conservation technician (*tecnico di restauro*), personal communication October 1998.

²⁰ Brandi, 1977; Cagiano de Azevedo, 1953; Melucco Vaccaro, 1989; Marconi, 1984.

²¹ Brandi, 1977, p. 84.

Pictorial integrations in the *tratteggio* technique made with watercolour paint are adequate in this kind of environment, and in accordance with conservation theory. The watercolour is estimated to be reversible and it is compatible with the lime plaster. The *tratteggio* technique makes an “invisible” integration, when looked upon at a close distance, but the integrated parts are clearly distinguished at closer investigation. Paraloid B 72 is not reversible and it is not compatible with lime plaster. If applied, the impression of the surface will change. Therefore Paraloid should, in my opinion, not be used.

At the Domus Aurea in Rome extensive conservation work was in progress before the building was opened to the public in 1999. This building, of enormous size, was built by Emperor Nero after the great fire in AD 64, and completed in its essential parts before his death in 68.²² At present about 100 rooms have been discovered, which is roughly the estimated extension of the right wing of the complex. Most of the building is covered with earth and by later buildings. The most severe problem at the site, according to the director of the conservation programme, is the penetration of rainwater and humidity from above.²³ After heavy rain, water continues to penetrate the rooms for days, making the surroundings wet and constantly humid. Penetration of water results in calcareous depositions on the walls, thus hiding the paintings behind a white efflorescence of calcium and salts.

Conservation interventions have been performed inside the building. Restoration of the Fourth style wall decorations has been made. The interventions, to a great extent, consist of the removal of deposits, mainly of a calcareous type. Tests have been made which reveal that the colours of the murals are brilliant and intact underneath the deposits. Different methods for removal and cleaning are used, such as impacks of ammonium carbonate, to make the deposits more easily disposed of, and for the thicker deposits, and removal with a scalpel is occasionally used. Various conservation methods are tested, such as treatment with barium hydroxide, which hopefully will slow down the speed of formations of new calcareous layers, according to the director of surface conservation.²⁴ The only way of solving this problem entirely is by preventing the penetration of water from the ground, which is an enormous problem to resolve, due to the environmental circumstances.

It has, however, been decided to leave an extremely thin calcareous deposit upon the paintings in order not to expose them to biological or environmental aggressions. The paintings remain fully visible and are protected by this thin film. Such a simple solution has the advantage of returning the paintings to visibility without harming them in their material aspect and, as it seems, without need for any immediate application of a surface protective which may later be regretted. This may be considered as an excellent example of a minimum intervention since, according to the conservation theory, the interventions do not interfere with the authenticity of the paintings. When I returned to the Domus Aurea for a visit in September 1999,

²² Ling, 1991, p. 72.

²³ Antonello Vodret, personal communication.

²⁴ Elio Papparatti, personal communication.

conservation work in the rooms, open for visitors, was terminated, and the result must be described as very impressive, the settings of the spaces as sublime. This enormous conservation work must, in my opinion, be held as an example for conservation at its best, from the theoretic basis to the interventions made in real life, and finally the aesthetically performed presentation of the huge spaces to the public.

When large painted areas are missing, the conservator stands before a different kind of problem. One rule in conservation is not to invent a content in a missing area. On the other hand, even fragments of a painting on a wall need to be conserved, otherwise decay continues and soon the remains will be lost. Taking these considerations into account, conservation interventions may result in “islands” of paint within a monochrome background. There is no method, which can be used on all occasions, but in my opinion, the reconstruction made in the Villa of Oplontis shows one possible way of solving the problem. The thin lines, reproducing the pictorial scheme, facilitate the understanding of the motif without the addition of a false interpretation.



Fig. 38. The Villa of Oplontis. Reconstructed area of a wall decoration.

Use of Encaustic as a Modern Surface Coating

It must be stated from the beginning, that at this moment, it is not safe to say whether encaustic is a valid method for surface coating or not. The various mixtures of wax must be tested for a longer period of time, and on some more materials, during various controlled circumstances. Nevertheless, a systematic testing has been made as part of this research project, and in all cases performed, the result has been satisfying. The various applications, which have been made according to a specially developed research design, are described in the case studies. At this point it may, however, be relevant to briefly summarise.

Various mixtures of Punic wax have been tested by this author, mainly as a surface coating, and on one occasion, as paint. Before these applications were used in real life, a series of experiments were performed. The first application of Punic wax was made in 1995 on a statue of white marble. The statue, being placed in a garden, was covered with biological growth. After cleaning, Punic wax was applied, and later the surface heated. When the surface had cooled it was rubbed with a cloth. The stone received a slightly darker hue, notable to a trained eye. In 1999 the statue was cleaned with water and a soft brush. Cleaning was easy, and the application on the marble had not undergone any changes. In 1995 I used Punic wax, with the addition of some Venetian turpentine, as paint on a wall in an entrance. The supporting material was concrete. The paint was used directly on the wall and, so far, there have been no visible changes in the material. In the period 1997-98 Punic wax was used as a surface coating on some bronze statues, and the artist was very satisfied with the substance and the result. No changes in the material have been noted. Finally, a few tests have been made on fragments of Roman wall paintings. The negative effect is that the hue of the underlying structure immediately becomes somewhat darker, the positive aspect is that the lustre is beautiful and that, so far, no changes in the material have been noted. On one fragment, Punic wax and Paraloid B72 were compared. At the time of application, Paraloid was absolutely colourless, a positive quality, but a year later the Paraloid-treated surface had become darker than that of the Punic wax. The lustre of Paraloid is the most negative factor, from the aesthetic point of view, since the surface receives a hard lustre.

It is my intention to continue experimenting with various applications of Punic wax. When the number of performed applications have increased, and more applications of these mixtures have been studied, it will be possible to state whether Punic wax is an adequate material for coatings, or not.

Presentation of ancient art

Statues or fragments of statues, which are destined to exhibitions in museums, are today, after cleaning, generally kept the way they were found, without any material additions to their form. The exhibited fragment, often combined with elegant constructions of black iron or steel and plexi-glass, thus becomes a work of art in its own. Presentations are often simple as well as dramatic, and illumination of the fragment is made with well-placed spotlights, just as for the lone actor on the theatre stage. This leads to the focusing of all interest, partly on the fragmentary stat-

ue and partly on its bearing construction, which together with its illumination becomes a separate, and exclusive work of art. Statues, which are presented outside in the open air, are generally restored in their material aspect. Surface lacunae will mostly be stuccoed with a lime/marble putty, pigmented to resemble the colour of the stone surface. This stucco may be diluted with water or with water and acrylic resin. Old repairs with Portland cement will be removed, if present, and replaced with reconstructed parts in a more suitable lime/marble-dust putty, as mentioned above. Consolidation is a general custom, and a final impregnation of the stone is often considered as necessary. As a result, these kinds of statues maintain their morphological visual shape, but become transformed as matter.



Fig. 39. Exhibited fragments of polychrome terracotta statues. Museo Etrusco, Villa Giulia, Rome.

Important three-dimensional sculptural works of art in open-air environments are often transferred into museums, as a final resource to maintain them as matter and as works of art. Such solutions have to be accepted, due to the complexity of modern environmental problems, consisting of general air pollution, traceable as, e.g. smog and, so called, acid rain. Since the polluted air corrodes marbles as well as metals, it has become necessary to transfer some selected statues into museums in order to save them, and if possible to replace them with copies. As a result, it must obviously be accepted to interpret copies as substitutes, rather than as fakes.

Discussion

There is, and always has been, a problem of discrepancy between conservation in theory and practice. Winckelmann stated the importance of the documentation of conservation interventions, at least in publications. Cavaceppi agreed with Winckelmann but, when restoring, he performed reconstructions of losses up to 1/3rd of the size of the object. To determine whether the reconstructions were shown on the object or in publications requires a separate study.

Wall paintings are part of the immovable cultural heritage, but are frequently transferred from the archaeological sites for various reasons, and have often become overrestored by ambitious persons responsible. As a rule, stone objects, when treated, are nowadays impregnated with various chemical substances, with the good intention of preserving them for the future. The problem is that, due to efforts in saving the objects, they are often transformed, chemically and physically, and when trying in one respect to maintain their authenticity, this is destroyed or at least irreversibly changed, in another respect.

The issue of minimum intervention in conservation seems to be a proper guideline in conservation, when combined with the rule of making a critically and consciously performed restoration. By critically judging the problems related to each conservation intervention, and searching for the most adequate solutions in each separate situation, and by respecting the rule of performing the absolute minimum intervention, it would be possible to end up with not causing changes, in the material or in the initial artistic intention. Changes, which are due to the loss of material, remain, and such changes have to be accepted. Some consideration should also be given to the negative effects of chemicals on humans and nature, i.e. in "real life" conservation there should be an equilibrated approach to art, culture, nature and life. There seems to be a point, when we have to ask ourselves, whether the massive chemical treatments of objects, accepted on an international level, are justified if they endanger health and the quality of life.

CASE STUDIES

Some issues are common factors for the case studies presented below. The *decision process* connected to conservation interventions is such a factor, and so is the approach to *documentation*, which in these cases has been verbal, photographic and graphic. Chemical-technical investigations have been made on the material presented in case studies 2 and 4. These methods are thoroughly presented only in case study 2, since the analyses performed are the same, and there is no need for repetition. The results achieved are, however, for obvious reasons presented in both cases. Ocular investigations have been made of the material observed in case study 3, but these investigations were not as complete as those made in the studies mentioned above. *Historic and art history studies* and *co-operation with other professionals* are important common aspects of the case studies.

The studies concern objects related to different contexts. Case study 1 concerns architecture - an open-air exposed graffiti façade. Case study 2 concerns museum objects - Roman portraiture in a protected environment. Case study 3 concerns archaeological finds – fragments of Roman wall paintings planned to be exhibited in connection to their find context. Case study 4 concerns archaeological finds from a relatively long period, defined in Pompeian styles, and presents the process of documentation, sampling and determination of materials, all documented during the various phases of the investigation.

The Roman context is a common factor for Case studies 2, 3 and 4 and the material analyses, consequently, deal with the determination of materials used by the Romans. The possible presence of wax has been investigated. Materials in Case study 1 are considered to be from the Renaissance and the results are not presented in this context, since those materials are not within the limits of the present dissertation. The decision process concerning conservation is a link between the projects, although the situations and materials differ. The specific process of each project will be presented below.

Case study 5 concerns the conservation of marble objects, mainly from the Roman Imperial period. Case study 6 concerns experiments, which have been made in order to reconstruct Punic wax, and to understand the practical differences between the different wax-paints and painting methods, which have been investigated in this dissertation.

Case Study 1:

Palazzo Calabresi at Viterbo

Introduction

The present study describes a working process leading to suggestions on the conservation of the graffiti decorated façade of Palazzo Calabresi at Viterbo. The considerations were made by a group of professionals and students as an integrated part of the international co-operation programme, aiming at the restoration of the façade and suggestions for future use of the building complex, nowadays owned by the Comune di Viterbo. The building has been abandoned for a long time, and therefore presents a vast selection of damages, in addition to its many architectural components representing a range of historical phases. Due to the specific characteristics of the palace, the conservation project was supported as a Raphael Project by the European Union, with participating parties from three nations: Italy, Sweden and Great Britain. Integrated in the conservation study, which follows recommendations of ICOMOS, ICOM, ICCROM and ICR as well as other relevant authorities, are professional groups of art historians, archivists, architects, conservators and chemists, also co-involving the local authorities etc.

This study illustrates issues connected with planning of the conservation of the graffiti-decorated façade. In focus are ethical questions such as how and for what purpose the building and its façade should be restored. The necessity of documentation of the building through its historic periods is stressed, as is also the need of documentation of the remaining decorations. The overall objective has been to perform analyses of the materials used in construction of the façade, with the objective of providing the necessary information needed to consciously decide on the issues mentioned above.

The theoretical frames within which decisions about conservation interventions should be taken are examined, not only in general but also on public property in particular, since Palazzo Calabresi is a public building, not in use. The fact that the building is not in use leaves open for any relevant suggestion for its future use. The importance and need for documentation of the various historical periods which might be observed in form of changes in the structure of the building is stressed, since these documents are the foundation for an understanding of the building itself, and constitute the base for decisions on why and how to act, leading to the questions on how to restore and transform it.

Also stressed is the importance of chemical-technical analyses of the material which constitute the areas which are to be restored, in this case the graffiti façade, since the results of such investigations are the necessary means for decisions concerning the conservation interventions.

Finally the over-all importance of collaboration in groups of professionals with continuous discussions on discoveries made, methods to use, results achieved and goals to work for is pointed out.

The building complex

Palazzo Calabresi is a building in an evident state of decay, and not inhabited for a long period of time. It was selected for a conservation programme, with the intent of rescuing the building from becoming a ruin. The palazzo is situated within the ancient town walls of Viterbo, indicating that the building may originate from after the 13th century. A date before that is not likely, since these quarters date from between 1200 and 1300.¹ The exact dating of this particular palace is not known, but at present it may be defined as a medieval building, rebuilt and transformed into a renaissance palace. The 16th century palace was extended across the block, with a larger frontage facing Vicolo dei Magazzini and a smaller facing Via Calabresi. Annexes also reached Via Roma. Palazzo Calabresi was originally organised with a central courtyard, still possible to individuate. Nowadays only the central part of the palace remains, with the main entrance towards Via Calabresi. Other exterior remains are the loggia at the piano nobile and a secondary entrance located in the building, facing the former courtyard. There are vaulted ceilings at the piano terra and coffered ceilings with painted original decorations at the piano nobile. A staircase with varying characteristics connects the floors, and at the second floor a few steps also connect the palace with the adjoining annex building.

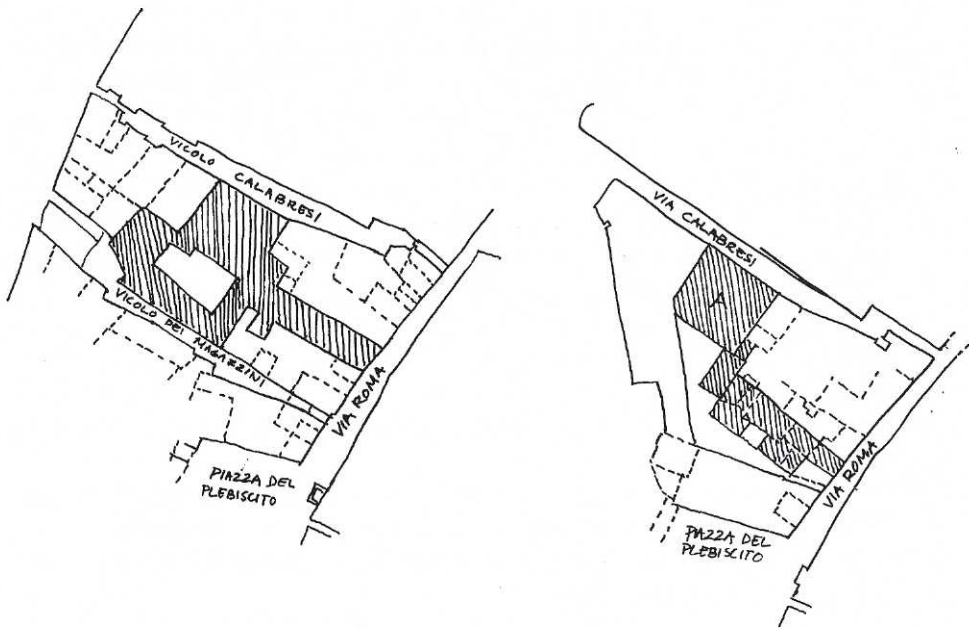


Fig. 40. To the left: Palazzo Calabresi and its annexes, according to the original 17th century plan.
Fig. 41. To the right: The present Palazzo Calabresi and its annexes.

¹ Silvia Silvestri, art historian and participant of the project, personal communication.

The palace has a graffito façade towards Via Calabrese. This façade has reached an advanced state of decay. The stone mouldings framing windows and doors and the front door are made in a local volcanic tuff, peperino, just as the cornices dividing the front in horizontal sections. Due to the specific characteristics of the palace, the conservation project of Palazzo Calabresi was supported by the EU in a Raphael Project in 1998.²

Incorporated in the project, which followed professional and scholarly-scientific principles of ICR and other authorities, were art historians, archivists, conservation architects, conservators and chemists, environmentalists, media representatives and at the same time co-involving local regional authorities etc. The objective of the study has been to analyse, explain and understand the history of the palace through its different phases and during different ownerships, to define its location in the urban structure and to study the materials of which it was built and decorated, all aiming at correct conservation. Suggestions for preventive conservation were important issues of the programme, including anticipated maintenance and future use of the building, taking into consideration the facts mentioned above. With preventive conservation is intended the elimination of anything harmful for the object and to provide for the most favourable circumstances possible.³ Documentation consisting of descriptions, drawings and photography was consistently made, thus following the recommendations by Lagerquist, Wolters etc.⁴ The Italian recommendations NORMAL were followed when documentation of decay was made. The importance of following standardised forms for documentations has been pointed out by e.g. Nordbladh and Rosvall.⁵

The professional formation of the group working with the project must be considered as responding to the demands of Marconi, who argues for the necessity of such collaboration teams of professionals.⁶ It was a great convenience to be able to ventilate problems as they appeared, with persons representing different professions. As pointed out by Zanardi, restoration is located academically between art theory and natural sciences, and there has to be a communication between the different disciplines, in order to achieve serious and valid results.⁷ Degni presents conclusions of the same kind, after completed conservation of the façade of the church S. Carlino in Rome.⁸ These discussions must be considered as good experience and are advantageous when the practical work of conservation begins, since the solutions and the final aims have been jointly considered by many complementary participants.

² The Swedish group was at Viterbo for field work during one week in October 1998.

³ Melucco Vaccaro 1986, p. 179.

⁴ Coles, 1995, p. 59; Lagerquist, 1996, pp. 23-40; Lange, 1993, pp. 115-116; Melucco Vaccaro, 1986, p. 179; Mora, 1996, p. 93; Price, 1987, pp. 25-31; Wolters, 1988, p. 123.

⁵ Nordbladh and Rosvall, 1975, p. 58.

⁶ Marconi, 1988, p. 105.

⁷ Zanardi, 1982, pp. 19-21.

⁸ Degni, pp. 10-11.

Graffito

Graffito façades appeared during the 15th century in Florence, and were successively spread to other towns in central Italy. The first known example is Palazzo Davanzati in Florence, built in 1427, and in Rome there are examples of such decorations from the middle of the century.⁹ Simple geometric decorations, imitating stone, is known since the Middle Ages.¹⁰ Those simple decorations developed into more complex motifs, such as geometric ornaments with fields of decorative floral motifs in a rather linear style, imitating carved reliefs and stone structures. Towards the end of the century several Florentine palaces appeared with figure motifs in renaissance style, later followed by baroque decorations, covering most of such walls. The initial aspect, depicting stone, combined with the illusion of decoration in low relief, however, was generally kept in mind.¹¹

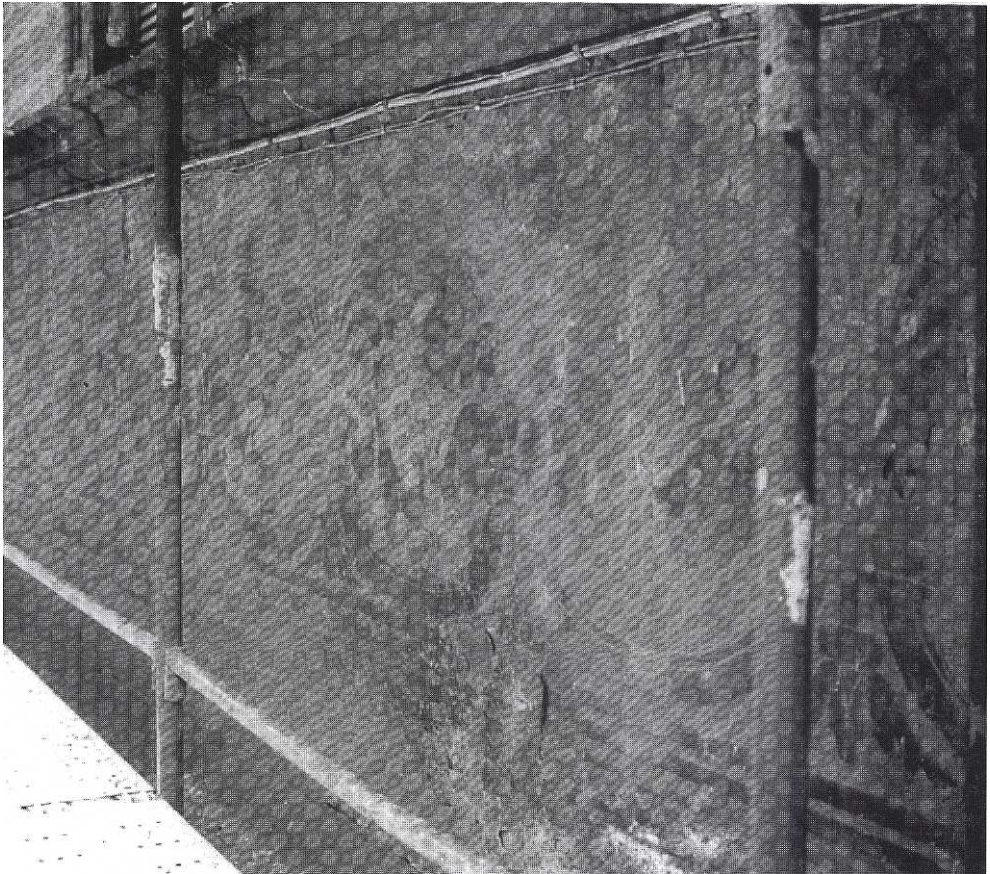


Fig. 42. Palazzo Calabresi, façade, graffito decoration. The palmette motifs at the piano nobile.

⁹ Thiem, 1964, p. 19.

¹⁰ Errico, 1985, p. 57.

¹¹ Forcellino, 1988, p. 130.

The decoration of Palazzo Calabresi is similar to early decoration in Florence, Rome and other cities in central Italy. The conclusion can be drawn that the Calabresi decoration may be dated from the end of the 15th to the first decade of the 16th century. This dating is based upon two main considerations. The first is taking into account that the graffito fashion probably arrived to Viterbo some decades later than to Rome, where the fashion had been introduced by the Medicean popes.¹² Secondly the style of decoration was outdated at the beginning of the 16th century, since more complex decoration with figure motifs appeared during Renaissance.

The material used for this kind of decoration was a coloured plaster layer. Upon the first rough layer, the *arriccio*, a layer of dark grey or black plaster, generally containing pozzolana, and pigmented with charcoal or burned straw, was applied. Occasionally the first plaster layer was pigmented in some other colour, such as yellow, red or blue.¹³ While this mortar was still wet, an ultimate and very thin white layer of lime was applied. As soon as these layers had set, the motif could be scratched into the surface, by means of partial removal of the white layer, thus creating a black and white image.¹⁴

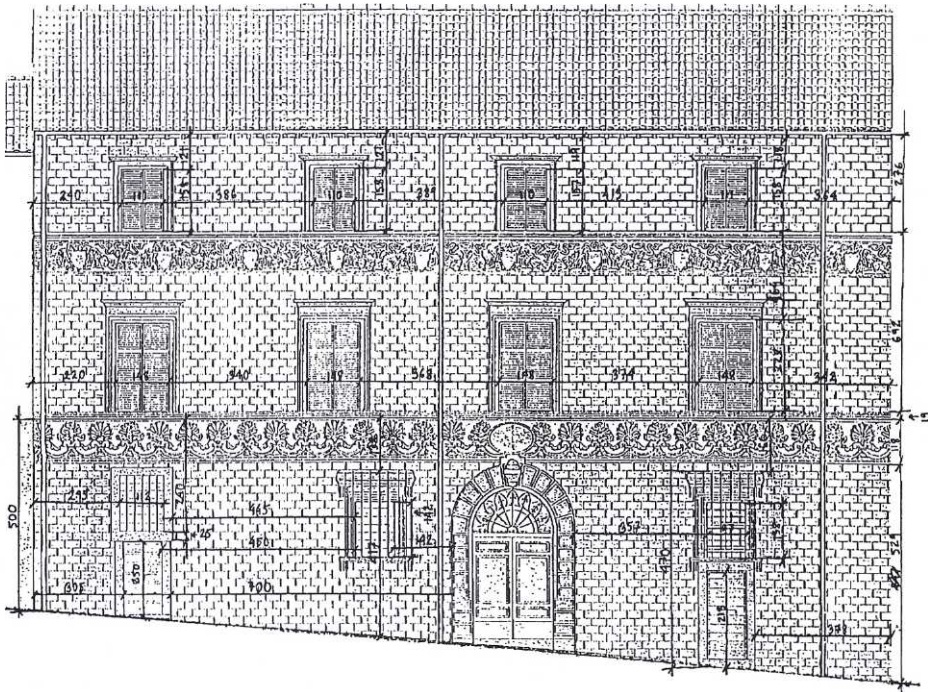


Fig. 43. Palazzo Calabresi. The façade towards Via Calabresi. Measures of the façade.

¹² Errico, 1985, p. 55.

¹³ Errico, 1985, p. 58.

¹⁴ Lange, 1993, p. 46; Thiem, 1964, pp. 18-19.

The conservation program

As initially mentioned, Palazzo Calabresi is situated in a slightly bent, narrow street, ending in a semi-closed area, from where Via Roma is reached through a vaulted opening. The façade is not exposed to direct sunshine, and therefore it is protected from great changes in temperature, a problem resulting in thermal shocks. Neither is it exposed to extreme winds, causing problems of entropy.¹⁵ The building, consequently, is not exposed to particular thermodynamic problems that might cause severe problems, and therefore should have to be regarded with respect to future maintenance. Even though the actual climatic circumstances were recorded only during one single autumn week, with some observed changes in temperature and dampness, no evidence provided reasons to believe that this specific façade would ever be exposed either to extreme sunshine or to heavy winds, since it is situated in a sheltered area.

The façade of Palazzo Calabresi is, as stated above, extremely weathered, but there are no severe problems with its architectural legibility, since enough of its decoration remains to make a reconstruction possible, at least presented as a tentative proposal. The graffito decoration has been made the usual way, with black mortar applied before the ultimate white layer of the surface, into which the decoration has been scratched, thus revealing the underlying black colour. Two ornamental friezes with floral motifs in black and white are integrated in the decorative system of the façade. The same combination of colours appears in a false bugnato, i.e. a decoration imitating rectangular stones, the stones being black and defined by white lines.

The very damaged upper decoration was tentatively reconstructed with the use of raking light, and graphically transferred to large plastic sheets. Three different coats of arms were observed in the decoration, disposed at equal distances and nine in total. The three different figures were also transmitted to plastic sheets. Two of the coats of arms, one presenting a pattern of lozenges and the other an eagle, were identified as belonging to the noble family Almadiani, the first known owners of the palace.¹⁶ The third escutcheon, consisting of horizontal stripes, belongs to the Florentine family Mancini.¹⁷ The last private owner, the Calabresi family, did not possess any coat of arms. By observing and documenting the decoration as a whole as well as the escutcheons separately, it was possible:

- a) to define a probable period within which the decoration was made,
- b) to identify the escutcheons, providing a means for identifying the families who previously have owned the building,
- c) to enable a decision whether to reconstruct the decorations or not,
- d) to provide accurate measurements of elements, making possible comparisons with similar decoration on other buildings, and
- e) to organise documentary material for future needs.

¹⁵ Massa and Paribene, 1982, pp. 13, 16.

¹⁶ Scrittoli, 1988, pp. 274, 280.

¹⁷ Silvestri, 1998, p. 2.

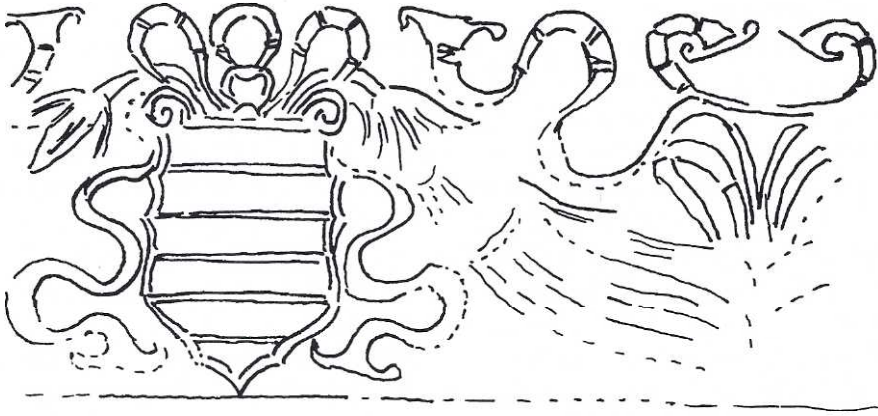


Fig. 44. Reconstruction of the upper decoration based on documentation made with use of raking light.

A painted decoration above the front door was documented the same way as described above. Samples of the materials were taken from different parts of the façade in order to make possible the determination of the composition of plaster used, pigments, binders etc. Since there was no existing correct drawing of the building, the façade was thoroughly measured, with the objective of constructing an accurate drawing of the façade. All kinds of deterioration and other kinds of information observed were documented on preliminary drawings, which later were transferred by the architect to the ultimate drawings, with correct measures and decorative elements inserted.

The above-described documentation led to the following results:

- a) the decoration was probably made around 1500, since i) the family Mancini is known in Viterbo since then, and ii) the Mancini coat of arms could not possibly be represented on the façade during the ownership of Almadiani (the question of why coat of arms representing two families are on this façade is further studied in archives by the art historians), and iii) the style of the graffiti decoration indicates a dating to this period.
- b) the coat of arms of the Almadiani family usually consists of an eagle with its wings spread out at the upper part of the escutcheon, and the lozenge pattern below. In this case the decoration has been divided into two separate parts, and appear at intervals with the Mancini family coat of arms. This may possibly be due to a marriage between the families or other another form of unity.
- c) it was decided not to reconstruct the decoration, but to make a reconstruction documented on paper, which may serve as information.
- d) the full size decoration on plastic sheets may be transported and compared with other similar decorations, thereby it will be possible to link decorations to a common source, or a common decorator.
- e) by keeping all documentation collected it is possible to show the gradual changes of the palace, e.g. in an exhibition. Also the deterioration registered and the suggested reconstruction, decisions and actions taken are this way recorded, and may be discussed.

Responsibility

At this point it may be appropriate to mention a few words about responsibility. In the Italian context, the architect is ultimately responsible for the conservation programme, and consequently his program is normally followed. If the architect wants to, he may agree to discuss the conservation programme with conservators or historians etc, and maybe, to consider some changes in a programme. This is important, since the decisions concerning a specific conservation program do not formally depend on the opinion and the competence of the conservator. The architect, on the other hand, needs the support of a superior authority, e.g. a soprintendenza or a commissioner. Therefore a programme must be based on serious interaction between all parties involved. Wolters argues about the necessity of making continuous controls while operating at a building, since there are always new and important observations and discoveries to be made.¹⁸ This probably will be followed, if the architect in charge of a conservation project considers such observations necessary, and if there is enough time, money and education to permit such interaction and consideration.

Conservation suggestions

As to the issue of defining conservation methods, the group of conservators had a slightly different approach than the architect. He presented on the other hand a “full programme”, consisting in the elimination of car traffic in Via Calabresi, elimination of wires, lamps and other recent additions to the façade, cleaning with brushes, chemical wood treatments to kill possible woodworms, and ions to convert rust on corroded iron. With respect for interventions on stone material he suggested biocide treatment, consolidation, cleaning with impacks of ammonium carbonate or resins, and finally a protective treatment.¹⁹

The conservators very much agreed on transforming the narrow lane to a space primarily for pedestrians, since car traffic is a major environmental problem. Elimination of the non-functional elements, such as e.g. outdated electric wires on the façade also seemed quite justified, in spite of awareness of the fact that later additions are part of the history of the buildings and should therefore generally not be removed.²⁰ The Swedish group agreed on starting cleaning by brushing off the dirt, but found it adequate to use biocides only on limited areas where biological growth could be determined, since there were no signs of any extreme biological growth. Further recommendations from the group were to make initial tests of different solutions for cleaning, to observe the actions and later decide what to use. Impacks of ammonium carbonate on certain areas may not be excluded, since there were some incrustations on the un-washed side of many of the architectonic details.

The Swedish group did not agree on a general consolidation of the stone, since there was no particularly pronounced problem of decay, but agreed however on con-

¹⁸ Wolters, 1988, p. 123.

¹⁹ Either RC 80, a product produced by Rhône-Poulenc or a similar product by Akeogard.

²⁰ Brandi, 1952, p. 118.

solidation of such parts which were either flaking or sugaring.²¹ Finally, the conservators agreed on a surface protection with traditional methods, but not to a chemical impregnation of the stone, at least not prior to testing alternatives. What surface protection would be the better choice in this specific case was not possible to decide in advance, but it may be convenient also to test *scialbature* on a lime basis in different compositions. At renewed reasoning about the surface protection, the architect agreed to perform some tests with various *scialbature*. The question was raised, why a *scialbatura* should be used and not the commercial product RC 80? To begin with, a *scialbatura* is a lime wash, a conventional method used since Antiquity. In this case, a local *peperino* was planned to be coated. A fine-grained dust from such stone might be favourable, in order to keep the visual impression of the natural stone. By using this mixture the hue might be expected to be somewhat lighter than the stone itself, due to the lime component. Stone materials like *peperino* and tuff were generally covered with stuccoing or lime wash during the Renaissance.²² Therefore, it is according to tradition to cover such stones with a light lime-wash, since they were probably covered in such a manner in the first place.

A lime wash is preferable to stuccoing, since it is not known if a stuccoing was actually made in this case, and if so, how it was executed. It could be applied just as a protective, resembling the actual colour of the stone. It is not transparent, and therefore it is of great importance to consider the colour from case to case. A lime wash, further, has the advantage of not transforming the material of the stone, since it just protects it, for some years.

The chemical products, on the other hand, are transparent, and they are produced to impregnate and integrate the stone, and they will not normally be washed off, but generally it is not known how they will alter, at least not in a longer perspective. When choosing a lime wash the choice is a non-transparent sacrificial coating, and choosing a chemical implies a transparent application, with the intent of leaving the stone visible. Small-scale tests with applications of alternative products on relevant materials should be performed to determine the most suitable products to use in this specific case. It may be done by spreading the proposed products on similar stone surfaces, and comparing the results to test-results achieved by using the substances offered by the chemical industry. Before finalised result from such trustworthy testing it is impossible to conclude on what is the better alternative.

The Swedish conservators and the architect involved in the project agreed upon the conservation programme of the graffito decoration and the mortar areas, using old compositions of mortar. Since degradation of the façade varied from one level to another, the conservation programme should be adapted to suit the problems observed for each register, but with the over-all intent to re-establish the stability of the façade material and to return to a homogeneous unity of the entire decoration.

²¹ Flaking means lifting paint. Sugaring means that the stone, due to decay, becomes brittle and when touched, the crystals fall off, looking like sugar.

²² Forcellino, 1988, p. 126.

The future use of the building has been discussed. In this particular case it is not possible to follow the recommendations of Carta Venezia to let the building precisely serve its traditional functions, since the building has been transformed several times and does not exist in its original shape.²³ The Swedish group, taking into consideration its characteristics, its size and its location in the town, has carefully planned an appropriate use of the building. The experiences from the project and the issues of future maintenance and use of the building will be presented in a separate project report.²⁴

Conclusions

It was a great experience to participate in the planning process of this conservation project, practising established guidelines and recommendations in conservation. The discrepancy between theory and practice has been stated by scholars and scientists, and also by conservators operating in the field. Experiences even in this partially didactic project confirm that there is a gap between theory and practice. As mentioned above, the restoration of the building had been decided before the Swedish participants were contacted. Italian conservators and building contractors had been contacted, indicating that conservation interventions had been planned before the Swedish group arrived. During the week *in situ* at Viterbo, there were daily contacts between the participants at the fieldwork, and vital discussions around the table. At the end of the period, the architect presented a complete conservation programme. The Swedish group could not agree with that programme, mainly due to the intention of consolidating stone with RC 80, a relatively new product of which the long-term effect was not known. The group from ICUG returned to Sweden with samples for material analyses of plasters, binders and pigments, to be examined and analysed at ICUG. These samples should be the base for decisions concerning what conservation materials to use. It was important that analyses were performed rapidly, in order to have the results available before the actual conservation of the façade started. Some tests were never carried out, due to questions regarding the didactic situation and the analyses equipment at the institute. The results from examinations of some samples were available in the spring of 1999, when conservation of the façade had already begun. Consequently, analysis results were not available before conservation started, and neither were there any demands for such results from the Italian participants. Finally, the Swedish report was not accepted for publication, and information about actually performed conservation interventions or the final result never reached the group of Swedish conservators. The experiences from this EU project have been inspiring and there are questions that require an answer. It would be interesting to study the EU declarations of cultural policy, to study which projects were supported economically and how these projects were carried through.

²³ Feilden and Jokilehto, 1993, p. 60.

²⁴ Unpublished report at ICUG.

Case Study 2:

Fayum Portraits in Nationalmuseum

Introduction

This case study deals with observations, documentation and analysis of some Fayum portraits, belonging to Nationalmuseum in Stockholm.¹ With the objective of determining the materials used for these paintings, an initial general survey was made, followed by a material-technical investigation of some selected paintings. The selection of objects for an in depth study was made, according to the principle of ascertaining, as far as possible, that the different encaustic techniques, *wax-painting* and *painting with Punic wax* as well as *tempera painting* would be included. The working process, aiming at a better understanding of some Fayum portraits is presented below. The considerations and the following decisions, on *what* to investigate, and *how* to proceed, are briefly pointed out. The documentation, sampling and material analysis is described, and the questions posed in the process are related to established guidelines in conservation theory. The overall objective was to present some adequate documentation about these objects, in order to provide for facts, which would form the necessary basis for a plan to follow for the maintenance and the future display of the portraits.

Some important issues are left out of this study, due to its very limited size. Historical aspects, such as the methods of 19th century excavations and early conservation treatments, have not been considered in the present case study, and neither has the investigations led to suggestions on a new dating and provenance. Issues concerning tradition and context in which the portraits belong have also been left out in this study, but all issues mentioned above are described in the complete investigation report, published by ICUG in 2000,² and in a revised form, written in Swedish, as the yearbook 2000 by Nationalmuseum.³

Background to the project

In the autumn of 1996 contacts were made with Chief conservator John Rothlind, Head of Conservation department at Nationalmuseum in Stockholm, in order to receive information about some Fayum portraits in the Nationalmuseum. At that time I was working on a study concerning the encaustic painting techniques, which were part of my Ph.Lic. thesis.⁴ Some questions regarding those techniques, as well as of their provenance, state of preservation and previous conservation interventions, were answered, but not all, due to the lack of previous documentation. The

¹ The Swedish National Museum of Fine Arts.

² Freccero, 2000, b.

³ Freccero, 2000, a.

⁴ Freccero, 1997.

general impression was, at that time that no analyses of the mummy portraits in Nationalmuseum, or of those deposited in Medelhavsmuseet had been made.⁵ No interventions of conservation were known to have taken place, and no reliable data concerning their original provenance were available. In the summer of 1997 new contacts were made, this time including Chief Curator Dr. Görel Cavalli-Björkman, Head of the research department at Nationalmuseum, who gave her approval to the project of studying the Fayum portraits from the perspectives mentioned above. Contacts were made with Il Soprintendente, Dr. Giorgio Bonsanti at Opificio delle Pietre Dure in Florence and Dr. Mauro Matteini, Director of the Scientific laboratory at the Opificio, who approved of participation in the project, contributing by performing the necessary scientific analyses, together with laboratory staff.⁶

Ancient materials and techniques

The Fayum portraits are generally made on standing, rectangular wooden panels, the grain of the wood following the height of the board. The panels are mostly very thin, from about 1-2 mm to a maximum of 7-8 mm. Many panels are slightly convex, and it has been assumed, that this is related to the insertion of the paintings into the mummy bandages, when they were bent in order to make the panels fit in better, than a flat panel would do. The upper edges of these panels were commonly cut back, before being attached to mummy bandages, resulting in irregular shapes at the top. The different ways of cutting back the tops are, however, considered as indicative for different local traditions. The arched top was frequent in Hawara, the chipped one in er-Rubayat and the shouldered in Antinoopolis.⁷ These portraits are traditionally considered as either being *encaustic* or *tempera* paintings. Between the paint layer and the supporting wood was a *primer*, e.g. glue, or a *gesso* preparation, in Egypt mostly made of gypsum and glue. If just glue was applied, this would form a thin, almost invisible film between the support and the paint layer, while the gesso appears as a distinct layer, mostly white. On occasion, dark khaki or grey gypsum grounds occur.⁸

⁵ The Swedish Museum of Mediterranean and Near Eastern Antiquities.

⁶ Dr. Archangelo Moles, Dr. Carlo Lalli and Dr. Giancarlo Lanterna.

⁷ Corcoran, 1995, pp. 44-45; Walker, 1997, p. 15.

⁸ *Ibid.*

⁹ Doxiadis, 1997, p. 21.

¹⁰ Berger, 1904, p. 219.

¹¹ Parlasca, 1966, pp. 27-28.

The *tempera* technique was well known in Ancient Egypt, as well as in other early cultures. *Tempera* indicates that the pigments were dispersed in water, with some kind of binder added, usually animal glue.⁹ *Encaustic paintings* were made either with natural beeswax, melted and pigmented, or with Punic wax, which is chemically treated and partially saponified beeswax. *Encausto* is the Latin form of the Greek word *enkaostos*, which means “to burn in, burning in”. The term was in Antiquity referred to a specific technique of painting with wax, when the paint became heated and burned into the surface. Today the term is used for wax-paintings in general. The significant, practical difference between natural beeswax and Punic wax is, that the melted beeswax solidifies very rapidly and has to be worked quickly, while Punic wax solidifies slowly, and may be applied without haste. It has been assumed that a specific metal tool, a *cauterium*, was used for encaustic paintings to shape and mix the wax during the painting process.¹⁰ Encaustic paintings have some characteristics in common, such as the marks of tools that appear on the surface, and in addition, a lustrous appearance, and specific for wax. Punic wax paintings have not been clearly defined, and such a definition has been one of the objects of this study. Since this paint may be spread with a brush it may present certain characteristics significant for a *tempera* painting, but the presence of beeswax might, on the other hand, be noted in a possible mixed working technique, with the characteristic signs of hard tools as well as the lustrous appearance.

Mummy portraits in Nationalmuseum

Nationalmuseum in Stockholm owns 15 mummy portraits and 12 fragments of portraits, all painted on wooden panels. They are, according to the inventory records, painted either in *tempera* or encaustic. These paintings represent the common styles, current during the Roman Imperial era. Some of the paintings are of a high quality, technically as well as artistically.

The original provenance of the portraits is known in just a few cases. Most of the paintings were previously in the Graf collection. This has mainly been possible to discern by the circular marks made on the backsides of the panels, which occur on paintings in the so-called Second Graf collection. Responsible for marking the paintings was the Viennese art dealer, Bruno Kertzmar, who had this collection documented, labelled and numbered, after the death of Graf. The negative number of the photo was glued to the panel, and a violet stamped circular mark was made to indicate the number in the collection given by Kertzmar. According to Parlasca, the last number is 228.¹¹ The portraits in this second collection are considered to have been less restored than those of the first, which consist of the paintings exhibited, published and sold by Graf. Many of the portraits in Nationalmuseum present marks, such as described above.

Graf was excavating in the area around er-Rubayat, and therefore it has been assumed, that the major part of his collection originates from that area. This leads to the assumption that many of the paintings in the Nationalmuseum do as well. Two paintings were sold to the museum as early as in 1890, by F.R. Martin, “who brought them home from Egypt”, and six portraits were bought from N.V. Löfgren, Stockholm, in 1954. The major part of the portraits were, however, donated to the museum by Dr. Max Dinkelspiel, Stockholm, in 1953. Ten of the paintings that had

belonged to Dinkelspiel were documented as previously being part of the Second Graf collection. The portraits were accompanied by an undated certificate, typed in German, together with some registration forms and documentary photographs of the paintings, which now are in the archives at the Nationalmuseum. In this document, it is stated that the paintings had been described, measured and photographed by a Dutch scholar, Heinrich Drerup, who, in fact, was the first to examine the portraits in the Graf collection one by one, and date them.

Dating

In the museum inventories, all mummy portraits are defined with a provenance from Fayum. This is, of course, a correct definition, but since Fayum is a large area, consisting of many find sites, it was important to try to determine a more precise location, and to give an updated opinion on dating as well. There have been, and are still, disagreements in the dating of the Fayum portraits, from earlier suggestions such as by Graf, dating some portraits to the Hellenistic period and Drerup suggesting the end of the tradition as being in AD 393. Nowadays, dating is made within a much more limited period, beginning in about 14 AD, and ending roughly at the middle of the third century AD.¹²

The documentary phase

At the first meeting with Astrid von Hofsten, at that time working as a conservator at Nationalmuseum, a working plan was set up, with the objective of outlining the project, and to define how to document its progress. It was decided to initiate by creating documents adequate for this occasion, which included a photographic representation of each portrait in the inventory. All objects were carefully observed by von Hofsten and the author, and the observations were noted in the registration forms, which consequently contain all available and relevant information about the objects investigated, listed under different headings. The importance of documentation in conservation has often been stressed.¹³

Available information in the museum inventories was noted to begin with. The scarce information consisted mainly of measurements of the object, a short note on the technique, a note on the subject, and on when and how the object was incorporated in the museum collection. In a few cases there was also a note on some kind of conservation interventions, and on decay observed. All information available was very limited, mostly consisting of a couple of lines in the inventory. Photographic documentation of all objects was accessible in the museum archives. In addition, there was the document, mentioned above, concerning the 10 portraits from the Second Graf collection.

Each object was then observed and its characteristics were documented. The visual analyses consisted of studying the surface, and in listing the types of deterioration observed. Beside the verbal description, any form of decay was indicated with graphic representations on plastic sheets placed upon the photos made at the museum archives. Except for notes about the observed decay, the paint surface was

¹² Borg, 1995, 1996, 1998; Doxiadis, 1995; Walker, 1997, 1999.

¹³ Coles, 1995; Feilden, 1993; Lagerqvist, 1996; Rosvall, 1972; Zander, 1993.

studied, with the intention of making a preliminary definition of the paint material. The impressions regarding the paint structure, i.e. whether it was lustrous or dull, were noted, as were the various kinds of tool-marks. Based on this information the paintings were classified as probable tempera, probable encaustic or probable Punic wax paintings. In addition, the visual appearance of the colours was registered, since that might be an indication of pigments used. The absolute necessity of collecting only valid information, based on scholarly-scientific methods, including formulated hypothesis, has been pointed out by Lagerqvist.¹⁴ After the first phase the registers contained necessary information about:

- a) inventory number, measurements,
- b) previous owner, and information from the museum inventories,
- c) a description of the subject,
- d) the state of conservation of the wooden panel,
- e) the state of conservation of the paint surface,
- f) an observation of the paint, suggesting painting technique,
- g) a description of the colours, with indication of specific pigments,
- h) definition of how the top of the panel had been cut back,
- i) any remains of mummy bandages,
- j) indication of previous conservation interventions, and
- k) indication of retouches

Based on the information collected, the next phase was planned, since it was now possible to make a decision on how to make a selection of paintings for further investigation. In order not to provoke further damage on paintings with severe problems of material stability, such items were immediately excluded from further investigation. Also paintings presenting obvious signs of conservation treatments were excluded, in order to avoid inadequate information during the material analysis.

The determination of paint binders was the main objective, since the binder indicates the paint, and consequently the painting technique. The ground layers had to be studied, in order to determine if there was any correlation between the paint material and the ground layer, which has been suggested.¹⁵ If such a correlation could be ascertained, this knowledge would be possible to apply to other similar portraits. Any possible connection between paint and preparation, and the actual state of decay, was observed. The decision was to make a choice, at first according to the main objectives, and secondarily in order to receive a varied set of samples, including also pigments, gold, bitumen and linen. After discussions, the issues to be studied were defined as follows:

¹⁴ Lagerqvist, 1996, p. 99.

¹⁵ Doxiadis, 1997, p. 94.

- a) the composition of paint binder,
- b) the composition of ground layer,
- c) correlation between paint and ground layer,
- d) determination of a few pigments,
- e) the presence of gold,
- f) the presence of probable bitumen, and
- g) the presence of probable linen bandages

Some pigments were considered as interesting to study, because they frequently occur on mummy portraits. The intention was to make a determination of some pigments, known to have been used during the Roman Imperial period, with the objective of verifying their connection to the period. Pigments available during Antiquity have been described, in several publications, by various authors.¹⁶ The presence of pigments from later periods, would indicate, either that additions had been made on the painting after excavation, or that the painting was not an original. Analysis of possible bitumen and linen was considered to be of interest, and such analyses should be made, only if there was sufficient time and adequate possibility. The only objective for such complementary analyses would be to confirm that those materials were occasionally used. As far as gold was concerned, it was interesting to find out, if possible, if gold was used together with other expensive materials, and also what was to be made if there was time and possibility. Eight paintings were finally selected for further investigation. Three of them were considered as possible encaustic paintings (nos. NMAnt 2302, 2315 and 2321), two as possibly painted with Punic wax (nos. NMAnt 2313 and 2320) and the remaining three as probable tempera paintings (nos. NMAnt 2304, 2305 and 2306).

Photographic methods

The paintings were at first photographed with colour slide films in normal daylight and then in tangential or raking-light. Photography in daylight provides a picture of the painting seen from the front, which presents the shape, the object and the general aspect of the painting without focusing on anything specific. Raking-light can provide valuable information on the state of preservation of the paintings and on the painter's technique, since focus is set on the appearance of the surface, e.g. if there is a relief in paint or if there is lifting paint. A large-size black-and-white photograph of each painting was used as a location diagram.

Observations in ultra-violet fluorescence light

The paintings were observed in UV-light, with the objective of studying the possible fluorescence resulting from, e.g. specific *pigments*, such as any organic lake, and *glues, binding media or surface coatings*. UV-light has the property of causing fluorescence in various substances. This invisible ray is immediately adjacent to visible light; the light source used has a wavelength of c. 365nm (UV 400-100nm).

¹⁶ Aldred, 1994; Augusti, 1967; Barov, 1990; Berger, 1904; Dinsmore, 1988; Forbes, 1965; Johnson, et al, 1995.

Selection of samples

The surfaces of the selected paintings were viewed under magnification, ranging from 4 to 16 x. For media analysis and pigment identification, some minimal samples of paint were removed with a pointed scalpel and a tungsten needle, under 10 x binocular magnification. The samples were taken around areas presenting damage, such as lifting paint, and near the edges, and the exact location of these areas was marked on the location diagram. Microscopical samples were selected for analysis of binding media, and placed between laboratory glass lids, locked with adhesive tape. Samples containing all layers were kept in sample glass bottles, and later mounted as cross-sections. In a few cases, an additional sample was selected, for possible future pigment analyses. In one case, NMAnt 2305, samples were also selected from the possible bitumen and linen bandages. The samples were removed by von Hofsten and myself in concordance with the staff at the laboratory of Opificio delle Pietre Dure, and brought to Florence for examination.

Scientific investigation techniques at the Opificio

The investigation techniques adapted for the present study have been the stratigraphic analysis of sections in optical microscopy, which was made in diffusion light, and in addition under UV-radiation, for the examination of fluorescence caused by the materials. For that purpose the selected samples were enclosed in polyester resin and the surfaces were orthogonally grounded. An optical microscope, Zeiss Axioplan, equipped with objectives from 5 x to 20 x, and with a lamp of mercury vapour, was used. Each cross-section was documented in the observation techniques mentioned above. The same sections were utilised for SEM investigation, using an electronic scanning microscope, Stereo-Scan 440 Leica Cambridge, and examined by elementary microanalysis EDS, using a system Link-Gem from Oxford. Other samples, in powder form, were selected, and their compositions analysed in the Spectrophotometer FTIR, (Fourier Transform Infrared Spectrometer), using an equipment Perkin Elmer 1725X, adapting the technique of making micropellets (\varnothing 1,5mm) in KBr.

Conclusions

The documents, i.e. the verbal conservation registration form, the graphic representations of decay, the colour slides in normal light and in raking light, as well as in UV-light, proved to be of value during the project, as were also the large-size black-and-white photographs, used as location diagrams. The combination of those documents provided the necessary information, and was most useful on occasions when questions arose during the analytical progress of the study.

The chemical-technical questions posed, were answered, and in many cases, more facts than expected, were revealed. Encaustic, as well as Punic wax paint, was determined, but no traditional tempera paint, since those paintings selected as probable temperas had been made with a paint containing saponified beeswax. The tempera paint used, only contained minor traces of beeswax and soaps, i.e. indication of a diluted Punic wax. Encaustic painting on gesso preparations, as well as on a primer, was determined. In no case was there any sign of a paraffin wax, which was a commonly applied substance at the excavation sites.¹⁷ There were no additions of later pigments noted either. A few samples contained materials of which the presence could not be explained.

The scholarly aspects of the investigation need to be studied much more, since there are no definite answers to be given, according to the nature of the humanistic discipline. Based on the information presented on each portrait register, and comparing with the in-depth study results made by the Opificio, it will be possible to act consciously and to make decisions on curative measures and future display of the objects.

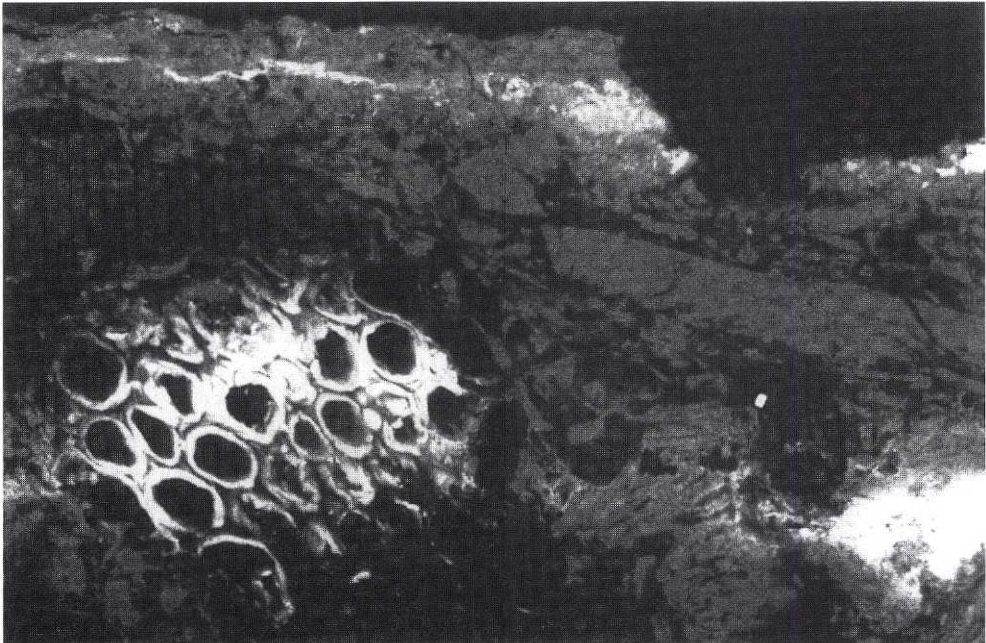


Fig. 45. Sample 2305. SEM examination – EDS analysis. The photograph reveals the different materials in the sample. To the left, the tubular structure of a microscopical piece of wood which was attached to the sample.

¹⁷ Norman, 1988, p. 15.

Case Study 3:

San Lorenzo in Lucina

Introduction

The present case study illustrates issues connected to the material investigation, conservation, and the successive presentation of fragments of wall paintings excavated beneath the church, San Lorenzo in Lucina. The excavations were made by Olof Brandt at the Swedish Institute of Classical studies in Rome in 1993, 1995 and 1998. At focus are questions such as *if* and *how* to conserve this material, as well as *if, how* and *for whom* to present it. The objective was to study how these wall decorations were made, what pigments were used and which were the binders. A final objective was to test some conservation methods. The five strata excavated consist mainly of filling materials such as earth, clay and sand, constituting at least two known floors or levels of a courtyard or a street. (see Fig.47).

In the autumn of 1998 I was asked by Brandt to study the fragments. In the spring of 2000, scholars from various disciplines, forming a research school, have been studying issues concerning the building, the piazza and its history. The reports, including a revised paper concerning the present investigation, are planned to be published by the Swedish Institute of Classical studies in Rome in 2001.

San Lorenzo in Lucina, the excavation site

The 5th century church, San Lorenzo in Lucina is situated on the *Campus Martius*, in central Rome, in the area where the Emperor Augustus constructed his huge Mausoleum, the Ara Pacis and the sundial, *Horologium*. This church was constructed upon an early Christian baptistery, below which are preserved the remains of a 3rd century Roman *insula*. Below these walls are remains of an even earlier *domus*, a building not excavated, due to the high level of the ground water. A Roman *insula* was, generally speaking, a multi-storey and multifamily building in an urban environment, a common type of urban house from the 1st century AD and onwards. Paintings in this kind of building were probably plain, even though some rooms in the earlier *domus* may have had richer decorations. The fact that the fragments were found in filling material makes determination of their original context uncertain. Some fragments may, in addition, have changed position from one level to another at the time of a successive elevation or at the time of an earlier excavation. One possible hypothesis however is, that the original wall decorations were torn down and replaced with new decorations when the building was re-built and re-decorated in the 3rd and in the early 5th centuries.

Material investigation

According to Vitruvius as many as six layers of plaster and stucco should be applied on the rough render coat when preparing a wall for painting.¹ He recommended that three layers consisting of lime and sand, followed by three layers made of fine lime-marbledust should be applied in order to make sure that the walls would be smooth and strong, and not easily subject to any damage.

Preparations such as those have been found e.g. in the Villa of Livia at Prima Porta and other buildings belonging to the Imperial family or to other persons of high rank.² Even though the Vitruvian recommendations on wall preparations were followed to some extent, observations of excavated wall preparations show that 2-4 stucco and plaster layers were generally used.³

A well-made preparation, consequently, may be dated to the Augustan period, but also to a later period, if the high standard was kept by the following generations. Well-made preparations existed before the Augustan period, and Vitruvius referred to what was common knowledge. Only a wealthy person could afford to pay for high-class materials and qualified workmanship. A simple wall preparation, consisting of e.g. plaster and one or maybe two stucco layers, may be attributed to a modest house during any Roman period. The decorations in San Lorenzo probably date from the 2nd century AD and later, indicating that 4th Style and late Roman paintings can be expected. Maybe some fragments of an earlier decoration have survived.

Pigments

High-class wall paintings of the Augustan period are smooth and shiny and the colours are saturated.⁴ During the Hadrianic period a classicistic revival was shown, e.g. in the choice of colours and materials. There are only a few remains of high quality decorations from the Antonine and later periods.⁵ The existence of elaborate wall decorations can, however, not be excluded.

A variety of earth colours were used for mural paintings, e.g. red and yellow ochres, ferric oxides and green earth. The most frequent green pigment was celadonite, a green earth.⁶ Egyptian blue was the most common blue pigment, and is in fact the only blue pigment used for mural paintings identified by Bearat.⁷ Black pigments were carbon, obtained either from charcoal, soot or bone. White pigments were generally white clays such as ancient *paraetonium* and other earths, chalk or calcite. A white colour could also be obtained by sparing the lime or lime-marbledust preparation in mural paintings.

Vessels containing ancient pigments have been found at several excavations, and the chemical compositions have been analysed. The results have been compared

¹ Vitruvius, VII,3.

² Ling, 1991, p. 1991.

³ Dr. Bo Ossian Lindberg, personal communication, May 1997.

⁴ Barbet, 1998, p. 109.

⁵ Mols, personal communication, February 2000.

⁶ Bearat, 1997, p. 269.

⁷ Bearat, 1997, pp. 14, 24-25.

with information on pigments available in ancient times, given by Pliny and Vitruvius.⁸ Most pigments mentioned in those ancient sources and analysed with modern methods have been identified.⁹ Comparisons between pigments found in vessels and those used for paintings in the same rooms as the finds, reveal that there is a distinct correspondence.¹⁰ Since the results have been published, there is a rather vast selection of descriptions and photographs which are useful for comparison as far as the fragments in this study are concerned.

Cinnabar, ancient *minium*, the natural form of mercuric sulphide, was very expensive and has been found only in the richest decorations.¹¹ Due to its cost it was probably ordered only by wealthy families and used for decorations in noble houses, while earth pigments were primarily used for decorations in more modest environments. Cinnabar was often applied upon yellow ochre.¹² Maybe this combination of layers was used to give a golden hue to the cinnabar, or to increase the brilliance of the red colour and in addition reducing the cost. Another explanation may be that the yellow undercoat had the function of a protective coat between the lime plaster and the sensitive cinnabar pigment.

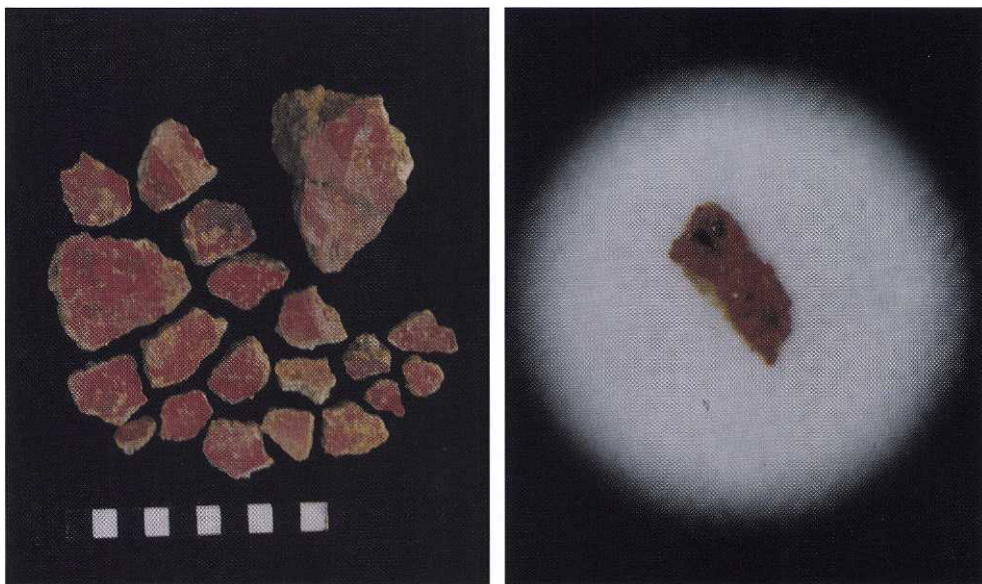


Fig. 46. *To the left*. Fragments from US 80, with cinnabar decoration.

Fig. 47. *To the right*. Sample 80:II, photographed in 75x magnification. Microscopical black mineral grains appear in the cinnabar red surface. At the lower left side of the sample, some of the ochre layer is visible.

⁸ Augusti, 1967; Barbet, 1997; Varone and Bearat 1997.

⁹ Bearat, 1997, p. 14.

¹⁰ Rozenberg, 1997, pp. 65-71.

¹¹ Ling, 1991, p. 209; Rozenberg, 1997, p. 67.

¹² Barbet, 1998, p. 109.

At Herod's palace at Jericho high quality Roman murals have been found and studied. There were no traces of any special undercoat beneath the cinnabar colour on those 2nd style paintings, which may indicate that the colour was protected with Punic wax.¹³ Cinnabar has the disadvantage of turning black when exposed to bright light, and should therefore be protected with Punic wax, which formed a protective shield upon the painted surface.¹⁴ According to Augusti, cinnabar was not used for *al fresco* painting, but was employed for a special wax-tempera technique, i.e. using saponified beeswax.¹⁵ In either case the cinnabar pigment was protected from

- a) direct contact with the lime base, or
- b) from contact with the oxygen in the air, which were the two factors mentioned in ancient literature causing the transformation of cinnabar.

The fragments in San Lorenzo in Lucina

Dating may in this case be principally done by referring to the level where the fragments were found, since the decorations were made before the time when the different fillings were added. Some fragments may have been moved within the fillings during previous excavation or construction periods.

The structure and material composition of the fragments may be used for dating. Due to the small size of the fragments, mainly monochrome, it was not possible to reconstruct a significant area. The pieces may, in addition, not necessarily belong to the same wall, even at each specific level. Considering the environment to which the fragments probably originate, one would expect to find 2-3 applications of plaster and stucco. These observations confronted to known facts such as the variations in Roman decoration depending on the ambience and context may provide valid information concerning the fragments.

Samples

When the loose deposits had been removed and the surfaces been cleaned with deionized water, representative samples were taken from fragments found at the stratigraphical units 88, 87, 80 and 44. The two red colours (probable cinnabar and red ochre), the yellow (probable yellow ochre), black (probable carbon black), white (probable lime), green and violet. The cinnabar colour was particularly interesting to study, since such a colour was found on white as well as on yellow preparation. The samples were removed with a pointed scalpel under magnification and disposed in plastic sample bottles. Two samples from each spot were taken, in order to have duplicates. One set of samples was sent to the Institute of Conservation, Göteborg University (ICUG) for analyses of pigments and binders, and in particular to inves-

¹³ Rozenberg, 1997, p. 67.

¹⁴ Vitruvius, De Arch. VII, 9,3.

¹⁵ Augusti, 1967, pp. 79-80.

tigate the possible application of Punic wax upon the cinnabar fragments. The following samples were taken:

88 I-II	Dark red colour on white layer, powder.
88 III-IV	Green colour on white layer, powder.
88 V-VI	Yellow colour, powder and flake.
88 VII-VIII	Violet colour, powder.
87 I-II	Dark red colour, powder and flake.
80 I-III	Cinnabar (?), wax (?) small flake.
80 IV-V	Cinnabar (?), yellow, wax (?) all layers.
80 VI-VII	Dark red. Powder.
80 VIII	Paint or dirt? greyish layer.
44 I	Stucco. Pigment (?).

Some observations could be made while cleaning the fragments.

Some colours were well fixed and integrated with the plaster. Those were mainly yellow and red earth colours, applied *al fresco*. Other colours had not integrated, but could easily have been removed, indicating painting *a secco*.

Underneath the probable cinnabar red on some fragments, there was a yellow layer, probably yellow ochre, just as described by Barbet.¹⁶ The underlying yellow layer was hard, while the superimposed brilliant layer had a greasy character, which may indicate that Punic wax was applied.

Some fragments were brittle and could hardly be touched, while other were hard and stable. Most of the brittle fragments were white. Some of these had remains of an indefinable decoration. Among the brittle fragments, some seemed to have lost their original shape, since they presented deformation and surface cracks, suggesting that the layers had been rapidly and carelessly laid. These fragments were probably part of a wall in a simple room.

Chemical-technical analysis

A few samples were observed in a microscope with the objective of studying and photographing the particles included. A binocular microscope, Nikon SM2-U with a photographic attachment Microflex HFX and 7.5 – 75 magnification. The investigation was made at the Central Board of National Heritage in Stockholm, under the supervision of Dr. Runo Löfvendahl.

Sample 80:II, probable cinnabar and ochre. (Photos 1-4, the upper side in 75x magnification). A thin layer of cinnabar red was identified on an ochre layer. Below these layers, the lime plaster was noted. Microscopical black grains, mainly biotite and hornblende, were observed. The upper red layer had a lustrous surface, and the ochre coloured layer was less shiny. (Photo nos. 5-7, the back side in 75x magnification). The ochre coloured layer was quite distinct, and also on this side there were black grains and in addition some fibres which may be residues from a plant. The sample was saved for future analysis to determine the binder.

¹⁶ Barbet, 1998, p. 109.

Sample 80:IV, probable cinnabar on a white layer. (Photo nos. 16-20 in 30-60x magnification). The red pigment had inclusions of black mineral grains, probably biotite. A vitreous, greenish tourmaline crystal was identified. The extremely thin paint layer was applied on a very fine-grained white lime plaster.

Sample 80:VI, a dark, brown-red layer on white preparation. (Photo nos. 8-10 in 60-75x magnification). Various brown shades were noted, and the pigment is probably dark red or brown ochre.

Sample 80:IX, a black pigment on white preparation. (Photo nos. 11-15 in 60-75x magnification). The pigment was very fine-grained. Three distinct layers were observed. The upper, thin and pale layer was probably a surface coating, applied on the black paint layer, and at the bottom was the white preparation. The sample was saved for future analysis of the coating.

Sample 88:III, a green pigment on white preparation. (Photo nos. 33-36 in 75x magnification): This brilliant green pigment had inclusions of minor black mineral grains. The colour derived from one pigment and was not a mixture of blue and yellow. It may be appianum.¹⁷ The sample was saved for further analyses.

Sample 88:VI, a yellow pigment, probable ochre. (Photo nos. 33-36 in 75x magnification). The brilliant yellow pigment corresponds to samples presented by Augusti as *sil atticum*.¹⁸ Saved for future analysis of the pigment.

A partial chemical-technical investigation of three samples, selected as probable cinnabar, was made at ICUG. Samples 80:II and 80:III proved to contain mercury or quicksilver (Hg), aluminium (Al) and iron oxide (Fe), sample 80:V just Hg and Fe. The traces of Fe indicate ochre. Cinnabar, ancient *minium*, is a mercury sulphide, i.e. quicksilver, confirming that the red pigment is cinnabar. Aluminium has been traced as one of several chemical components in many red-brown colours at Pompeii.¹⁹ Aluminium and silicates are present in natural clays. Consequently, some earth pigment or fine clay may have been mixed into the upper preparation. Aluminium was also used for the production of red lakes. A red lake may have been applied upon red ochre in order to increase the brilliance of the red colour. According to Augusti, cinnabar was frequently falsified during Antiquity, and there are several ways of obtaining a bright red colour. The most common substitutes were red ochre's and *minium*, lead oxide (Pb₃ O₄).

Since the important question regarding beeswax was not resolved at ICUG, the sample was brought to the scientific laboratory at Opificio delle Pietre Dure in Florence, where Dr. Moles helpfully studied the sample in a binocular microscope, and identified an organic matter, below and surrounding the pigment, indicating that the substance was not applied upon the red paint layer, but used as a binder. The transparent matter was not dark as could be expected of ageing oil, egg is excluded on the lime plaster, and the binder was therefore considered to be beeswax or saponified beeswax.

¹⁷ Augusti, 1967, p. 101, sample 215B.

¹⁸ Augusti, 1967, p. 95, sample 89.

¹⁹ Augusti, 1967, pp. 82, 90.

Conservation of the fragments - objectives and methods

Being part of filling materials, the original context is uncertain. One reasonable assumption is that wall decorations were torn down, at first during the early 3rd century, when the domus was perhaps rebuilt and then during the successive periods of building activity.

The fragments in this study were found:

- a) In the US 88 and 87, i.e. below the first known floor, at the construction level of the 3rd century insula,
- b) in US 83 and 82, i.e. between the first and the second floor, below the basilica, and finally
- c) in US 44, where two fragments of painted plaster were excavated at the level of the filling for the 15th century chapel.

To begin with, the fragments were cleaned, in order to get a better view of the surfaces and colours. While cleaning progressed it became obvious that the reconstruction of any decoration was excluded, even though some fragments could be fitted together. Most fragments were very small, in measurements ranging from 5 x 10 mm – 55 x 65 mm. 12 fragments were much larger, measuring roughly 80 - 100 mm. Some fragments consisted of plaster layers and stucco, while on others only the stucco was preserved. The thickness varied between 5-25 mm, and for the larger between 35-60 mm. The stucco was generally 4-8 mm, but occasionally a 10-12 mm layer was measured. In a few cases it was possible to distinguish two stucco layers. The remaining plaster was mostly fragile, with a tendency to pulverise when touched. The next question was therefore *if* the plaster should be removed *or not*.

By *removing* the plaster it would be possible to obtain:

- a) an unchanged material composition, with authentic characteristics,
- b) a relatively homogeneous thickness of the fragments,
- c) the fragments would not pulverise and fall apart in the exhibition stand,
- d) no addition of consolidation material would be necessary,
- e) presentation could be made in a thin layer of suitable plaster or stucco, and
- f) it would be easy to number the fragments on the flat back surface.

By *not removing* the plaster one would obtain:

- a) the material structure would remain unaltered and authentic,
- b) the fragments would remain of various thickness,
- c) the fragments would have to be consolidated in order not to pulverise,
- d) the material composition of the fragments would change,
- e) a rather thick layer of plaster would have to be used in presentation, and
- f) areas for identification numbers would have to be made on the plaster.

Independently of which decision would be made, the fragments would not be “original” after intervention. In the first case the material composition would be unchanged, but not the structure, since plaster would be removed. In the second case the structure would be unchanged, but the material composition would not, since some consolidation material would be applied.

There is not one method that is always carried out, but the procedure has to be decided from one case to another. In some conservation reports the total removal of plaster from the backside of mural fragments is described.²⁰ Other reports refer to the decision of letting the plaster layer remain and become consolidated.²¹ The general impression after discussing the matter with different conservators seems to be that nowadays the plaster is generally not removed, but remains on the fragments, occasionally ground to a suitable thickness. Before making a final decision, removal of the plaster was tested on a few fragments, but excluded, since there might be problems if performed on larger fragments. These may fall apart, due to their size and brittle constitution. Consequently, samples had to be removed before any consolidation treatment was made.

Cleaning

Cleaning tests were made by

- a) dry cleaning with a brush, and
- b) cleaning with deionized water and the use of brush, Japanese rice paper, or
- c) with a special sponge, Wallmaster, used for the cleaning of murals.

The use of water and sponge was most efficient and delicate. A scalpel was used to remove earth from the plaster, the sides of the fragments, and when necessary to remove limited layers of earth on the paint surface. These combined methods are frequently used for cleaning excavated murals and mural fragments.²² Hard deposits were left upon the surface at this initial cleaning. Salts were extracted from the fragments by use of deionized water in paper pulp, which was applied to the fragments and left to dry. The paper was then removed, and samples were taken. While cleaning the fragments and removing the samples the following observations were made:

An additional cleaning with a 10-minute application of Viscor, a water-based cleaning gel, was tested on a few fragments (80:11, 80:95, 82:1, 83:1 and 9), with the objective of removing some of the remaining incrustations. This treatment was very effective on fragments painted *al fresco*, but tended to dissolve deposits as well as some colour on colours applied *a secco*. The treatment was followed by cleaning with deionised water.

²⁰ Moreno, 1997, p. 305.

²¹ Stajkowski, 1997, p. 293.

²² Mora, 1996, p. 93.

Consolidation

Consolidation tests with casein were made on a few fragments. Casein is an organic consolidation substance from milk/cheese production, which was used for the consolidation of materials during Antiquity, but also until recent times, when inorganic compounds have substituted it, provided by the chemical industry. Casein in various dilutions of deionized water and a few drops of ammonia was applied to the plaster with a brush. In 24 hours the fragments had regained resistance to the touch, and did not sugar when moved. There was no obvious difference between the different solutions, which indicates that casein can be used very diluted, almost watery, on small objects such as these.

Three of the casein consolidated fragments were brought to San Lorenzo in Lucina and placed in a shelter with the objective of studying any changes in the material, as for example the development of mould, fungus etc. The natural environment in San Lorenzo is quite damp, and since the fragments are planned to be exposed in the building, it was important to test the casein solution before a general application. If the result proved to be good, casein would be used. A few other fragments were treated with an ethyl silicate based consolidant (Estel), which is known not to alter in humid environments. The negative part of this product is that it contains chemicals that are negative for human health, and a mask should be used during applications.

After having been disposed in San Lorenzo for one month, the fragments were observed. There were no visible signs of moulds etc, and no particular smell either. All fragments were therefore consolidated with casein with the addition of a few drops of ammonia, either by application with a brush, or by partial immersion into the liquid.

It was important to be able to move the fragments when trying to unite them, and look for a figurative pattern. After consolidation each fragment was given an identification number, on a dot of Paraloid B72, was applied to the plaster. The identification numbers consisted of the original layer number plus an individual number starting from 1.

<i>Layer</i>	<i>Fragments</i>	<i>Period</i>	<i>Finds</i>
44	44:1-2	8	medieval pottery, stucco, porphyry
77		4	pottery, stucco, tesserae, glass, bone, coin
78		3	pottery
80	80:1-135	3	pottery, stucco, tesserae, nail
82	82:1-14	3	pottery, stucco, bone, golden plate
83	83:1-9	3	pottery, stucco, bone
84	84:1-22	3	stucco, marble, bronze, nail, glass
85	85:1-3	2	stucco, marble, pottery
87	87:1-67	2	stucco, pottery
88/49	88:1-89/49:1-18	2	stucco, marble, bone
89		1	wall of the insula

Fig. 48. Numbers of fragments, 359 pieces, and their find context (stucco = mural fragments).

Surface coating

Ten fragments were selected for a test with saponified wax as a surface protective.²³ The fragments were selected, being singular and representing a wide range of pigments. A thin application of saponified wax emulsion was applied and left to dry for some minutes, and then the surfaces were heated with a hair dryer in order to make the wax sweat. When the pieces had cooled, the surfaces were gently rubbed with a cloth.

One fragment, no US 1, was selected for comparative testing of surface applications. The surface was divided in three parts, and at each end of the fragment a protective was applied. Area 1: saponified beeswax, area 2: no surface protective, and area 3: Paraloid B72. A considerable difference between these areas was noted. The Paraloid-treated surface received a uniform and hard lustre, but the colour did not change. The wax-treated area gained a soft lustre, but became slightly darker. At inspection in February 2000, the Paraloid-treated area had darkened and become rather brownish, while the wax-treated area had not changed at all.

All treated fragments were then brought to San Lorenzo in Lucina with the intent of studying any change in the material. During inspection some weeks later there was no visible change. At a later date, however, some fragments were left on the earth floor in the crypt for a period, and were shortly afterwards covered with some unpleasantly smelling growth, probably mould. Those that were placed on a level above the floor did not present any growth. This experience made clear that the crypt was not suitable for the exhibition planned, since also other materials such as paper and wood showed the same kind of decay.

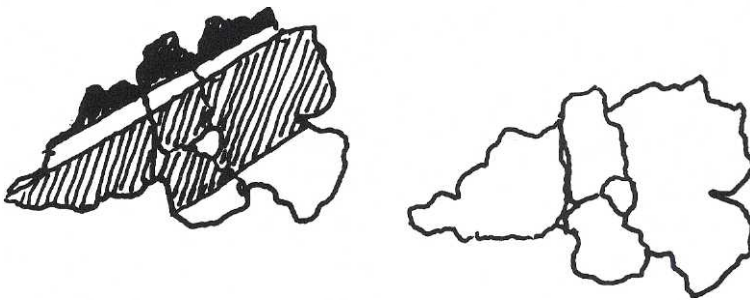


Fig 49. Reassembly of fragments 87:25, 29, 30, 31.

To the left: The decoration. *To the right:* The joints. Scale 1:1.

²³ 80:13, black; 80:17, violet with a white stripe on red ground; 80:27, yellow, stripe in terra; 80:28, striped in red, black, yellow, black; 80:35, light blue; 80:50, bright red with decoration; 80:127, terra; 84:20, white; 49:8, white, marble decoration; 49:18, bright red.

Documentation

Photos of the fragments were made before the investigation started. Just a few were photographed separately, others in small groups and the major part in their boxes. This seemed to be an adequate way to document the fragments in this particular case. The initial photos were made to record the status of the fragments, and the quantity within each group, i.e. finds at each specific level.

Some photos were made, showing fragments before and after cleaning with deionized water. Other photos were made to show the thickness and the number of layers of plaster and stucco. Stucco layers were measured and the thickest as well as thinnest measures noted. An estimate of the average thickness within each group was made. The characteristics of each fragment were studied and the main characteristics within the fragments from each level were described.

After consolidation and marking of the fragments some were selected for further photos, to show examples of possible joining and gluing of fragments, colours, patterns etc. Photos were made of fragments which were glued together and drawings were made to show the joints of the small pieces, and finally the ten wax-treated fragments were photographed.



Fig. 50. Some fragments at Unit 87, presenting white stains and a black band on the dark red surface. The upper fragment has a white area at the top. Hypothetical reconstruction. Scale 1:1.

Presentation

The very small fragments excavated at San Lorenzo in Lucina were, as mentioned above, found in filling materials at different levels below the 15th century chapel. Since it would not be possible to reconstruct any figural decoration, it was decided that the fragments should be shown as instructive material in a didactic exhibition. Thus the material could be exhibited in combination with brief information about ancient descriptions and modern analytical results, with illustrations showing how Roman murals were constructed, what pigments were used etc.

As work within the research school proceeded, and other kinds of excavated materials were cleaned and documented, it was decided to plan for an exhibition area containing all kinds of archaeological materials. Planning of the exhibition area was made in collaboration with Olof Brandt and the architect Mats Fahlander, who made the drawings. The final decisions and the realisation of the exhibition area were made by Brandt and this author, and the exhibition was opened to the public in September 2001.

Conclusions

Period 2: levels 88/49, 87, 85

US 88/49. The large group of white fragments with an unpainted top-layer probably belong to the same wall. Some have a band decoration painted with red ochre, some present red stains and some have an illegible violet decoration. The fragments are built up with a 2-4 mm stucco layer, on a plaster layer with red and brown inclusions (terracotta). Some stucco layers present deformations and cracks. A group of fragments with yellow and red ochre decoration probably belong to the same wall as well. Finally, there is a group of larger white fragments, with remains of rough plaster. Five of these are not totally white but show various earth-coloured hues, maybe due to discoloration or perhaps a deliberate attempt of imitating marble. One has remains of a relief decoration.

US 87. The white fragments with red ochre decoration are similar to the large group at US 88/49, mentioned above. Also these present the same kind of deformation and cracks. Such deformations are also characteristic for many of the dark red, white-dotted fragments, indicating that these were all part of the same wall, at different levels.

US 85. Two of the white fragments are similar to those mentioned above. The third fragment is different, since the top layer is very thin and shows various minerals. This fragment resembles the white group in US 84.

Period 3: US 80, 82, 83, 84

US 84. All fragments except two are white, most of them with unpainted stucco, and resembling those at units 88/89, 87 and 85.

US 83. 6 fragments present parts of a simple figural decoration, made on a rough plaster layer consisting of lime and sand and including black minerals. There is not much enough remaining of the decoration to understand the motif. The decoration was made with earth colours. The remaining fragments are painted with red ochre, and one is monochrome white.

US 82. Fragments painted in various hues of yellow ochre, similar to those at US 80, form a group within this unit. The red fragments resemble those at US 83. One fragment is distinctly different, and belongs to the decorated fragments at unit 83.

US 80. The fragments from this unit have mainly smooth stucco, some with remains of a decoration, and appear similar to the white fragments at US 88/49, 87 and 85. The dark red dotted fragments are very similar to those found at unit 87. There is a large group of yellow ochre fragments with a smooth surface, typical for the Antonine period. The main group consists of bright red cinnabar fragments, some of them with remains of a multi-coloured decoration. A rich variety of colours are represented within this unit, such as various shades of yellow, red and brown earth colours, as well as hues of violet, blue green, grey, black and white.

Period 8: US 44

Two white fragments, similar to those at 88/49, 87, 85 and 82. These fragments belong to the medieval context.

Most of the fragments did not fit together, but surprisingly many could be joined. Groups of fragments presenting similar structures or colours may be identified at each level, even though disparate pieces occur. The cinnabar fragments occur only at US 80. These are probably related to the yellow ochre fragments at the same level, and consequently dating to the middle of the 2nd century AD, i.e. to the Hadrianic, or maybe the Antonine period. Since cinnabar was a costly pigment, and the wall preparation well made, it is suggested that these fragments belong to an elaborate decoration in a public room in the *domus*.















The white-dotted, dark red fragments, some with traces of a black stripe, probably belonged to the same wall as the white fragments at this unit, since the cracks and deformations in the stucco is a common item. Deformations such as these were noted also on groups of fragments at US 88/49 and 85, i.e. within period 2. Since the colours and preparations within these layers are similar, most of them may originate from the same room. Decorations made with this kind of stain are known from e.g. service rooms, and used e.g. for high socles. It is therefore possible that the fragments were part of the socle, and that the decoration made on a white surface belonged to the upper part of the same wall. The very similar dotted fragments at US 80 may also have been part of this decoration. One of these, 80.46, partly presents a white, partly a dotted decoration, divided by a black line.

The six fragments with an illegible decoration at US 83 are definitely made later than the groups mentioned above. These, as well as the single fragment from US 82, which fits perfectly with the others, have been painted on a rough plaster layer, and there are no other similar fragments present in this investigation. These fragments are probably dateable to the Severan period.

The white fragments which appear at all levels, either have a 3-6 mm or a 2-3

mm well made and smooth stucco layer, or a very thin top layer with grainy appearance, due to the inclusions of minerals that are seen through the preparation. Some of the white fragments have rich remains of plaster, of a different composition from the major part of the fragments. These rough fragments instead resemble some slightly coloured fragments at US 88/49.

To conclude, it seems probable that most of the fragments belonged originally to the excavated room or a nearby room. The cinnabar decoration, maybe connected to the smooth yellow ochre fragments, was probably part of an elaborate ambience from the Hadrianic-Antonine period, i.e. in the *domus*. All other fragments indicate a simpler type of decoration, and probably were part of the 3rd century *insula*. Some correlation between fragments within each period has been noted, even though there is an evident disorder between the units, caused by successive diggings and fillings.

-  white
-  white, stained
-  blue
-  yellow ochre, band
-  yellow ochre
-  bright red, cinnabar
-  red ochre
-  red ochre, band
-  white dots
-  violet decoration
-  ornamental decoration
-  red stains
-  borders
-  stripe, band

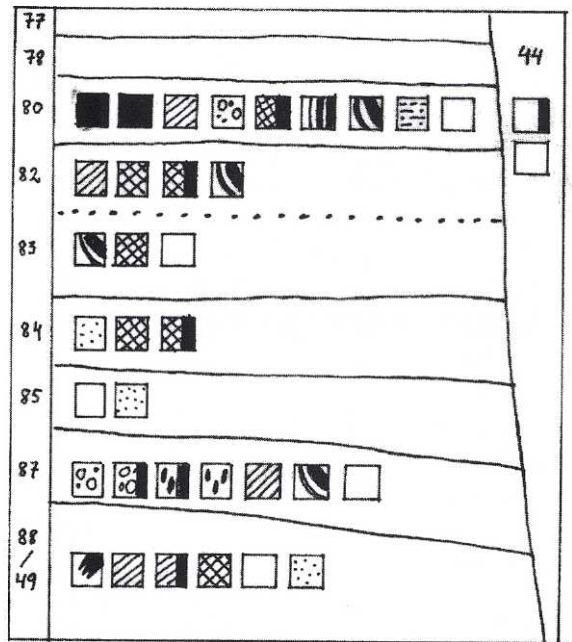


Fig. 51. Representation of the fragments.

To the left: The symbols used.

To the right: The fragments within the stratigraphical units.

Fig. 52. Fragments of wall paintings composed by A. Freccero. From the exposition of excavated materials at San



Lorenzo in Lucina.

Case Studies 4a, b and c:

Introduction

The objective of the present study has been to investigate some methods for identification of the original context and the dating of Roman wall paintings, based on the analyses of stucco and plaster layers, pigments and binders. With the original context is intended factors such as what kind of building, e.g. villa or *insula*, or room, e.g. service room or atrium, the painting was made for. The methods have been 1) identifying and measuring the stucco and plaster layers, 2) studying their characteristics, e.g. grain size and inclusions, 3) studying the paint surface – colour and structure, and 4) a chemical-technical investigation of samples of selected material. The assumption that the determination of materials might contribute to a better understanding of the environment for which Roman wall painting were made, comprises

- a) the statement by Vitruvius concerning wall-preparations for mural painting,¹
- b) the fact that murals, composed of six layers of plaster have been found,²
- c) the fact that most murals were made of less than 6 plaster layers,³
the assumption that Roman murals were at their highest standard at the time when Vitruvius was active, i.e. during the Augustan period,⁴
that simple preparations might be dated either before or after the Augustan period or be part of a decoration in a simple house or service room during the Augustan period,
- e) the assumption that explicitly manifesting social status was important in Roman society. This indicates that costly and high class materials, used for wall paintings, were ordered only for public spaces or by wealthy families for their official ambiances, while materials used in buildings of the lower classes, consequently were of a lower standard,⁵ and
- f) the fact that the study of plaster composition has been found successful at Pompeii.⁶

Dating is traditionally made on stylistic grounds, and the Four Pompeian styles have been thoroughly investigated, ever since the classification of Mau in 1882. Such classification is the basic tool for dating, since interpretation of form, colour, and painting technique, makes it possible to define a range of time, within which a painting could have been made. There are, however, disagreements in dating, due to variations in the stylistic interpretation. It is well known that difficulties in dating may in addition be due to the fact that some people in any period of time may pre-

¹ Vitruvius VII.

² Ling, 1991, p. 199.

³ Dr. Bo Ossian Lindberg, personal communication, May 1997.

⁴ Borrelli, 1980, p. 82.

⁵ Leach, 1993, p. 145; Clarke, 1991, p. 16; Scagliarini Corlàita, 1998, p.57; Wallace-Hadrill, 1994, p. 154.

⁶ Meyer Graft, 1997, pp. 318, 319.

fer old-fashioned paintings while others want the latest in fashion, which may lead to a continuous use of an earlier style, while the succeeding style has already been established and maybe even overdue. Finally, very little of the original decoration remains, and dating on stylistic grounds is not possible.

Measuring, may be an additional dating tool, revealing if there is a definite correlation between material composition and the different periods as represented by the Four Pompeian styles. The material composition and the quality of craftsmanship may be possible to link to the owners' status. By studying the material composition it is also possible to see whether repairs or structural changes in walls were made after the original mural painting was made.⁷

The fragments in this study originate from Prima Porta outside Rome. For some reason this investigation has been divided into a, b and c, although the materials are closely related. To start with, I was given the opportunity to study some First style fragments, and at a later time one fragment found at the atrium in the Villa of Livia. It seemed natural to present the vast First style study and the only Third style fragment as separated studies, due to the differences in number as well as in excavation context. I was hoping to study fragments from the Pompeian and Post-Pompeian periods, and this possibility came when the first two studies were already defined. It was not either clear, until much later, if fragments from all periods represented were possible to be examined at the Opificio or not. Therefore, the division made at the beginning has remained.

The study started with an ocular investigation, combined with measuring and identification of the stucco and plaster layers. All information was noted on registers. Drawings of the fragments were made in scale 1:1, and used for sample location diagrams. Colour slide photographs were made showing the decorated surface. In some cases additional photos of the backside, or the profile, of the fragments were made. Then, samples of stucco and paint were removed for analysis of the composition of plaster, stucco, pigments and binders, and brought to the scientific laboratory at the Opificio delle Pietre Dure in Florence, where the chemical-technical investigations were performed by Dr. Archangelo Moles, Dr. Giancarlo Lanterna and Dr. Carlo Lalli. The present investigation was made in concordance with Dr. Gaetano Messineo and Dr. Matilde Carrara, Soprintendenza Archeologica di Roma, XX circoscrizione, and with the support of the Swedish Institute for Classical Studies in Rome.

⁷ Meyer Graft, 1997, p. 318.

Case Study 4a:

Torre di Prima Porta First style decorations

The Torre di Prima Porta

The excavation site, Torre di Prima Porta, is named after the Medieval tower on a nearby hill, c. 200 m from the Villa of Livia. Under the tower, and in its immediate surroundings, there are remains from the Archaic period, during the 9th century BC, as well as such of Etruscan and Roman origins. A complex of subterranean rooms have been excavated, some still preserving their original stucco on the walls.⁸ Among these rooms, partially carved in the rock and partially constructed of tufa blocks, are spaces identified as cisterns. These rooms are accessible through an open doorway, followed by a gallery and stairs leading to the vaulted cisterns.

Objects from the Archaic period until the late Empire, have been excavated at specific locations, specified and described by Messineo.⁹ There seem to have been various periods of building activities, with successive structural changes within the original building, e.g. in the Hellenistic period, and finally during the middle of the 1st century BC. Some finds, such as the identical structure of tufa blocks, and similarities between mosaic pavements, indicate a possible integration of the site with the nearby Villa of Livia. These buildings were, during the Augustan period separated by the Via Flaminia.¹⁰ Finally, the Medieval tower was erected, upon part of the Roman building.

The First style fragments, investigated in this study, derive from the *cisterna meridionale*, situated east of the tower. In the same context two portraits of terracotta were found in the interior of the cave. One of the portraits, representing a bearded man, is dated to the Late Republic. The other portrait, with remains of polychromy, is the head of a woman, and dated to the late Hellenistic period. In the upper layers, fragments of wall paintings were found, all made in the First style, and datable to between the 2nd and 1st centuries BC. These decorations were usually imitations of marble, often made in a fanciful and not necessarily naturalistic manner, but could represent a vast selection of colours.¹¹ The panels appear in relief, delimited by flat and depressed borders, and were built up by various layers of stucco. An incised line frequently delimited one panel from the next. The fragments were, at the time of excavation, recorded as belonging to four specific groups, A, B, C or D, with differences within the groups registered as 1, 2, 3 etc., published by Messineo 1989-90.

⁸ Messineo, 1986, p. 725.

⁹ Messineo, 1986, 1989-90, 1991.

¹⁰ Messineo, 1986, p. 732.

¹¹ Borda, 1958, p. 5; Mau, 1908, p. 39.

The fragments investigated

Twenty-four First style fragments, excavated in 1985, have been investigated. The fragments were chosen according to the principle that they should be representative examples of commonly found colours, decorations and profiles. All fragments, except two, were chosen as *not previously* having been conserved and thereby contaminated by modern conservation materials. The previously treated fragments were included in the study due to their decoration, which was well preserved. Full size drawings of these fragments were made, and their stucco and plaster layers were measured, but thereafter excluded from further investigations. The decoration very much resembles one in the Hellenistic Palace at Pergamon, documented by Wiegand.

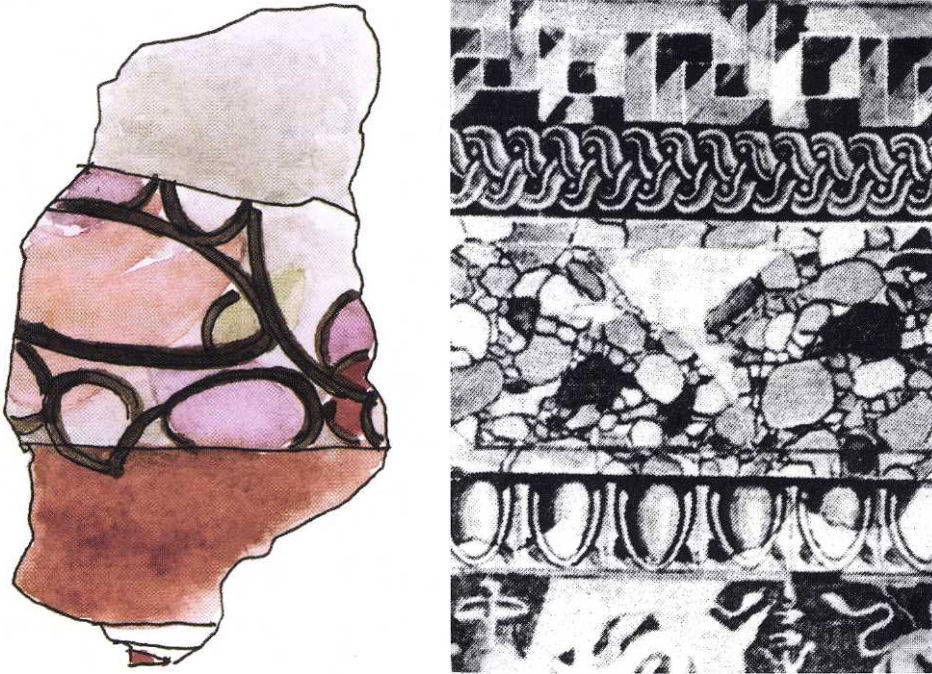


Fig. 53. *To the left:* Fragment from Prima Porta.

To the right: Wall decoration from the Palace at Pergamon. After Baldassare.

The investigation

All fragments were cleaned with deionised water. Hard deposits were removed with a scalpel, otherwise a soft brush or a sponge was used. The surface of three “false marble” fragments were water repellent, and consequently previously coated. After cleaning, the stucco layers were measured and full size drawings were made. The grain sizes of sand and glassy particles in the layers were noted. The visual investigation was made with a magnifier, which means that further layers may be identified if viewed under a microscope.

During cleaning it became obvious that the painting techniques were two, i.e. the paintings had either been made *al fresco* or *a secco*. The colours applied *al fresco* were well integrated with the surface and did not soften or dissolve during cleaning. Colours applied *a secco* tended to soften or dissolve, and in many cases the surface deposits were harder, than the paint. After testing, and when needed, applications of ammonium carbonate in paper pulp, or Viscor, a gel adapted for cleaning of mural paintings and marble, were made in order to remove remaining surface deposits.

Testing

Tests were made to study *if* and *how* the surface of two fragments, the blue TPP 426405 (77) and the yellow TPP 426462B (137B) reacted to deionised water, Viscor and ammonium carbonate, i.e. if one substance would be more suitable than another for softening the hard deposits. An application of each substance was made with cotton, folded on sticks, and identified as I, II and III. After 5 minutes, each spot was softly rubbed with a respective cotton stick. Finally the surface was cleaned with deionised water.

TPP 426405 (77): Deionised water dissolved some colour, ammonium carbonate less colour, and Viscor, dissolved no colour at all.

TPP 426462B (137B): Deionised water dissolved no colour, ammonium carbonate, and Viscor, dissolved hardly any colour at all.

Results

The stucco generally contained white and brilliant components, some with a crystalline appearance. The layers were mostly two, upon which a distinct and shell-like surface layer was distinguished. This last layer was hard and smooth and with a thickness of about 1mm. This shell-like structure is apparently due to smoothing and compacting of the surface. Since such a shell appears on every fragment, it will not be specifically mentioned, when the layers are described.

In the group of 10 (8+2) "false marble" fragments, the stucco layer was generally 4-5 mm, as well as the plaster layer underneath. Among these fragments, seven had a plastic profile, and three were flat. One of the flat fragments had two distinct stucco layers, all the others just one. The remaining fragments show similar results, the upper stucco layer 3-5 mm and the lower layer 4-6 mm, if there was a profile. If the fragment was flat there was no lower layer. In one case, there were three stucco layers.

Most fragments contained remains of plaster, only four did not. It is, of course, not possible to say anything about the original thickness of the plaster, or about the number of mortar layers, since there are only few remains, and no limitations at two levels. In two cases, there were two distinct plaster layers, in all other cases just one.

- a) eighteen fragments had 2 distinct stucco layers, one fragment had 3 layers, and the remaining eight had 1 stucco layer. Four of these eight fragments had no remains of plaster, and those, consequently, may have had an additional stucco layer.
- b) all fragments had a shell-like surface, in addition, constituting the paint layer.
- c) all fragments had an *upper layer*, made of fine and homogeneous stucco, with the grain size of less than 2 mm Ø.
- d) most fragments had a fine grained *second stucco layer*, made as the stucco described above, with the inclusion of larger grains, c. 2-3 mm Ø.
- e) One fragment had fine-grained stucco of the kind first described, but with inclusions of 3-5 mm Ø.
- f) All stucco layers obviously contained lime, fine sand and marble dust. In some cases there were inclusions of other materials, such as minimal glassy, or glassy black particles and possible travertine.
- g) All plaster layers contained lime, and fine sand, and, generally (22 cases), glassy black articles. In some cases there were some inclusions of glass-like particles, and of some red and brown particles as well.

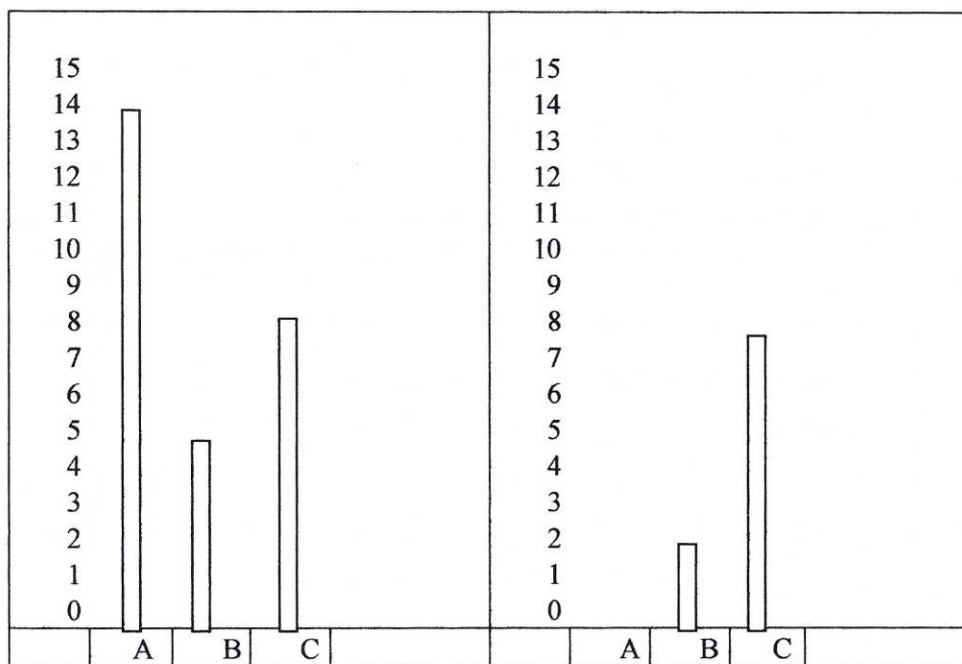


Fig. 54. Stucco layers.

To the left. The measurements of grain sizes, of all fragments investigated. To the right. The grain sizes of the "false marble" fragments.

A = 1 layer, with the grain sizes of less than 2 mm.

B = 2 layers, with grain sizes of less than 2 mm (the upper layer), and 2-3 mm (the second layer).

C = 2 layers, with grain sizes of less than 2 mm (the upper layer), and 3-5 mm (the second layer).

Conclusions

The number of mortar and plaster layers cannot be determined, due to the fact that there were no fragments containing all those layers. The layer immediately below the stucco, i.e. the last plaster layer, was mostly composed of lime and fine grained sand, generally with the inclusion of glassy black particles and sometimes with the inclusion of glassy particles and of larger grained sand. The sand grains were mainly rounded, while the glassy particles had distinct edges. Results from the material analyses performed at Opificio, did not reveal any presence of quartz, but the glassy particles instead proved to be alabaster. Other inclusions in the lime/sand plaster were marble and travertine particles.

The stucco layers were generally two, the upper of a finer grain-quality than the lower, and in addition there was always the compacted and shell-like, 1 mm thick upper layer, often constituting the paint layer *al fresco*. Analyses of the stucco, made at the Opificio, show that alabaster dust was frequently used for these preparations. The inclusion of this brilliant, and very costly material, explains the glittery appearance of the surfaces, and also the brilliance of the colours.

The materials used for plaster and stucco were of the highest possible quality for these First style decorations. This was not expected, since the hypothesis was that the practice of using alabaster-dust was invented slightly later, during the Augustan period. Consequently, the use of costly materials and high-class workmanship, were not inventions of the Augustan period, but rather a tradition inherited from craftsmen during the Republic, or maybe even earlier. Therefore, Vitruvius, when describing the materials for wall-preparations, based his recommendations on the actual knowledge of the craftsmen during his lifetime.

Roughly half of the samples seem to have been painted *al fresco*. In a few cases, the painting technique could not be distinguished, due to weathering of the surface. Most fragments had additional paint layers, which clearly indicate that the paint was applied on a drying or dry surface. In some cases, there were indications of some ancient surface application, since the paint appeared to have a greasy consistency. Pigments used, binders and possible surface protective may be determined in a future analysis of the samples. Results of analyses from the Opificio reveal that beeswax had been applied on some fragments.

Cleaning and removal of incrustations on surfaces painted *al fresco* are not a great problem, since the pigments are well integrated to the surface. Such cleaning may be done with deionised water, ammonium carbonate, or Viscor, followed by cleaning with deionised water and a soft brush. Remaining incrustations were mechanically removed with a scalpel. There is a definite difficulty in cleaning mural fragments, if there are hard surface incrustations, and if the paint layers are applied *a secco*, since the incrustations are harder than the paint. By softening the incrustations, the paint softens too, or becomes less attached to the surface, and is, therefore, easily removed. Deionised water and a scalpel may partially remove incrustations without harming the paint. Identification of the binders is important for finding a cleaning method adapted for each kind of paint.

Case Study 4b:

Villa of Livia at Prima Porta, Atrium Third style decorations

The Roman context

It has been assumed that this excavated building was the country estate of Livia, recorded in ancient sources by e.g. Pliny and Suetonius. According to Pliny, it occurred on one occasion that Livia, at the time when she was engaged to Octavian, “... while she was seated an eagle, passing in the sky, dropped into her lap a hen of remarkable whiteness, without hurting it; she regarded it with wonder, but undismayed, and there was a further miracle: it was holding in its beak a laurel branch bearing its berries. So the augurs ordered that the bird and any chickens it produced should be preserved and that the laurel branch should be planted in the ground and guarded with religious care. This was done at the country mansion of the Caesars standing on the banks of the river Tiber about nine miles out on the Flaminian road; the house is consequently called *The Poultry* (*Ad gallinas*), and the laurel grove so begun has thriven in a marvellous way. Afterwards the Emperor when going in a triumph held a laurel branch from the original tree in his hand and wore a wreath of its foliage on his head, and subsequently every one of the ruling Caesars did the same.”¹ Suetonius tells a similar story.²

The mansion owned by Livia was situated at about nine miles from Rome close to the ancient Via Flaminia, a road constructed already in 223 or 222 BC, and repaired by Augustus in 27 BC.³ At Prima Porta there are remains of the ancient crossroads of Via Flaminia and Via Salaria, indicating that the villa was built in a strategic position. The site mentioned in ancient descriptions was thought to be localised at the village of Prima Porta, and only in the middle of last century was the villa actually identified. This led to the discovery in 1863 of the cuirass statue of Augustus, now in the Vatican Museum, and of the famous garden paintings, now in the Museo Nazionale Romano.

Excavations

Recent excavations at the villa have resulted in the unearthing of various objects from the Roman period. Apart from the remains of masonry and wall paintings, several floors with mosaics or in *opus sectile* have been found. These are dated to the Republic, the Augustan and the Antonine periods.⁴ In this study one large fragment from the atrium is studied.

¹ Plinius, NH, XV, 135-137.

² Suetonius, Galba, I.

³ Messineo, 1991, p. 2.

⁴ Dr. Peter Liljenstolpe, head of the Swedish excavations at Prima Porta. Lecture at the site, October 3, 1998.

The fragments of wall painting

Remains of an elegant decoration still *in situ*, is situated close to a concrete foundation in the atrium. This decoration, mainly in yellow and red on black, was made on a smooth and shiny surface, upon which the painted decoration appears slightly in relief. In areas where the decoration is weathered, the underlying black layer shows, indicating that the painting was made in a mixed technique.

The detached fragment from the same decoration was kept in the laboratory of the Soprintendenza at Malborghetto after excavation. The fragment had not been cleaned or consolidated and was therefore suitable for material analysis. At the visual inspection, some samples were removed. Observations were registered on a form, photographs were taken and drawings in scale 1:1 made. The samples were brought to Opificio for material analyses. At a second occasion, the plaster and stucco layers were measured. During the period in between, the fragment had been cleaned and consolidated with Paraloid B72. Some particles in the stucco were removed although they probably preserve some application of Paraloid at one surface.

Conclusions

The plaster preparation was made in several layers, the upper layer containing alabaster dust. Pigments identified were cinnabar, yellow ochre and carbon black. There were no traces of wax. The fragment had been treated with a surface protective.



Fig. 55. From the atrium at the Villa of Livia. The mural fragment still *in situ*. Detail.

Fragment no VLA (1)

Provenance: Prima Porta, Villa of Livia

Location: Atrium, room 43

Excavation date: 1997

Object: Fragment of wall decoration

Subject: Third style (1st century, c. 20-15 BC)

Measures, mm: Surface: 200 x 115; stucco: 17 (2+4+5+4+2) plaster: 45 (23 + 22)

Photos: Colour slides.

Bibliography: Not published.

Description

Fragment of a wall decoration. On a black monochrome preparation an elegant floral motif appears in red and yellow. The fragment was part of the atrium wall decoration, partially still *in situ*.

State of preservation

The stucco is hard and solid, and the painted surface seems stable too. It is partially covered with surface deposits.

Investigations

Some samples were removed with the objective of determining the pigments and binders used. The samples were removed with a pointed scalpel and disposed in plastic sample containers. It was difficult to take cross-section samples due to the very hard and compact surface, into which the black colour was completely integrated. The red paint was well affixed. The yellow colour, also extremely hard, seemed to have been made upon a white application, slightly in relief. At one spot, an area of paint lifted, and this is the only large sample collected. Samples in powder form were taken, and these were also difficult to remove. The fragment was not cleaned before sampling, just part of the surface dirt was removed with the scalpel.

Cross-sections

VL.I. Black paint layer at the extreme right side.

VL.II. Red paint layer at the right upper edge.

VL.III. Yellow paint layer from central decoration.

VL.IV. Yellow paint layer from the lower left edge.

Powder

VL.1. Black paint layer.

VL.2. Red paint layer.

VL.3. Yellow paint layer.

VL.4. Yellow paint layer.

Additional samples

These were removed from the plaster at a second investigation of the fragment. Paraloid B72 will probably be traced upon one side of the particles.

VLA: A, alabaster? Analyses revealed the presence of only calcite (alabaster).

VLA: C, carbon? Analyses revealed silicates and nitrates, indication of carbon.

VLA: M, marble? Analyses revealed only calcite (marble or alabaster).

VLA: T, travertine? Analyses revealed silicates, quartz, (probable travertine) nitrates (inquination).

VLA: Q, quartz? Analyses revealed only calcite, i.e. marble. (No quartz).

Further observations

Except for the visual inspection and measuring of the layers and particles included in the plaster and stucco, no further investigations were made. The fragment was not cleaned. It was quite obvious that at least the yellow colour was applied after the black surface had dried. The applications of plaster and stucco was made according to the description of Vitruvius, and it seemed to have been made in six or seven layers.

Chemical-technical investigation at the Opificio

VLA I. No visible paint layer.

VLA II. Two layers. 1: remains of stucco preparation. 2: paint layer with red pigment, probable cinnabar. Intense red fluorescence.

VLA III. No visible paint layer.

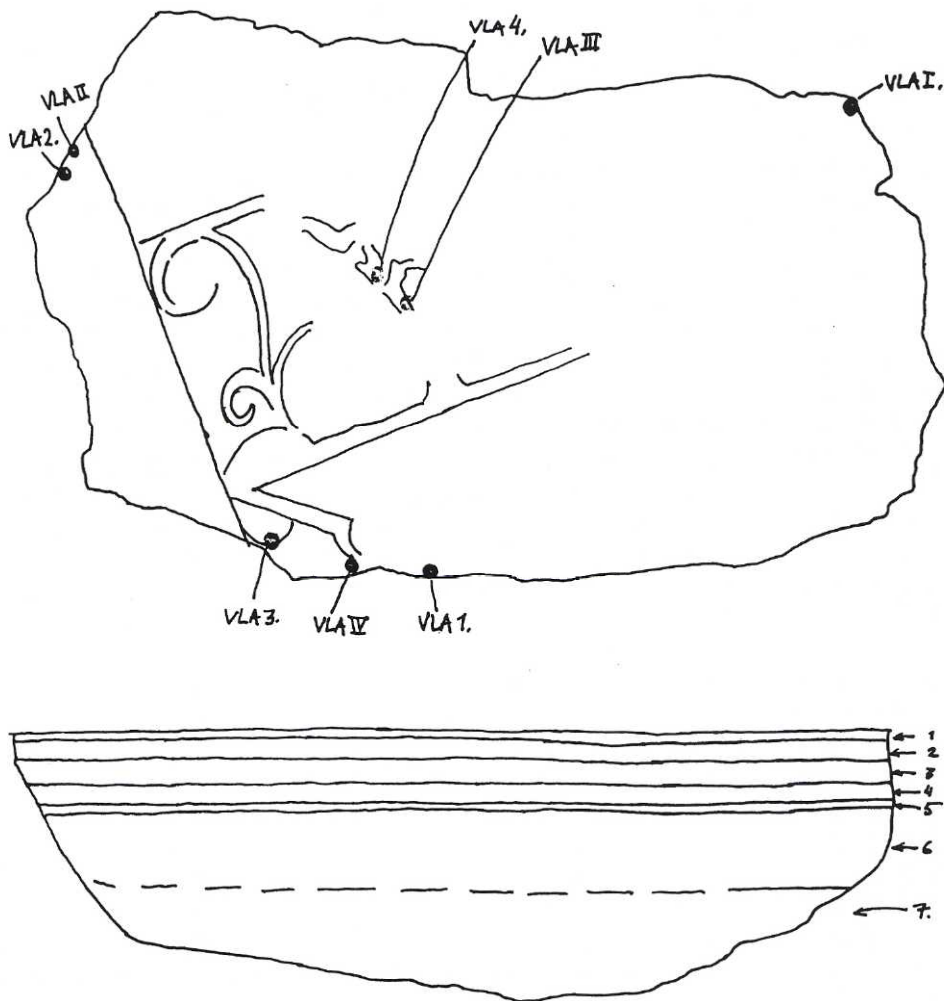
VLA IV. Three layers. 1: preparation with only calcium carbonate. 2: yellow paint layer. 3: another yellow paint layer, with intense yellow fluorescence.

VLA 1. Only stucco.

VLA 2. Calcite and aragonite and minor quantities of silicates (red ochre).

VLA 3. Calcite, silicates (yellow ochre) and an organic substance.

VLA 4. Calcite, silicates and an organic substance (acrylic polymer).



Fragment no. VLA (1)
Scale: 1:2.

Above: Samples removed
Below: layers 1-5: stucco
layers 6-7: plaster

-
- ← 1. Inclusion of small, brilliant white particles
 - ← 2. Inclusion of particles 0-1 mm ϕ .
 - ← 3. Inclusion of white & yellow particles 1-2 mm ϕ
 - ← 4. Inclusion of white & yellow particles 2-3 mm ϕ
 - ← 5. Inclusion of small brilliant white particles.
 - ← 6. Inclusion of black and white particles
 - ← 7. Inclusion of red, black and white particles.
(red - terracotta? black - carbon? white - lime?)

Fig. 56. The fragment investigated and the positions of the sampling areas. Scale 1:2.

Case Study 4 c:

Villa of Livia at Prima Porta Fragments dated from the Republican to the Late Roman periods

The present case study is an investigation of fragments of First and Third style decorations and Post-Pompeian decorations, i.e. from the Republic and Augustan to the Antonine and Severan periods. The four Pompeian styles are well defined but not much attention has been given to the Post-Pompeian period.

The Post-Pompeian period is not uniform, various sub-periods are known, such as the Hadrianic period, when there was a classicistic revival. Since the following period is not well documented, it is difficult to understand whether a decoration is from e.g. the Antonine or the Severan period. Therefore, masonry is often used for dating. The Post-Pompeian decorative scheme continued to be used also in the early Christian catacombs, and traditional pagan motifs were transformed into Christian vocabulary. Since the Post-Pompeian style spans over a long period, observable changes must be assumed to exist. In this study, concerning fragments and not paintings, any attempt at exact dating (within the various styles) has been avoided, since there is not enough evidence for making stylistic determinations. The argument in this case study is that there were not only stylistic changes but also variations in the material composition, and that these factors have to be regarded as parts of the same whole.

Results

Ten First style fragments, seven from the Augustan period, nine from the Antonine, and nineteen Post-Pompeian fragments were investigated, according to the system previously described. The First and Third style fragments were made of the highest class materials and were of excellent craftsmanship. Also those dated to the Antonine period were carefully made, while those from the later Roman period were more simply executed. Alabaster dust in the stucco was determined in the later period, when the stucco layers were thinner and less shiny. The variety of pigments used was similar throughout the period.¹

Discussion - Case studies a, b, and c

The results from the investigation at the Opificio show that the materials used at Prima Porta for plaster and stucco during the Republican, Augustan and Antonine periods were of the highest possible quality. It was a surprise, though, that alabaster-dust was used for the First style decorations, a practice assumed to have been of a later date. Consequently, the use of costly materials and a high-class workmanship, were not inventions of the Augustan period, but rather a tradition inherited from craftsmen of the Republic, or maybe even earlier. Therefore, Vitruvius, when

¹ The documentation is available in Freccero 2000, III.

describing the materials and methods for wall-preparations, based his recommendations on the actual knowledge of the craftsmen during his lifetime. Also the fragments dated to the Antonine period were made of high-class materials, while the late Roman wall preparations were of inferior quality.

The Third style fragment had more plaster layers than any other, indicating that such a careful preparation was made in important rooms like the atrium, while fewer layers were applied in general. The compacted, hard and shell-like upper surface was a common characteristic for all fragments, even though the smoothness and lustre was extreme on the Third style fragments, and almost as brilliant on those from the First style. The thickness of the stucco layers increased from the First to the Third style and then gradually decreased. Fragments from the Republic have roughly a 5-6 or a 9 -11 mm stucco layer and those from the Augustan period generally have an 11-12 mm layer. The atrium fragment had the exceptional thickness of 17 mm. During the Antonine period the layer was generally 5-6 mm and during the Severan and later periods only 4-5 mm. The measures registered in Case studies 4 are shown in Fig. 55.

All fragments from the Villa of Livia have a well-known find context. Most of the fragments originate from decorations in private rooms, except one fragment from the Augustan and five from the Antonine period, which were excavated at the atrium, and consequently made to be seen by the public. No fragments derive from any kind of service room. The original context of the fragments found in the cistern at Torre di Prima Porta is not known. The very high-class quality of the fragments causes one to believe that even these originate from a decoration in a public room, but not from a simple space.

15		x			
14					
13		x			
12		x			
11		xxxx		x	
10					
9	xxx		xx	x	xx
8			x		x
7	x		x		x
6	xxx		x		x
5	x		xx	xxxx	xx
4	x		x	x	xxx
3				x	x
2					xx
1					
0					
mm	A	B	C	D	E

Fig. 57. The registered thickness of the stucco layers. X = one fragment

A = the Republican period, First style fragments

B = the Augustan period, Third style fragments

C = the Antonine period, Post-Pompeian fragments

D = the Severan period and later, Post-Pompeian fragments from Room 14A

E = the Severan period and later, Post-Pompeian fragments from Room 14B

11	xxxxx
10	xx
9	x
8	x
7	xx
6	xxxx
5	xxxxxxx
4	xxx
3	xx
2	
1	
0	

Fig. 58. The stucco layers registered on First style fragments in Case study 4a. x = one fragment

The method of observing the material composition and measuring the layers and grains, has proved to be useful. In most cases the impressions from the ocular inspection were verified by those achieved at the chemical-technical analyses. The white or yellowish crystals which could not be identified at the beginning, were identified as alabaster. The ocular inspection revealed that the monochrome layers were made *al fresco*, since the pigments were integrated with the surface. In those cases where a decoration was present, this had obviously been made when the stucco had dried. The binder, or binders, were not identified. The pigments did not vary through this period, but the same colours, mainly earth pigments, were used. Egyptian blue and cinnabar were found in fragments from all periods, except for the late Roman. Whether or not these pigments were represented on the Post-Pompeian fragments was not analysed.

Red hues were mainly identified as red ochres, secondarily as cinnabar.

Pink hues either contained red ochres or cinnabar.

Brown hues were obtained either by a) mixing pigments, such as red ochre or cinnabar with carbon black, sometimes with the addition of yellow ochre or, b) by the successive application of two colours, e.g. a layer of red ochre covered with a layer of carbon black or vice versa.

Violet hues contained the same pigments as the brown hues.

Green hues generally consisted of a green earth (terra verde) or Egyptian blue mixed with a yellow ochre or a green earth.

Blue hues were generally obtained with a mixture of Egyptian blue and carbon black. In one case exclusively Egyptian blue was identified (fragment VLA 43 A from the Antonine period). Occasionally there were two separate layers either of carbon black, yellow ochre, terra verde or cinnabar covered by Egyptian blue.

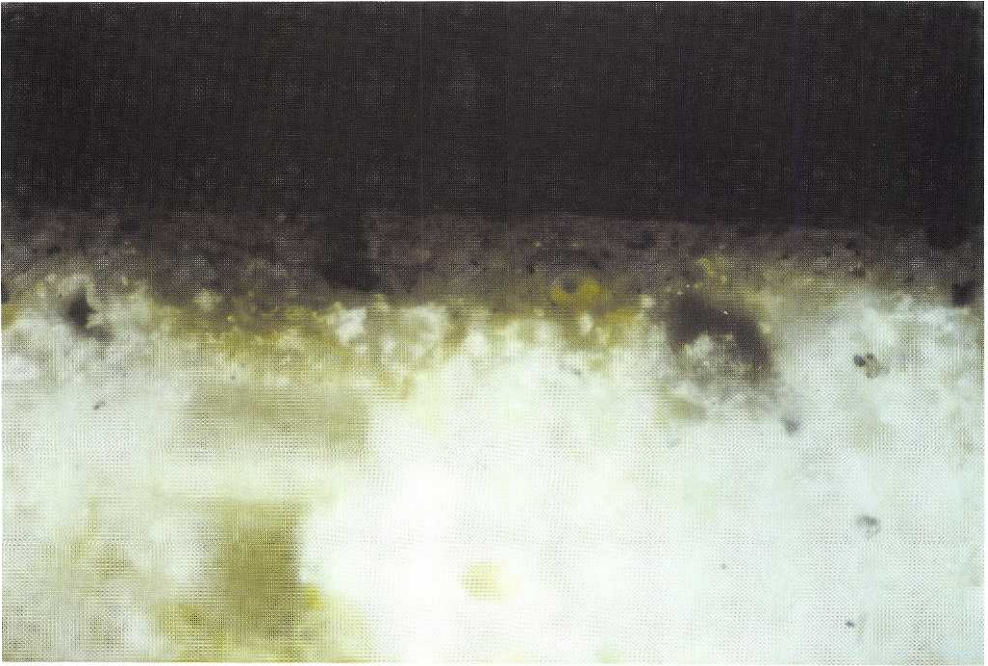
Yellow hues were mainly ochres. In one case an organic yellow was identified (fragment 44A from the Antonine period). Sometimes a layer perceived as a yellow colour was a red layer with a very small amount of pigment grains.

White hues consisted of the white preparation with sparse inclusions of pigments.

Grey hues consisted of the white preparation and sparse inclusions of pigments.

Black hues consisted of carbon black, sometimes with the addition of an earth pigment.

Fig. 59. Fragment 44 A from the Antonine period. Optical microscopy. The grains of red ochre and of



carbon are clearly visible in the upper, cinnabar red layer, as well as in the half transparent layer of beeswax below. Some grains of a yellow ochre are dispersed in the sample. Calcite crystals may be observed in the preparation. Photos: Opificio.

Above: The sample photographed in diffusion light.

Below: The sample photographed in UV-light.

Some organic material was observed on stratigraphic investigations of sections with optical microscopy. Such material generally occurred on cinnabar coloured fragments, and was found on samples from the Augustan and Antonine periods. SEM and FTIR investigations of one such sample (VL 44A, from the Antonine period) revealed the presence of beeswax or saponified beeswax.

The material stability of these fragments was good, and they could be handled without any necessity of a consolidation treatment. On the other hand, many fragments presented thick and hard incrustations, which were very difficult to remove. The Late Roman, Post-Pompeian fragments which were removed from the wall in connection with this study, were easily cleaned with a soft brush, since cleaning was made before the salts had crystallised and the incrustations had become hard.

As long as there was only one paint layer, made *al fresco*, the removal of hard incrustations was less problematic than on the additional paint layers. Fresco-painted areas could be cleaned with deionized water, ammonium carbonate in paper poultice, or Viscor, softening the incrustations without causing any additional problems to the surfaces. The removal of hard deposits on areas painted differently, caused great problems, since the incrustations were sometimes harder than the paint. Consequently, if the binder of such paint could be identified, it might be possible to choose a cleaning method adapted for each case, dissolving solely the incrustations.

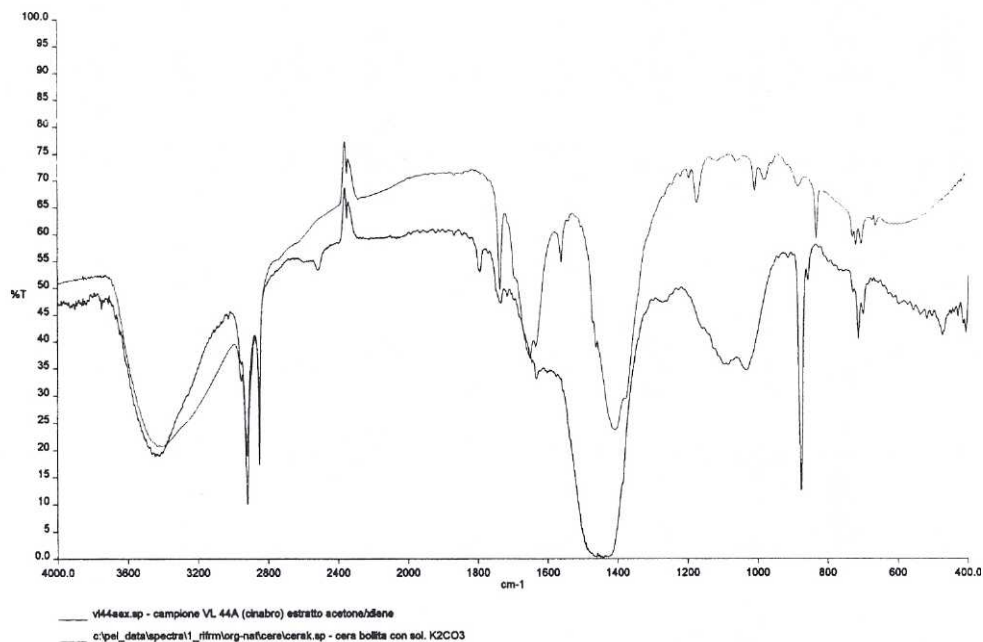


Fig. 60. Fragment VL 44 A. FTIR photomicrospectrometry. The upper spectrum shows cinnabar extracted with acetone/xilene and the lower shows the spectrum of a reference sample of beeswax boiled in K₂CO₃.

Case Study 5:

Villa San Michele at Anacapri

The Villa San Michele at Anacapri on the island of Capri is situated on a high cliff with an extraordinary view of the Bay of Naples. This house was created by Dr. Axel Munthe, who as a young man fell in love with the island of Capri, and in particular the site where he constructed his home. The book he wrote on this subject immediately became a best seller, and it still is.¹ The house is situated in a beautiful garden, where many marble objects are exposed, such as columns, sarcophagi and statues, mainly from the Roman period.² Water flows in small canals, the colours of flowers and bushes glow in the sunshine or in the shadow below great trees. There are pergolas and open places, in fact it is a garden offering many sensations, not unlike the *horti* of the Roman period. The garden at San Michele and the building reflect the personal taste of Axel Munthe as well as the general taste of the epoch, i.e. the beginning of the 20th century.



Fig. 61. The Villa San Michele, view through the Loggia di Hermes.

¹ The story of San Michele, first edition published in England in 1929.

² Andr n, 1957; Andr n, 1962; Kleiner, 1977; Ministero per i Beni culturali ed ambientali, Napoli e Caserta, 1997; Oliv, 1957; Pavese and Thomasson, 1997; Thylander, 1964.

These marble objects, surrounded by vegetation in a subtropic climate, are exposed to various kinds of deterioration, caused by the conditions of this environment. The objects are more or less covered by biomass, such as lichens and fungi. To some extent such growth underlines the atmosphere of the garden, illustrating the passage of time. On the other hand, too much of an invasion of lichens and moss makes a garden look abandoned, and even more importantly, damages the works of art by corroding the material. Many cracks in the marble occur, caused by the expansion of corroded iron nails, another problem caused by humidity. In this case study, only aspects related to marble decay, caused by biomass and conservation issues connected to such problems are presented.

Pollen and spores are always present in the air causing biological pollution. These easily form layers on rough surfaces, and unless these layers are wiped or washed off at intervals, they will form the basis of higher forms of life, such as lichens, fungi and moss.³ The lichen is a symbiotic compound between algae and fungi. The algae produces organic substances through photosynthesis, while the fungi acts a shield over the alga, protecting it from sunshine and reducing the variations of humidity. Form and colour of the lichen depend on its combination of alga and fungus. A number of chemical compounds, such as salts and organic acids, can be formed in the lichen cell. Such acids sometimes have strong colours like red, yellow or brown. Due to the nature of lichens, these are not harmless, but have the potential to penetrate marble surfaces, disintegrate marble crystals and discolour the stone.⁴

The stone conservation project at the Villa San Michele was planned by its director Ann Marie Kjellander and this author. To start with, an overview of the general situation was made, and the state of preservation of all marble, limestone and terracotta objects, indoors as well as outdoors, was registered. The degree of deterioration was listed between 0 and 3, 0 being no observable decay and 3 being a case of emergency. Based on these results, a conservation plan was made. At this phase it was decided to try to form a didactic conservation project, involving the Institute of Conservation at Göteborg University, offering practical conservation experience to students studying the conservation of stone in 1998. In addition, it was regarded important to invite representatives from Italian conservation authorities such as ICR, as well as professional conservators representing corporations such as CBC in Rome, making possible exchanges of experiences. Consequently, when the project started weekend seminars on various subjects were realised.

The present project was carried out in the spring of 1998 and 1999. It was initiated with the main objective of cleaning and consolidating some of the most deteriorated works of art, in order to save the material from escalating decay. The basic idea was to use as harmless materials as possible, and always starting with the mildest method possible. Consequently, work started with the removal of dust and earth, performed with soft brushes. Work progressed with cleaning with water, followed by water and the traditional Swedish cleaning soap compound "såpa", made of extracts from the pine tree. If necessary, more effective substances and methods were used, e.g. ammonium carbonate conveyed by paper pulp. The working progress

³ Tiano, 1991, pp. 56-57.

⁴ Tiano, 1991, pp. 58, 63.

and the decisions made for each object were documented in specially prepared conservation forms, illustrated by drawings and photos, made for each object.

During the initial period, conservation interventions were concentrated to the Loggia di Hermes. This way it was easy to supervise the students and to control the working progress, compared to having students working over a vast area. The loggia was also chosen for aesthetical reasons, since it seemed more appropriate to upgrade the appearance of one ambience rather than to clean single objects in different locations. During the second period, conservation interventions were made on selected objects in the garden, in the atrium and in the loggia. The programme was carried out with the intentions formulated at the start. Some new materials were tested, e.g. biocides. Dr. Rosalia Varoli Piazza and the conservator Lidia Rissotto from ICR in Rome had suggested such a treatment, since biocide treatment had proved to be effective during similar circumstances.⁵ Tiano has studied the antialgal effect of some biocides on stone.⁶

It must be stated that the author as well as the students, reacted very strongly against the use of biocides, but agreed to perform some tests. The reason was that a few statues and portraits of marble were either covered with, or strongly discoloured by lichens. The surface of these objects was corroded and sugaring, and cleaning had to be delicately made. Therefore, one of these statues was selected for an initial test series.⁷ Some detergents and one biocide were applied on small areas at the base of the statue. Our experience of biocide treatment is, however, that such an application may, in some controlled circumstances, be the most delicate way of removing lichens on corroded surfaces. After cleaning, the next question was, if and how to make a surface coating on the statue. Since a protective coating is irreversible, and has to be compatible with the material coated, it was decided to test a few materials for coating, and study the results before applying any material on the statue.

Comparative material tests were made on a marble slab and later placed on the ground in the garden to be exposed to the same environmental aggressions as the works of art. The surface protectives (RC 80, Wacker 290, Silo 111, and saponified beeswax i.e. Punic wax, made by the author) were applied. Directly after application, it was noted that Silo 111 was easily applied and that the protective film was very thin, smooth and did not change the colour of the marble. RC 80 and Wacker 290 added a yellowish hue to the stone, and the layers were not completely smooth but slightly uneven. The Punic wax was applied on the last sector of the stone, and when the surface had dried, it was heated with a hairdryer, and then polished with a rag. This surface became smooth and received a silky lustre. The surface became slightly darker than it was before the wax application.

⁵ Information given at the seminar on Capri, June 1998.

⁶ Tiano, 1979, pp. 252-260.

⁷ The Roman funerary statue at the chapel of San Michele, representing a mother with her little son.

Fifteen months later, the slab was inspected. Fallen leaves and earth covered it. The loose particles were brushed off, and the slab was carefully studied. The film of Silo 111 was still practically invisible, and there were no signs of any decay. The sector with an application of RC 80 had become dotted, and had deteriorated more than any of the other materials tested. The surface treated with Wacker 290 appeared uneven and the protective had partially worn off. The Punic wax had become slightly darker, and a complete removal of the surface deposits was not possible to make with a soft brush. The remaining deposits were, however, easily removed with a humid rag. After this initial ageing period, the surfaces of Silo 111, as well as Punic wax were consequently undamaged. After inspection the marble slab was replaced on the ground, and the intention is to control the ageing progress at intervals, before one of the substances will be chosen for coating the Roman statue.



Fig. 62. The Etruscan sphinx. A white marble statue completely covered with lichens. Villa San Michele, Anacapri.



Fig. 63. Various kinds of lichens, covering the Etruscan sphinx.

Discussion

Works of art in open-air environment such as at Villa San Michele, are exposed to biological aggressions. These are not harmless but contribute to gradual deterioration. On the other hand, the charm of a milieu such as the San Michele garden, depends on its combination of art and vegetation, becoming a work of art in itself, and has to be respected as such. To a certain degree, decay or ageing, such as biological growth has to be accepted. On other kinds of objects, such as portraits, statues and figural reliefs, it is important to continuously remove the lichens etc., in order to save these works of art for the future. The main reason for giving some works of art particular care is that details that have been carefully treated are generally also the first to deteriorate. Stone carving causes micro-cracks in between the crystals, and therefore fine-worked areas are easily subject to decay. Figural motifs must also be considered in their respect of representing a person or as narrating an event, a message that tends to become dissipated if the surface is covered by deposits or partially lost.

Conservation interventions cannot always be carried through in the same manner, but must be considered on each occasion. It is also of vital importance that the objectives of conservation interventions are explicitly formulated and that work is then carried out according to these principles.

In October 2000, the conservation interventions performed during 1998 and 1999 were inspected, and the general impression was that the substance used for cleaning was not crucial for the long-term result, but of major importance was that cleaning had been carefully executed. This means that objects cleaned with “såpa” were still equally clean as those cleaned with e.g. ammonium carbonate. No changes, expected or unexpected, could be noted. Therefore, cleaning should be performed with methods as harmless as possible. After cleaning, regular maintenance measures at intervals should normally be sufficient.

The issue of surface coating and what material/materials to use, is still an unsolved question, which may be considered when the substances on the marble slab have been ageing another year or two.

Case Study 6:

Experiments on encaustic painting

During the period between 1995 and 1997 the author was making a series of experiments, with the main objective of testing and evaluating the qualities of different wax-paints, different supports, and the interaction between these factors. In addition I tried to make Punic wax as described by Pliny, or, Punic wax as described by Pliny and interpreted by various scholars. In addition, wax tempera, diluted with turpentine, was tested in order to see if there would be any significant difference between this wax mixture and the others tested. The mixture was made of the same components as the *cera colla*, used by artists during the Renaissance. The first series of experiments were made in the summer of 1995 and different wax paints were created and tested on panels, measuring 30 x 60 cm, having had applications of various preparations. The paints were

- a) natural beeswax which was melted and pigmented,
- b) paint of saponified wax, i.e. *Punic wax*,
- c) the same Punic wax as a surface coating on a lime-based paint, and
- d) beeswax dissolved in turpentine, *wax-tempera*.¹

Each of the different paints were applied to panels prepared with lime plaster,

- 1) lime-marbledust plaster, i.e. *marmorino*,
- 2) a commercial Portland cement and lime mixture, *KC-plaster*, and
- 3) a commercial gesso product, *alltek*.

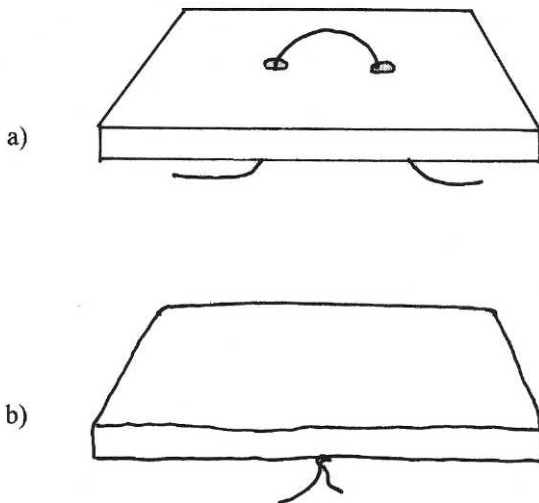


Fig. 64. The preparation of panels. a) The panel and the wire, used to tie the panel to the stand, b) the panel prepared with concrete.

¹ The emulsion was called "wax-tempera" by Inganni (1979), a term which was used also in the test series.

The objective was to test if one of the four paints was better suited for mural painting than the others, and if the preparation had any influence on the material stability of the rather large size panels prepared. A double set of test panels was made and half of the samples were placed outdoors, completely unprotected from climatic changes. The other half were kept in a simple barn thus protected from rain, snow and wind, but not from changes in humidity and temperature.

The sets of panels were disposed in stands, designed for this occasion. The stands in open air were placed against a wall in a south-west position, leaning against the wall, to make them as much disposed to climatic changes as possible, with the intention of making them age rapidly. These panels were consequently exposed to direct sunshine, rain, and winds containing salt and fine sand from the nearby seaside, as well as frost, snow and ice in the winter. They remained in this position for more than four years.² During the first two years the samples were regularly inspected, and later observed just occasionally. After two years exposure to outside environment, much of the paint layers had disappeared, but it was still possible to see the patterns engraved and the colours originally used on all panels, with exception for the paintings on the commercial gesso panels, which just lasted a few months, and fell off together with the preparation during the first winter.

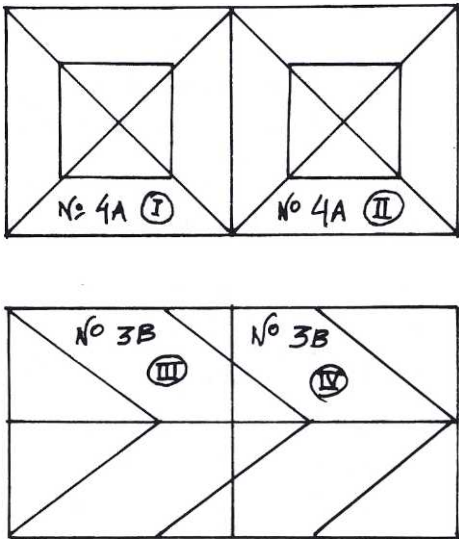


Fig. 65. The patterns on the panels.

Above: No. 4A I and 4A II. (Recipe no. 4 = wax-tempera. A = outdoors. I = Lime-plaster, unheated and unpolished paint. II = Lime-plaster, heated and polished paint).

Below: No. 3B III and 3B IV. (Recipe no. 3 = Punic wax on lime-painting. B = indoors. III = KC-plaster, unheated and unpolished paint. IV = KC-plaster, heated and polished paint).

² In December 2000, when this was written, the panels still remained in the stands.

The panels disposed in the barn have not changed in these five years. In this initial phase, the objective was to study how wax reacted on different supports, and to see if there was any correlation between support and wax-paint. The tests were recorded and are available in complete form in a working paper at ICUG, presented in 1996, "Encaustic painting; a case study of encaustic painting techniques on different mural groundings" as well as, slightly reduced, in my Ph. Lic. dissertation in 1997.³ A brief summary of the test results is presented below.

As mentioned above, the panels prepared with the commercial gesso, *alltek*, did not last through the first winter. This was not a surprise, since the product was not intended for outdoor use. The manufacturer has a different product available, which is especially intended for open-air environments. All panels prepared with this gesso, and kept in the barn, have remained unaltered, just as the panels with other preparations. A couple of panels fell on the floor on one occasion, after two years, when the stands were moved from one side of the barn to another. The fall resulted in minor breakages at the edges, a damage which has not led to further decay. The only material change, which may be noted is that, the application of natural beeswax, melted and un-pigmented, has become somewhat darker, while the pigmented parts do not seem to have changed. Since there is no visible material decay, all paints and preparations must be considered as equally resistant, during the circumstances presented above.

In December 2000 most of the panels kept outdoors showed distinctively the patterns engraved, and they have some remains of colour. Consequently all preparations have been adequate, and some of the paint applications are promising, although none is good enough for commercial use at the present stage. The plaster proving to be the better for these circumstances is lime-plaster, i.e. showing less decay, or being almost completely materially intact.⁴ The paint most promising is Punic wax paint and Punic wax applied on lime-based paint, i.e. those applications appearing as being most intact, having most remains of colour. The better combination of materials was Punic wax on lime-plaster preparation (2A I and II), followed by un-pigmented Punic wax applied on a decoration made with lime-based paint on KC-plaster (3A III and IV).

In the next series of experiments, performed in the summer of 1996, different kinds of saponified wax, or Punic wax, were tested on a new set of panels. The panels used were rather large-sized, measuring 60 x 120 cm. These were prepared either with lime plaster or with lime-marbledust plaster, *marmorino*, since those preparations had, after one year, proved to be most durable in the study made previously. These preparations were also considered as particularly interesting, due to the fact that they were generally adapted for Roman mural preparations. In this case interest was focused upon different paint mixtures, such as saponified wax with the addition of an animal glue, a resin, lime or oil. The same saponified wax was divided into portions, and into each portion one of the substances mentioned was added. The objective was to test applicability, aesthetic appearance and, in a longer perspective of time, the durability.

³ The experiments are presented in the Ph. Lic. thesis at Göteborg University 1997 *Encaustic painting and ganosis*.

⁴ The evaluation of these results was made November 20, 1999.

In addition, two large-size panels were divided into 32 square fields and the possible saturation of pigments in the paint was tested, beginning with a small addition of pigment until gradually reaching a stage, considered as ultimate saturation, i.e. when the paint was almost too dry to apply on any preparation. Various natural earth pigments were used on one panel, and some artificial, i.e. chemically produced pigments were used on the other. This resulted in one panel of ochre-red-brown-green appearance and the other representing white-blue-black colours. The resistance against some “normal” kinds of mechanical damage and scrawling were tested on another large-size panel. When the damages had been made, some methods for cleaning and repair were tested. A final test series was performed with applications of the same paints on gypsum board, on request of the architects following this part of the project, since gypsum boards are frequently used in modern building construction. The combination of any of the wax paints and the gypsum board was unsatisfactory, primarily due to aesthetic reasons, and later for reasons of material stability. The major problem was that an adhesive tape of different material, and specifically made to close the minimal space between boards connected to each other, was glued to the edges of the boards. The disparate structural appearances could not be hidden with any of the paints tested, and the diversity between the gypsum board and adhesive tape remained obvious. None of the paints tested were opaque, but more or less transparent. Applications of paint were made in between one and five layers, and tested on any supportive material. All applications and results were registered, and the results were published in 1997.⁵

The final accomplishment of this third phase material testing was the performance of a mural painting. This was made with the objective of testing one of the Punic wax mixtures on a full scale. The painting was made as an integrated part of the project, in collaboration with White arkitekter in Göteborg, and the telecom company Ericsson, Ericsson ETX, at Mölndal close to Göteborg. The project was supported by Ericsson and Forskningsstiftelsen för Samhällsplanering, Byggnadsplanering och Projektering, the latter contributing economically also to the first two series of experiments mentioned above.

A wall in the entrance to one of the commercial buildings of the Ericsson Company was chosen. The environment in this entrance is exposed to specific problems, due to the flow of warm air, separating the outdoor and indoor climates. The difference in temperature and humidity is, during winter, quite extreme. Another factor to consider before painting was the constant passage of persons and materials through this rather narrow room. The wall chosen for decoration was made of a creamy white concrete, and the motif was painted directly on this material. The paint applied was a Punic wax mixture containing Venetian turpentine, even though a mixture containing lime could have been selected just as well. The decoration was made in February - March 1997, and at an inspection two years later it was still completely intact. Grey dirt on some areas was noted, and this dust was removed with a dry cloth.

⁵ Freccero, 1996.



Fig. 66. Panel STD VII. Earth pigments and carbon black mixed in Punic wax and applied on a lime plaster test panel. Each colour has been applied on four areas, the area to the left containing just a little pigment, those towards the right successively more.

From the top: Yellow ochre, raw terra di Siena, burned terra di Siena, raw terra, burned terra, burned umbra, terra verde, carbon black.

A description of the project is included in the publication “Enkaustik; experiment med Puniskt vax”, 1997.

Samples were later removed from some of the earlier test-panels, and brought to the Scientific Laboratory at Opificio delle Pietre Dure in Florence, in order to make a comparative test between these samples and those taken from ancient materials of some Fayum portraits. One of the samples, containing saponified beeswax and lime, presented a spectrum similar to that of some samples from the Fayum portraits. That specific substance is therefore planned to be further investigated in the future.

In addition, all the emulsions or substances described above, were used in some additional tests, and applied on wood and paper, just to see if and how they could be applied for artistic purposes on other materials than plastered walls, but no systematic registration of the results was made. In one unregistered test series, the capacity of different mixtures to penetrate through a thick, hand-made paper was observed, and photographed. The penetration capacity varied greatly between the different mixtures. The same emulsions were also tested on wet lime-plaster, in the *al fresco* technique, with excellent results. These tests are planned to be re-made, registered and evaluated.

Finally, this emulsion, with the addition of some oil, was used as a surface coating on a white marble sculpture, placed in a garden in the south of Sweden. The statue had been exposed in the garden for some years, and its unprotected surface was covered with biological growth. The sculpture was cleaned with soap-water and a soft brush, followed by careful washing with clean water. When the surface had dried, an application of saponified wax was made. As soon as this application was dry, the surface was heated with a hair-dryer, making the wax “sweat”. Later the surface was rubbed with a clean cloth. The pedestal, on which the sculpture stood, was just cleaned and left with its surface un-coated. This was done in the spring of 1997, and two and a half years later, in the end of November 1999, the marble surface was still rather clean, especially in confront to the un-treated base.

Pliny indicated *natron* for making Punic wax, and Schiavi described this double salt as significant in her experiments on Punic wax.⁶ In December 1998 I had the opportunity to collect such salt at Wadi Natrun in the Libyan desert northwest of Cairo in Egypt (see chapter “Material technology and materials” above). The salt was tested, but the result was disappointing, since it did not make paint possible to spread. When the salt was examined at the laboratory of Opificio the results showed that it was contaminated as an effect of air pollution. Consequently such salt is chemically not the salt described by Plinius anymore, and it can therefore not be used for the experiments planned, but has to be substituted by other chemicals, composed as ancient natron.

⁶ Schiavi 1961:I.

Discussion

At this point it is too early, and not possible to make a statement about the long-term qualities of the various types of beeswax tested. Neither it is possible to determine which is the better paint, nor if one of the Punic waxes tested is equal to that used in Antiquity. So far it may be stated that the wax mixtures used on the preparations in the experiments first performed, and still kept indoors, have remained in an equally good state of preservation during five years, while all panels kept in open-air environment have suffered great damage, and the paint is almost entirely lost.

The varieties of Punic wax on large panels have remained unaltered when applied on stucco or plaster. The pre-fabricated gypsum panels are all destroyed, since the gypsum did not resist the humidity in the barn, and gradually became deformed and partially covered with mould. The wall-painting made at Ericsson still remains intact, and there has not been any need of re-treating the marble statue with Punic wax. Seen from the practical, and the aesthetical, point of view, the various emulsions of Punic wax which were tested, were comparatively similar, and were easily applied.

Chemical-technical analyses showed that one of these mixtures, containing an addition of lime, was of similar composition as samples of Punic wax from ancient Fayum portraits.

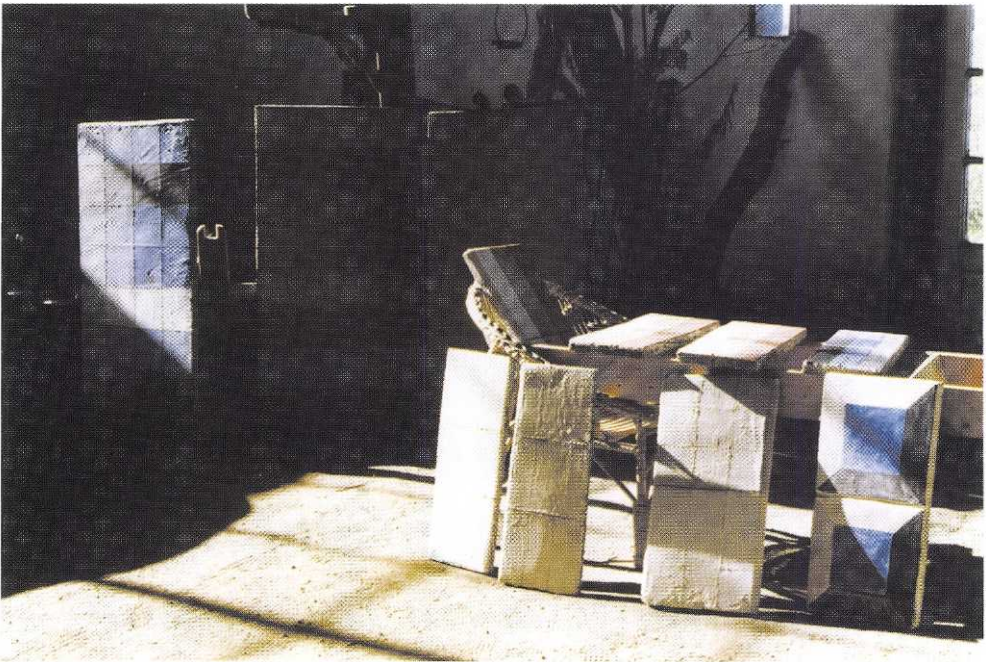


Fig. 67. Various test panels during work, exposed in the barn.



Fig. 68. Polished and un-polished Punic wax surfaces.

To the left: Punic wax pigmented with red ochre applied on a gypsum panel. The surface was rubbed up with a sand-paper.

To the right, top: Decorated panel, polished with a rag.

To the right, bottom: Punic wax with various earth pigments applied on cement. The upper part of the panel is unpolished, the lower polished with a rag.

DISCUSSION AND COMPREHENSIVE CONCLUSIONS

This study initiated as a reaction to the misuse of some cancerogeneous and toxic materials in conservation. Such a reaction could inevitably only lead to the question – did any materials exist, acceptable in modern conservation, which might substitute harmful chemicals? When searching for an answer, there is an immediate choice of either looking backward or forward for a relevant solution. My choice was to study the past, with the objective of understanding what was used before the introduction of modern detergents, consolidants, surface coatings and adhesives. These issues, combined with my interest for beeswax, as paint, a modelling material and a coating, have remained the basis for the following studies.

Terminology and the cultural context

To begin with, it was necessary to understand what was intended during Antiquity with the terms *encausto* and *ganosis*, mentioned by Pliny and Vitruvius, since these terms and concepts are surrounded by unclarities in recent as well as in historic and ancient literature. It was of vital importance to eliminate unclarities and misapprehensions, in order to make possible the discovery of a logical explanation of terms and concepts, applicable in the real world and not only in written terms.

The term *encausto* initially indicated that paint, or wax, was heated and “burned in”, thereby to some extent penetrating the surface of the supporting material. This original meaning seems to have been lost already during Antiquity, since Pliny uses the term for three methods, and “burning in” i.e. final heating, is adaptable just for two of these methods. If used for “the first method” mentioned by Pliny, heating would melt the paint and ruin the painting. The common factor was beeswax, not final heating. *Encausto*, consequently, was not used strictly according to its original meaning of “heating” during the Roman period, but rather indicated “wax-painting”. Also nowadays encaustic is used synonymously with wax-painting. There have been attempts to combine *wax-painting* with *encausto* in the original sense – i.e. “burning in”, and the results of such a combination must by necessity be disastrous, if applied on a decorative painting and not on a uniformly coloured area. Wax, pigmented and melted, during Antiquity was also used for filling the lines of engraved decorations on ivory. To heat the surface of such decorations would be favourable, since the melted wax would fill the lines perfectly. Beeswax, chemically transformed into Punic wax, was used for painting ships, for painting portraits, and maybe for large size decorations. Punic wax was also used for surface coating on marble, i.e. *ganosis*. Final heating was part of the *ganosis* process. To sum up, inconsistencies in terminology appear to be a linguistic problem. Existing unclarities are also caused by lacking understanding of the paintings techniques. The present state may have been the result of continuing quotations of literary passages, and without a complete understanding of the content.

The next research issue was to be able to establish whether or not *encausto* and *ganosis* were actually part of the artistic tradition in the Mediterranean area, i.e. in real life, and not only appearing as quoted concepts in ancient literature. The present study confirms that *encausto* and *ganosis* were commonly known methods for painting and surface coating. These methods were mentioned in ancient Greek and

Roman literary sources roughly from the 4th century BC and throughout the Hellenistic-Roman period. The latest of ancient notes known on encaustic are from the Middle Ages, and, as known, beeswax was used for surface coating on statues during the Renaissance and later. In fact, the tradition of coating with wax never really ceased to exist. There is, as far as these facts are concerned, no discrepancy between ancient literary sources and evidences from archaeological finds, and this is also confirmed by chemical-technical analyses of samples from ancient materials.

Encaustic painting and *ganosis* were consequently part of the artistic tradition in Graeco-Roman society. Encaustic was used for painting and *ganosis* was a method of surface coating.

The next issue was to understand how and when these methods were used during Antiquity, and to explain their use within the cultural context. Evidences had to be found, i.e. objects representing encaustic and *ganosis*. For reasons of availability, focus, for some time was placed on encaustic painting.

The so-called Fayum portraits are examples of encaustic paintings from the Roman period. Some of these were traditionally called encaustic and others were considered to be tempera paintings. Lately it has been suggested that some were made with Punic wax. The investigation of materials used for Fayum portraits in Nationalmuseum has revealed that natural, i.e. raw, beeswax as well as saponified beeswax was used for such paints. Raw beeswax was used for paintings, which are generally defined as encaustic, i.e. wax-paintings where the glossy paint has been thickly applied and the surface appears in relief. Saponified beeswax was identified on portraits, which had characteristics of encaustic as well as of tempera paintings, i.e. there was a combination of paint appearing in relief and paint applied in brush-strokes. Saponified beeswax has also been detected on portraits presumed to be tempera-paintings. The latter group of portraits had a smooth surface, the paint apparently applied with a brush, and no details appeared in relief. Consequently, this group may be considered as wax-tempera paintings. None of the presumed tempera paintings in Nationalmuseum was a traditional tempera with egg or glue as a binder, but all contained small amounts of saponified beeswax, i.e. Punic wax. This does not exclude that other mummy portraits may have been painted with some traditional tempera.

Consequently, the first and the third techniques mentioned by Pliny, have been carefully studied. The second technique, used for engravings, has been studied as well, but since no objects have been available for material analyses, such studies have not been performed. This was not a painting method, but a method exclusively used for engraved decorations on bone, ivory and maybe other hard materials. Therefore, the second method has not been of specific importance in this study, since painting and surface coating was the main issue.

Punic wax was used for surface coating on Roman murals and on marble statues. Plinius and Vitruvius have described the tradition of coating wall decorations with Punic wax, and analyses of samples from Roman wall decorations have proved to contain Punic wax. It is not clear, however, if such coatings were made on entire surfaces or just on areas painted with specific pigments. Results of material analyses show that such applications were made on red pigments, above all on cinnabar.

Neither has it been possible within this study, to consider the paints used for polychrome statuary, since that would have been an issue of too vast dimensions in this context. According to ancient literary sources, statues were painted, and *ganosis* was the method of protecting the colours as well as the marble from a rapid decay. The Roman concept *circumlitio* refers to painted statues, coated to obtain a protective shield. There is no reason for assuming that *ganosis* was not part of the sculptural tradition, since statements concerning painting and surface protection on murals have been confirmed. In addition, depicted painted statues appear on Roman wall paintings. The issue is, however, worthy studying in depth.

Materials and techniques studied are represented in Roman art. As a consequence, it was necessary to understand the Roman culture. The influence from Greek and Etruscan culture was the basis for the development of Roman art, but a mental foundation existed, which permitted the Romans to adopt these symbols from more developed cultures, and transform them into Roman. By gaining some comprehension of Roman mentality, it was possible to understand the repetitions of motifs in art, observable in the Fayum portraits, in wall decorations and in plastic art. It was further obvious that some objects within a “type” or a group of similar motifs were of high artistic value, while other appeared to have been rapidly made or by a less skilled craftsman. Such differences in appearance and material can be noted throughout the Imperial period, and may be useful indications of the status of the commissioner and of the period.

The investigation of Roman murals at Prima Porta shows, that the quality of the material used, as well as of the craftsmanship, were absolutely outstanding during the Republican, the Augustan and the Antonine periods, after which there was a general decline. The preparations, previously extremely thick and well made, became much thinner and more or less of the same standard as fresco preparations from the Renaissance periods and later. Preparations and painted decorations from the Republican period, i.e. First style decorations, were made as one unity, imitating marbles, by using first class materials. Decorations of this kind were made to last, to be assigned from one generation to those of the future. During the Augustan period, there was a peak of perfection as far as the surfaces of the wall paintings, and the number of layers are concerned. The brilliance of the surfaces seems to have been of particular importance. The materials used during the Antonine period were of the same standard as those of the previous periods, but the lustre of the surfaces was less elaborate than during the Augustan period. This country estate probably was the property of a noble family and later belonged to Augustus and Livia and the successive emperors. The materials used mirror the social background of these owners.

Decorations from the Post-Pompeian period are of a radically inferior quality, materially as well as technically. The only constant factor is the pigments adapted in painting, which appear to have been the same throughout the period. The only exception is cinnabar, frequently used in the earlier periods but in this investigation, not identified in murals made after the Antonine period. The results of the investigation of fragments of wall paintings at San Lorenzo in Lucina confirm that the material and technical quality was of superior class during the earlier period than later, even in this urban context.

Analyses of samples taken at Prima Porta as well as at San Lorenzo revealed that beeswax had been used to coat decorations made with cinnabar, confirming that the description and recommendation by Vitruvius was a common practice. At present it seems that such a coating was made on cinnabar decorations only, but it cannot be excluded that coatings were sometimes applied to protect some walls. A coating found on a black painted fragment from San Lorenzo has not been identified. Preparations and paints in the Vesuvian area have not been investigated within this study.

Ancient and modern materials in conservation

Knowledge about materials and the competence of using them are skills, which traditionally have been transmitted from one generation to the next, by working together. Ready-made materials did not exist until modern times and, consequently, the materials used in earlier workshops had to be manufactured by the craftsmen, who were therefore aware of their constituents and knew how to manipulate them when necessary.

Materials used in modern schools and workshops are mainly chemicals provided by the industry. Conservation materials provided by the chemical industry are ready-made, easy to use and "chemically correct", i.e. tested and approved by chemists. The conservator, therefore, does not have to "know" the material he/she is working with, but rather learn an appropriate way of using it. Ancient materials and methods tend to be deserted and forgotten, in favour of modern substitutes.

Some popular, modern chemicals contain toxic or cancerogenic components. A mask or other special equipment is often required, but seldom used, since conservation is slow and time-consuming labour, and the conservators, consequently avoid uncomfortable equipment. Not only the persons working in conservation are in contact with such materials, but it also affects the nearby surrounding, the air, ground and water. If the sewage system or the ground close to a building under restoration was to be examined, the result might be alarming.

Great quantities of unhealthy conservation materials are constantly used, and adequate protective measures are often not made. Considering the present situation and the effects of such toxic materials on individuals and the environment, the conservator has to make decisions of a standpoint, and either consciously accepts to work with these industrial products or to avoid them, completely or as far as possible. One way is to try to substitute cancerogenic and toxic materials with more harmless products. Research for alternative materials, compatible with man as well as art objects, has been going on for years, and is still a great challenge for the future.

While waiting for safe materials and appropriate methods to use them, there is no alternative but to use methods and materials available. Even materials regarded as unhealthy but effective must occasionally be used, under controlled circumstances. Most important is to break the trend of using such products unquestionably.

Beeswax is one of the many traditional materials, which might be used again in conservation. It is a stable material and it does not change much with time. It is a good water-repellent, but allows the supporting material to "breathe", i.e. it does not

entirely close the pores of the supporting material, but allows humidity within the material to evaporate. Like any other material it has its disadvantages.

Experiments have been made by this author in order to reconstruct the ancient compound Punic wax. Various mixtures have been tested such as paint on murals and, on a very limited scale, as a surface coating on marble. A positive quality is the silky lustre, which is never hard and uniform, but pleasant. One disadvantage of the product is that the supporting material becomes slightly darker than before. This may possibly be used as a positive characteristic, in case a white marble object has turned too white by cleaning. An application of Punic wax might give the surface a pleasant hue, combined with protecting it from renewed deterioration. The question is rather whether or not to accept a product, which changes the hue of the object. At present it seems as if this change appears immediately after application, but that there are no successive changes in colour. This kind of transformation is not specific for Punic wax, but can be observed also on modern coatings such as Paraloid B72, a product that is internationally used. Paraloid is initially colourless but becomes darker within a year after application.

A second disadvantage with Punic wax is that the surface becomes slightly sticky, and consequently allows surface deposits such as dust and biological pollution to remain on the surface. A surface treated with Punic wax, heated and rubbed, is, however, easy to clean, and the deposits do not seem to become firmly attached to the object.

Still it is not possible to predict the long-term results, since the first attempt by the author of coating marble was made only some years ago. The second test was made roughly sixteen months ago, which is a very short perspective. Applications were made on fragments of Roman wall paintings in the autumn of 1999, and the results so far are satisfactory. Although there are some negative aspects, Punic wax, at this moment, seems to be a good surface coating for marble and wall paintings. It is neither harmful to human health nor to the environment. How this compound, in a longer perspective, reacts with marble, lime and pigments in polluted environments, is still not possible to evaluate.

Ethics and guidelines in conservation

There are no conservation products which are perfect, and which respond to all demands, which have been formulated, or are wanted. Therefore, each conservator has to make a personal choice of which product to use in specific situations. There are general guidelines to follow, but at the end, the conservator has to stand up for a personal and well-grounded choice.

International agreements in conservation are of basic importance and constitute the operating frames. These theoretical guidelines are beautifully formulated but often do not constitute the basis of work in practice. Consequently, there is a problem, consisting of the gap between those high ideals and the actions taken in real life. As a consequence, theories are supplying the content for conservation programmes and reports, but considering the field of conservation as a whole, actions taken in practice are often made for strictly practical and economical reasons. It is impossible for a conservator to survive as a business manager, if he/she does not consider economical aspects. Therefore, relatively efficient methods are preferred to slow methods. Methods described and approved in technical literature tend to become continuously repeated, and there is little time for testing or searching for alternative methods. Only when the conservator participates in conservation projects, can such "luxury" be afforded.

Maybe the problems exist because conservation guidelines are theoretic constructions aimed at solving practical problems. Furthermore, these guidelines are formulated by intellectuals, experts in various fields connected to conservation, often employed by institutions, i.e. having the advantage of a regular salary and a secure position. It is not only natural, but also an obligation, to suggest or to strive for optimal conditions in conservation. The conservator, on the other hand, must often struggle to survive on the market, including competing with building contractors for large conservation commissions.

Conservation nowadays has become a word of honour, occasionally misused by the possibilities of making money in the conservation business, now attractive to great contractors and to industry. Conservation methods used by contractors, by nature are very different from interventions made by professional conservators. The problem is that the term *conservation* only indicates the action taken of conserving i.e. preserving something from decay or destruction. Seen in that perspective, even the building contractor aims at conservation. Conservation is in this context understood as a conscious act of preservation, performed by professionally trained conservators. Such conservation consists of securing the material stability, but also in respecting the material as such, its aesthetic appearance and the cultural values connected to the object. Securing the material stability is connected to good craftsmanship, which includes the knowledge about suitable materials possible to use in each singular case. Respecting the material as such means that transformations of the original material should not be made unless absolutely necessary.

There is a contrast between craftsmanship and industrial effectiveness. Conservation with traditional methods is a time-consuming activity, controlled by man, unlike modern industrial methods used by contractors. The latter are efficient, sometimes aggressive, and hard to control from a professional conservation per-

spective. Cleaning which may be done in a day by a machine, may take a week for a single person. If economical and time aspects are regarded as more important than the professional conservation of the object, the seriously working conservator may easily be excluded from any building or other large size project. It has to be seriously contemplated *how* to conserve, i.e. when a professional conservator should be in charge and when a contracting firm might be accepted.

The professional conservator

During the last decades, there have been profound changes in the attitudes concerning the field of conservation. Such changes occur as well in professional education as in the field of research and development of conservation materials and techniques. Conservation as a professional scholarly education is relatively new. Just some generations ago, skilled craftsmen performed conservation. The gilder, who was also a frame-maker, often professionally trained since childhood, performed the conservation or restoration of e.g. a gilded frame. The craftsmanship acquired by such studies, tends to be different to that of a school-educated conservator. While the prior has a deep knowledge of materials and techniques, often including secrets of the studio, inherited and used since generations, the modern conservator starts with theoretical studies, which later are applied in conservation interventions. The school-educated conservator has, on the other hand, been trained in understanding not only the chemical reactions between chemicals used, but also how to use modern techniques for analyses, as well as to plan and carry out conservation interventions according to international standards. The lack of practical experience is a disadvantage for a period of time, since a good result is not only a question of knowing what to do, but also how to do it.

Craftsmanship is of vital importance for the result of any conservation intervention, and consequently the conservator not only has to be a good craftsman but also should, in addition, have an artistic capacity and a sense of aesthetics, as far as the final touch is concerned. This does not refer to the sense of inventing, but to be able to make an intervention, which is aesthetically integrated with the object, restored. Equally important, at least for a recently educated conservator, is to be able to respond to the demands of the modern market, i.e. to be aware of international agreements and standards in conservation and documentation, and to know how to use modern technology. A well established traditional conservator or conservators' studio may probably rely on an established circle of customers, but many recently educated conservators must find their position at the market, and fight for it, independently if the person is directed towards working in a museum or a national board of heritage, at archaeological excavations, in a private studio, in collaboration with some building contractor, counting on international projects or maybe on material research.

Since no one can be the expert on everything, it might be wise to join in co-operatives, having the advantage of mutual support. In a group of professionals with different capacities, the total knowledge becomes broadened, and consequently increases the commercial power of the members. In a co-operative or project group, the members have the advantage of occasional collaborations and joint competitions for large-sized conservation projects, thereby approaching the field of the building

contractors. There is also the possibility of creating interesting conservation and research projects within the European community. Independently of the professional conditions, it is of vital importance for the conservator being responsible of cultural heritage, to be aware of results in recent research.

Encaustic in modern building construction

The Punic wax reconstructed by this author has proved to be useful as a protective on modern sculpture, made of marble as well as of bronze. In addition, the substance, with the addition of pigments, has been tested for a wall decoration on concrete. At present the results are satisfactory, the painting has not deteriorated during the four years since it was made. Since this is a relatively short time, it is still not possible to predict the long-term outcome of the experiment.

Punic wax was also tested on traditional supports such as lime-plaster and marmorino-plaster, as well as on modern materials such as industrially manufactured gypsum panels, frequently used in construction. The result on traditional materials was very good. When tested on the gypsum panels, the result was negative, since the joints between the edges were not possible to hide, due to the relative transparency of the paint. If the joints could be made in similar structure and material as the panels, this problem would be solved.

Punic wax in these test series was either applied with a brush or with a roller. The appearance of the surface became quite different depending on the application method adapted. It takes more skill to paint with a brush, since the brushstrokes remain visible and the colour varies. When application is made with a roller, the colour becomes uniform. Independently of the method of application, the surfaces could be heated and polished with a rag, thereby gaining a specific lustre.

SUMMARY

Issues regarding ethics in conservation, including the personal responsibility of the conservator as a professional, form the basis in this study. Out of this fundament, four issues have been developed; conservation, *material technology and materials*, *terminology*, and *art history*. *Conservation* comprises the history of conservation, conservation terminology, and guidelines in conservation, i.e., the professional fundament. *Material technology and materials* is a study of some ancient painting techniques and the materials used. The double objective of such an investigation is to be aware of materials and techniques used in Antiquity, and to study the possibility of their use today, in conservation or in modern construction. Related to ancient materials are issues of ancient and modern *terminology*. *History of art*, in this case, signifies that some aspects of Roman culture have been studied, since most objects important for this study belong to the Roman context. The aspects presented above are briefly described, followed by practical aspects, applications of theories in real life situations, and the evaluation of such combinations, presented in form of *case studies*.

Traditional and modern conservation methods, in particular beeswax as paint and a protective, are at focus. The characteristics of natural beeswax have been studied, but also its potential when used in combination with other materials. Therefore, some supportive materials, such as Roman lime plaster and preparations on wood, have been regarded. Ancient materials based on beeswax have been studied with the objective of understanding whether or not such materials might be accepted in modern conservation.

The reasons for starting this kind of a study need to be explained. In this case it was a combination of indignation and curiosity. Indignation was caused by the discovery of the use of dangerous products in conservation, in quantity and frequency. Curiosity was expressed as searching for explanations and alternatives.

The existence of unhealthy materials was not a novelty to me when entering conservation studies, but the massive use of strongly smelling solvents, adhesives and paints was quite a chock. Dangerous materials for a painter are mainly solvents such as turpentine or white spirit. Turpentine is hardly used anymore, and white spirit may be substituted with solvents based on e.g. extract of lemon. The stone carver sometimes needs an adhesive and uses it occasionally. The conservator on the other hand, uses varnishes for surface coatings on stone and ceramics, thinner as a solvent for enamels, epoxy resins as adhesives and also to reconstruct missing parts. The list of dangerous materials, which are constantly used, could be made very long. Maybe the situation is changing, but this was the case some five or ten years ago. Enamels and their solvents are probably not used for reconstruction of decorations on faience and ceramics anymore, since there are excellent substitutes. But, remembering a

class of students working with these materials, remembering the odours and remembering the headaches or indisposition at lunchtime and at the end of the day, still fills me with discomfort. Remembering two young women, one a student and the other a stone conservator, who had to interrupt their pregnancies due to foetus malformations, possibly caused by conservation materials, still make me convinced about my repudiation from dangerous products.

What materials could possibly substitute modern chemicals? For various reasons my interest was focused on beeswax. The first contact with this kind of material was to use it melted and pigmented, as paint. The next step was to add colour to the wax and shape it into leaves in an old fruit decoration, which had partly collapsed, and to reconstruct the fingers of a votive figure. Beeswax dissolved in white spirit was used as a coating on gilding and painted panels. The lustre of the surfaces became very sophisticated.

Beeswax could obviously be used in other ways as well, one of these called *encausto* and another *ganosis*. Part of this study consists of searching for the original meaning of those terms, and to understand the methods of application during Antiquity. Some existing inconsistencies in terminology contributed to making this a diffuse and time-consuming project. The somewhat unclear descriptions of Pliny and of the more precise notes on *ganosis* made by Vitruvius, were confronted with technology in real life. Finally it became possible to suggest interpretations of these materials and the methods connected to them.

Some causes of existing unclarities connected to encaustic may be explained by a literary apprehension and interpretation of the Plinian texts by later scholars. When describing the three methods of encaustic painting he mentions (a) painting with wax, (b) painting on ivory with a *cestrum* and (c) a method of painting ships by using wax paint, melted with fire and applied with a brush. At first (a) he mentions the paint i.e. the material, then (b) he mentions a technique, i.e. the supporting material and the operating tool, and finally (c) he mentions a supporting material, a paint and a tool. By analysing what Pliny wrote about these paints, the tools and the methods, and confronting it to what is actually happening in a real life situation, it becomes possible to reconstruct these techniques. Comparing this information with such given by Vitruvius and other ancient writers, and also to other passages by Pliny, conclusions on the subject may be either confirmed or rejected. Finally there is the possibility of searching for evidences of ancient objects, which may represent the three methods of encaustic painting.

The first method (a), painting with wax was, according to Pliny, one of the two ancient methods of encaustic. Painting with melted wax signifies that the paint has to be hot, i.e. fluid, and consequently preferably applied with a tool resistant to heat. Such a tool, *cauterium*, is spoon-like and was, during Antiquity, made of bronze. It could be used to pour the paint and for modelling the surface. Examples of paintings made in this manner, are some of the Fayum portraits, which were made with

coloured beeswax. The traces of tools used for modelling the paint are evident. The second method (b) was used for engraved decorations on ivory. In order to perfectly fill the thin engraved lines, wax ought to be hot and fluid. Excesses of paint may easily be scraped off as soon as the paint has set. Examples of antique engraved decorations with coloured lines do exist, but it has not been possible for this author either to analyse the kind of bone or the paint. The third method (c) has been subject to many speculations. In a number of studies the question of hot (Punic) wax has been at focus, while this author has chosen to focus on paint possible to spread with a brush. That seems originally to have been the innovation, which allowed painting on large areas, such as on a ship.

Punic wax was chemically transformed beeswax. By a complex series of boiling and drying, i.e. cleaning and bleaching, this product was finally used for coatings on marble and on wall decorations. Consequently, the substance must have been possible to spread, or craftsmen would have preferred other materials for surface protection. Punic wax would, in that case, not have been described as an adequate protective.

Encausto originally meant “burned in” i.e. that the paint or the protective was heated and consequently “burned” into the supportive material. Not even Pliny applied the term strictly, according to the terminological meaning, but used it in a more general manner for wax painting as well as for applications of wax coatings on painted surfaces. In one passage, Pliny mentions that Punic wax was applied on delicate pigments such as *purpurissum* and *caeruleum*, in cases when these were applied on wet lime, i.e. for wall decorations. Vitruvius describes the same process, and continues by stating “this process is called ganosis by the Greek”.

Punic wax, or saponified wax, may be defined as a link between *encausto* and *ganosis*. It was used for painting on wood and for surface coating. According to Pliny it was used for coating weapons (leather and metal) for medical purposes, and that waxes could be stained with some colours. Punic wax applied with brushes and resembling tempera has been identified on paintings. Wax has been identified in samples from Roman wall paintings, enclosing the pigments. Consequently, the encaustic techniques as well as Punic wax have been identified as part of the ancient material tradition.

Some ancient techniques became transformed during the passage of time, others ceased to have importance and became forgotten. Sculptors have used beeswax as a coating on marble and bronze until recently, when modern chemicals have substituted many traditional materials. Encaustic was abandoned as a painting technique already during Antiquity, mainly substituted by tempera and oil paint for small size paintings. Some artists have, at intervals, tried to reconstruct encaustic, e.g. Leonardo da Vinci during the Renaissance, Arnold Böcklin during the 19th century, and Jasper Johns who made some encaustic paintings in the 1950s. Beeswax in various forms has been, and still is, used as a material for artistic purposes.

Beeswax is an ideal modelling material, since it becomes malleable at roughly the temperature of 38°C, i.e. by the contact with human hands. It has a low melting point, generally at about 64° but oxidation with the atmospheric oxygen may increase the hardness and raise the melting point considerably, to around 120°. Beeswax has excellent qualities of impermeability to atmospheric moisture, and a surface coated with wax repels most solvents. Natural beeswax is virtually insoluble in water, unless saponified. Saponification is achieved by boiling the beeswax in water with a salt, e.g. soda or potash. *Natron* was, according to Pliny, used as the saponifying agent during Antiquity. *Natron* is an impure double salt, with desiccation qualities, which has been collected in salt lakes in the Egyptian deserts since the Pharaonic era. It was, among other things, used in the mummification process, for cleaning, for the production of glass and as one ingredient in incense.

Beeswax is a stable material, and does not change much with time. Beeswax used during Antiquity is still of the same chemical composition, and in addition, much the same as beeswax produced nowadays. Just as natural beeswax does not change much with time, saponified wax or Punic wax, also remains stable, and both maintain their original characteristics. The products are consequently easily recognised in chemical-technical analyses, but their presence cannot be used as a means for dating the object.

Beeswax was used as paint, and Punic wax was principally used as a coating on marble and on walls. Roman wall paintings are known to have a specific lustre. Whether such a lustre was due to an application of e.g. a wax, or if it was due to the preparation of the plaster and stucco, has been a subject of disagreements. Since Pliny and Vitruvius mention the application of Punic wax on painted walls, at least on some colours, the preparation and painting of Roman murals was the reason to make part of the materials studied in this dissertation.

Roman wall preparations from the Republican through the Antonine periods are extremely well made. Vitruvius recommends as many as six applications of lime plaster and marble dust plaster (stucco) on the rough layer. Preparations reflecting such a description have been found, and seem to have been common during the Republic and the Augustan periods, at least in houses of wealthy families. Plaster preparations, dated to these periods, often show lucid stucco layers of one centimetre or more. Lustre was achieved by compacting the layers, and smoothing and polishing them. The combination of the highest class materials and excellent craftsmanship contribute to the lustre of these walls. Applications of wax were made during Antiquity, since beeswax or saponified beeswax has been identified on samples examined. Whether such applications were made upon large areas or just on specific colours is not possible to say from the results within this study. Cinnabar seems, however, to have been coated with Punic wax, just as proposed by Vitruvius.

Ancient techniques connected to beeswax have been examined and are described

in this study. The issue is to understand whether or not such materials might be accepted in modern conservation.

Materials in conservation have dramatically changed during roughly the past fifty years. During the same period, conservation as a profession and as an academic discipline has undergone radical development. The academic structure has permitted the penetration of science into this field of traditional craftsmanship. Chemistry has overthrown traditions, laboratory tests and scientific research have substituted manipulations and variations of traditional technology. The voice of a scientist speaks louder than that of a craftsman. Chemical formulas and chemical reactions have seemed to be more reliable than results from experience, especially since craftsmen cannot prove their results in figures.

Conservation is relatively young as a professional activity. In ancient times, conservation was conducted either by artists or craftsmen. A skilled stone-carver or a sculptor made repairs or reconstructions on marble statuary, a painter made necessary infills and reconstructions on paintings. Repairing objects in the household was often within the domain of its owner, or otherwise by a craftsman. Preservation of heritage such as public properties was, and still is, attended to by an architect in charge. Cultural heritage such as statues, altars and paintings were restored in studios specialised in specific materials or art forms, i.e. the frame-maker and gilder also restored ancient wooden objects such as an altar screen or a candelabrum. The stone-carver created his own statues, but also worked with repairs or reconstructions of details on works of art within his speciality, i.e. he had a personal relationship with material as well as with form. Although commissions are still given to artists and specialised craftsmen, professional conservators nowadays perform the major part of the conservation of cultural heritage in Western countries. National education systems are slowly developing into systems of international standards, i.e. Western standards. Although some attention lately has been given to other cultural traditions, these standards are dominating, accepted by western scholars as a superior phase.

Prefabricated industrial products have, to a large extent taken over, and traditional materials and techniques have been largely abandoned also in conservation. This was maybe necessary during a period when conservators fought for conservation to be recognised and respected as an academic profession. At present it might be wiser to combine traditional experiences with modern achievements, and to make conscious selections among all possibilities available. The professional conservators nowadays have great possibilities of choices, in materials and techniques, but also in the professional field and how to work, i.e. whether to be employed or a free-lancer, working in a museum or with short time, national or international projects, being part of a co-operation team etc. It is possible that a conservator nowadays has to reflect upon the professional situation not only once but many times, and again and again make choices. The necessity of being able to consciously make

choices among all kinds of conservation materials available is of vital importance. Being aware of, and understanding, the cultural context of those objects which are exposed to conservation interventions is a vital factor for making adequate decisions, and necessary for achieving appropriate results.

During the formation period of conservation as an academic discipline, traditional craftsmanship was undermined and a new kind of conservator appeared, maybe not as competent in crafts, but well aware of scholarly historic research, chemical reactions, analytical methods, methods in documentation, computer processing, international agreements, legal rights, etc. International agreements and guidelines in conservation have the double effect of providing rules and strategies for the management of cultural heritage, and also providing the personal or collective power to have an influence on national and international boards of heritage, museums etc., but also on the academic level, making possible the creation of strategies and developments in education. It is important to study the development of national and international organisations in conservation, since being aware of the past makes possible to individuate progress in the future.

Issues concerning conservation principles and agreements are important and constitute the basis for actions taken in real life. Some statements, constantly repeated, and their actual application in practice, have been studied. These statements comprise e.g. that, at any conservation intervention, as little as possible should be done, and that the original material should be respected. Additional materials should be reversible, or at least they should be compatible with the material of the object restored. Statements such as these are by nature, possible to interpret, and to react to, in many ways. It seems logical that additional materials should be reversible, i.e. that a reconstructed area should be possible to remove. But, on the other hand, it is commonly accepted that such a removal is often combined with the risk of losing some more of the original material. In other cases, reversibility is not requested, e.g. when consolidating a material in severe decay. In such a situation, reversibility is the quality least requested.

The object of art and its material should be respected, but is it respected if impregnated with substances, which, strictly speaking, are not compatible with the original material? Silicates are commonly used for the impregnation of limestone and marble. According to the principle of compatibility, it may be argued that silicate should be used for only stone containing silicate, and not for limestone. Anyone within the field of conservation, however, accepts the use of silicate as a consolidant for marble.

As little as possible should be done, but who decides what is as little as possible? There are different ways of understanding, and when one person only recommends a maintenance intervention, another may accept cleaning, consolidation, infills and reintegration of colours. There are many possible ways to interpret several official statements of the conservation organisations. There is a similar lack of

clarity in the term, conservation. It is possible to understand any procedure connected to preservation. The conceptions behind some terms important in conservation are therefore presented in this study.

Ancient materials, used during the Roman era, have been at focus in this dissertation. Consequently the Roman cultural context has been regarded as well. Roman wall paintings, Fayum portraits, and to some extent, polychrome statuary, are the three modalities of Roman art, which have been studied, as bearers of a material and a mental tradition. The material aspect has been presented above, the context will be described below.

The tradition of decorating plastered walls was a heritage of the Hellenistic civilisation. Stucco decorations painted to resemble costly marbles have been found throughout the Hellenistic world. These decorations, imitating marble-coated walls, reflect a mode set at the Palace of Mausollos in Halicarnassos during the middle of the 4th century BC. Decorations of this kind appear in Roman Italy during the 2nd century BC, generally called the First Pompeian style. The decorative system, i.e. the manner of dividing the wall into an upper, a middle and a lower zone, was also a heritage of the Graeco-Hellenistic tradition. With the exception of some gradual or temporary changes in proportions between the constants, the system as such remained rather unaltered throughout the Roman period, and continued in the Early Christian and later Western traditions.

The Roman house was decorated according to some principles, which seem to have been followed and repeated throughout the period. Some reasons for the acceptance of strict rules in building and decorating may be explained by the hierarchic structure of Roman society and the traditional life of a Roman citizen. The *domus* of a Roman family was not only a private home, but also the office of the head of the family *pater familias* and the place of the daily reception of clients. The doors towards the street were wide open during daytime, and anyone passing by could see not only the owner and his clients, but also had a clear view through the official part of the house towards its interior, and somewhat more private quarters. Generally the view from the street-side comprised the *fauces*, *atrium*, *tablinum* and the *peristyle* garden, all decorated to impress the visitors and to illustrate the social status of the owner. Public parts of the house were, consequently, richly decorated with wall paintings, stuccoed ceilings, reliefs and pillars. There were also statues and fountains, exposed to be seen by all who visited the family. The floors in public rooms were made of mosaics or *opus sectile*, while those in the service quarters were often made of terracotta tiles, laid in a pattern called *opus spicatum* or fish bone. Wall decorations in service rooms were simple, often monochrome white, or painted in a simple black-and-white pattern.

The Roman house was consequently a place of official duties, built and decorated to manifest the political and economical power of its owner. The materials used for public areas were chosen to underline such impressions, and the technical qual-

ity of decorations made for public spaces show that good craftsmanship was connected to the use of high class materials. Observations of plaster layers and material analyses may be useful at archaeological excavations and the documentation of Roman houses, since such methods contribute to the identification of their periods of construction as well as of the status of their space. Expensive pigments such as cinnabar were used only in rooms of reception, while lime and earth colours dominate simple rooms and houses of less wealthy families.

It seems to have been important for the Romans to decorate their houses according to established schemes. Some motifs were regarded as appropriate for spaces such as dining rooms and reception rooms, while motifs chosen for libraries and peristyles had other qualities. The repetition of popular motifs is a characteristic of Roman art, and there are endless variations of some popular themes. The motifs originate principally from Greek mythology, but famous characters of Greek civilisation, such as philosophers and athletes also had their given places within the Roman decorative scheme. Copies of famous statues and paintings may appear in the same context as Greek originals, indicating that the question of original or copy was not as important as the issue of *decor*, i.e. the suitability within a given ambience.

Even though commonly acknowledged rules were followed in the decoration of spaces, Roman culture was not completely static, but there were gradual changes. Changes within wall decoration are defined according to the system of August Mau, who recognised the so-called Four Pompeian styles.

The First style, mentioned above, consisted of stucco relief decorations, painted to resemble various existing types of marble, often combined with brightly coloured fields. In the Second style, also called the architectonic style, architectural settings were painted on the walls, sometimes combined with real elements such as cornices and columns, thereby transforming the flat surface into fantastic constructions. Views of gardens and landscapes often occur in illusive openings. The Third style occurred during the Augustan period, and may be described as a classicistic style with some influences from Egyptian art, its landscape and society. During this period the wall becomes a flat surface with elegant decorations. The central field was generally decorated with a figural motif. The Fourth style is often defined as an eclectic style, since motifs from each of the previous styles appear, although modified, to create a new kind of harmonious unit. Typical of this style are the filigree patterns, framing the sections of the walls. The Fourth style is generally known from the period of Claudius and Nero, and the eruption of Vesuvius in AD 79, marks its end. Decorations made later are referred to as Post-Pompeian paintings.

Fayum portraits are a comprehensive term indicating Roman portraits painted in Egypt roughly between AD 17 and 250-75. Early portraits are dated to the reign of Tiberius, but there is no final date commonly agreed upon. In recent research it has been assumed that the tradition ended during the second part of the 3rd century AD.

The portraits were named after the district of Fayum, an oasis situated in the Libyan desert south of Cairo. At the end of the 19th and beginning of the 20th centuries a vast number of mummies were found during excavations in the Fayum area, and later on at other sites along the River Nile and in Northern Egypt. Some mummies had a portrait affixed over its face, sometimes painted in a naturalistic style, sometimes in a stylised manner. Repetitions concerning features, hair fashions and expressions are obvious, and also such which may be used to identify the artist or the workshop. Due to the evident desire of the depicted to resemble leading persons within the Roman aristocracy, it has been possible to date most portraits within limited periods of time.

The Fayum portraits were painted with encaustic or with tempera. Some are unmistakably encaustic paintings since the wax paint appears slightly in relief. Other portraits are definitely tempera paintings, since they have the specific characteristics of that medium, such as a dry surface where the single brush-strokes can be individuated. There are two sub-groups of portraits which resemble both encaustic and tempera paintings. One of these contains portraits painted with wax-paint in a mixed technique. On such surfaces the paint partly appears in relief, shaped with a hard tool, and partly applied with a brush, which leads to the suspicion that Punic wax may have been used. The other group consists of portraits painted with a lucid paint, flatly applied and with visible brush-strokes where lines were desired. These have traditionally been regarded as tempera paintings, but at least, occasionally, were painted with saponified wax, i.e. Punic wax.

According to ancient literary sources, Punic wax was used for coating painted statues. Such a procedure was the traditional way of giving statues the final shield of protection. Painted statues in wall decorations remain as evidences of such a tradition, as well as remaining statues with more or less discernible traces of polychromy. Research on the subject has in this study been limited to the literary level, since there has been no opportunity to take samples from relevant works of art for chemical-technical examination.

Case studies

In order to confront theories and real life situations, some issues were studied in depth. Each case study is connected to some important aspect of conservation, observations of materials, and of cultural aspects connected to the situation studied.

In *Case Study 1*, the relation between important guidelines in conservation, internationally agreed upon, and the actual situation in real life are studied. The materials are plasters and pigments, the cultural context is graffiti decorated Renaissance building at Viterbo in Italy. Being a cultural and educational programme, planned as a Raphael project and financed by the European Community, one would expect it to be carried out according to strict standards. Within this three-nation collaboration, the Swedish group consisting of conservation students from ICUG, was working in

practice at Viterbo for one week in 1998. Their role was described as documentation and material observations, leading to suggestions on conservation techniques and materials. The Swedish participants made a general overview of the façade, registering the different kinds of damages, which were noted, and also searching for possible reasons for decay. Full size tentative reconstructions of the graffito decorations were made on plastic films in raking light, and samples for material analyses of plaster and pigments were taken from relevant areas. Based on the results of analyses, final decisions regarding conservation materials should be made. During the field week at Viterbo, the Swedish group had daily meetings with the Italian participants, i.e. the architect in charge and the project secretary, and regular meetings with the constructor, the art historians, and representatives of the local government. Ethics in conservation, as well as methods and materials were discussed, leading to an agreement on how to proceed. In addition, on request, the Swedish group presented a proposal for the possible future use of the building.

The samples of plaster and pigments were brought to ICUG for analyses, and the results, which should have been available before conservation started, were not available until 1999, when conservation of the façade was already terminated. Neither were the results requested, indicating that conservation of the façade was carried out according to another programme. The theoretical part, i.e. the phase of planning and formulating a strategy and a final goal, was made perfectly according to academic demands. There were interdisciplinary debates and different opinions on conservation materials, on how to proceed and if and how to test materials which might be used. On the other hand it was disappointing, that the material analyses, which should have been the basis for conservation interventions, were never asked for, and that information about the interventions, which actually were made, never reached the Swedish group of conservators. Therefore it is not possible to draw conclusions regarding the conservation programme, but only regarding the discrepancy between theory and practice.

Case Study 2 regards the planning and realisation of a material investigation, the materials being beeswax, pigments and preparations, and the cultural context, Fayum portraits in Nationalmuseum in Stockholm, i.e. portraits from Roman Egypt in a museum collection. The first contacts between this author and representatives for the museum were taken in the autumn of 1996. The material study started in the autumn of 1997 as collaboration with the department of conservation at Nationalmuseum, and the Opificio delle Pietre Dure in Florence. This study was carefully planned. To begin with the aims of the investigation were defined, and a strategy laid out, not only for the observation of materials but also including suggestions on future conservation and maintenance. At first information was collected to make possible a selection of portraits for a further study in depth. Each portrait in the collection was verbally described on registration sheets and various kinds of deterioration observed were documented on plastic sheets, placed upon large-size

photos of the portraits. Finally, some portraits were selected for a material investigation. Samples were taken in concordance with the Opificio, and later brought to Florence for chemical-technical analyses.

Binders, pigments and preparations were at focus in this study. One issue was to find out if it was possible to make certain statements about whether paint was encaustic, Punic wax or tempera, through observations based on paint and preparations and the combination of these. The scientific investigation at Opificio was carried through and in 1998 the results were available. Based on these it was possible to confirm some assumptions, but there were also some unexpected results. The results are presented in the publications *Fayum portraits* and *Mumieporträtt*, both published in 2000. One aim of this material study was to understand the technology of ancient materials, thereby providing information which contributes to consciously performed actions in conservation. During the last year, all portraits in the collection have been brought to the conservation studio, where necessary conservation interventions have been performed, and a permanent, more suitable way of mounting and presenting the portraits is planned. A final result of this investigation was the exhibition of the portraits, when these were exposed in two cabinets in Nationalmuseum in 2000.

Case Study 3 concerns the documentation of archaeological material and conservation interventions performed for a planned didactic exhibition of the fragments at the church San Lorenzo in Lucina in central Rome. The materials, plaster, pigments and binders, and the cultural context, Roman art as represented by fragments of wall paintings in an *insula* building of Campo Marzo is in focus. The project was carried out in 1999, mainly in collaboration with Dr. Olof Brandt, who led the archaeological excavations at San Lorenzo in Lucina, providing the material investigated in this study. At a later phase, in 2000, this study was extended and became part of a larger scale research project at the Swedish Institute for Classical Studies in Rome.

Visual observations, including the measuring of plaster layers and grain sizes, descriptions of pigments and paint layers, were made. Decisions had to be made regarding conservation methods, in order to make possible any exhibition of the fragments. Documentation was carefully made and conservation interventions registered. As part of the project, all discussions leading to interventions or any kind of further steps were presented in the report. According to the initial plan, material investigations should be performed at ICUG, but a complete set of results was, for various reasons, never available, mainly due to the scientifically inadequate situation connected to analytical equipment. Some questions regarding pigments were resolved at ICUG and others at The Swedish National Heritage Board, and finally at the Opificio. Plans regarding the exhibition of the archaeological finds were made in collaboration with Dr. Brandt and the architect Mats Fahlander, later including the archaeologist Leif-Eric Vaag. The exhibition hall and the permanent exhibition were inaugurated in autumn 2001.

All parts of this collaboration project worked out satisfactorily, except for the scientific material analyses, which were not carried out according to the plan, but partly resolved. Consequently, a functional working plan and collaboration between competent professionals is necessary for success, but also, technological equipment for carrying out the plans.

Case Studies 4 a, b and c, refer to a collaboration project between different disciplines related to some institutes, the materials studied were plasters, pigments and binders, and the context is Roman buildings at Prima Porta, outside Rome. Institutes involved were Soprintendenza Archaeologica di Roma, Opificio delle Pietre Dure in Firenze and supporting this author, the Swedish Institute of Classical studies in Rome.

Fragments of wall paintings from the Republican to the Post-Pompeian periods were studied. Plaster layers and grain sizes were measured and general observations on plaster, paint layers and pigments were noted. Relevant samples were brought to Florence, and chemical-technical analyses were performed at the Opificio. The hypothesis was, that visual observations might reveal changes in materials and techniques which might be correlated with a specific time during this period, supposing that there was progress at the beginning of the period and decline at the end. This environment was probably in the possession of the Imperial family, indicating that materials and techniques used might be expected to be the very best, considering economical aspects. Cultural aspects connected to the function of the Roman house as an official space, were also taken into consideration, since one might expect that the *princeps* had to visually manifest his power and supremacy.

Visual observations of the material made it clear that the material quality and technology were extremely high already during the Republic, as visualised in the First style fragments. Fragments from the Augustan period were likewise, except that these were even thicker and more smoothly polished. A technological decline during the later Roman period was observed. Results from the chemical-technical investigation at Opificio confirmed these observations, and proved that the technical and material decline at Prima Porta started after the Antonine period. Until then, alabaster grains were used in the stucco preparation, which in addition, was very thick. During the later period, the stucco consisted of lime and marble dust, or just lime. Pigments were mainly earth pigments, constantly used throughout the period. Cinnabar was not found on fragments from the later period. Binder was generally lime, but occasionally also some organic matter was found. Beeswax or Punic wax was identified in samples with cinnabar pigment. To conclude, this collaboration smoothly progressed, and the results were presented in due time. These will be useful for future observations on Roman wall paintings.

Case Study 5 was a didactic conservation project, the principal materials studied were traditional and modern products for the conservation of stone. The cultural context was an old house at Anacapri on the island of Capri, partially rebuilt and

partially constructed by Dr. Axel Munthe during the middle of the 20th century, and containing a vast collection of Roman art and crafts. Many marble and terracotta objects at the Villa San Michele, were in great need of various conservation interventions. Considering the situation, and searching for a positive solution, it was decided to form a didactic programme, co-involving ICUG and students studying the conservation of stone. Before the programme was initiated in May 1998, a plan had been formulated by this author, including aims and objectives of the project. The programme was approved by the director at Villa San Michele and by ICUG.

One principal objective was to give the possibility to Swedish students to work with materials from the Roman period, in that way broadening their personal experiences of ancient art and culture. Another objective was to provide for them the opportunity of meeting Italian professionals connected to conservation and art history, having the possibility of asking questions and discussing experiences. An important objective was to initiate a conservation programme to preserve this Swedish heritage of Roman art in Italy, intended to lead to the formulation of a regular maintenance plan. One of the main principles was to use simple methods, and to avoid substances, which might be harmful for human health and the environment. The results in theory as well as in practice have been most satisfactory and sometimes overwhelming. One preliminary conclusion is that careful cleaning of a deteriorated object is of vital importance for the result. The project was carried out in 1998 and 1999, and is planned to proceed in 2001, after a temporary break for evaluation of the results.

Case Study 6, consists of studies and experiments concerning wax painting and the reconstruction of Punic wax. The materials included were natural beeswax and compounds of beeswax, various plasters and preparations. The cultural context was to reconstruct Roman tradition and to try to combine traditional materials and modern products. Experiments were carried out during the period between 1995 and 1997, starting with applications of various wax-paints on some plaster preparations. At the next phase, focus was placed on the reconstruction of ancient Punic wax, and the application of substances on plaster preparations and modern building materials. Reconstructed Punic wax was also tested as a surface coating on marble and bronze. Finally, a full-scale wall decoration was made at Ericsson ETX at Mölndal, outside Göteborg, as collaboration with White Architects and Ericsson. Evaluation of the experiments has been made at intervals, and is still proceeding.

Many important experiences were made during the period of these studies. Some are strictly related to the subjects investigated and others are related to collaboration situations. The overall experience is, that there is a discrepancy between theoretic constructions and the situation actually observed in real life situations. This becomes particularly obvious in the field of conservation, since guidelines are formulated for actions planned to be performed. Theoretical guidelines in conservation should be respected, but often are not. The reasons for such a discrepancy may gen-

erally be referred to a lack of adequate equipment, a lack of skilled specialists or a lack of time, all reasons related to economy. Ethics in conservation are at a high level and, if economy allows, should probably be followed as a standard procedure. One recommendation in conservation, often repeated, is the necessity of collaboration in groups of specialists. Such co-operation is one of the most important experiences made during this period of study. Participating in a project means contributing to obtaining results, which have been previously agreed upon. In a well functioning project group it also means having the advantage of learning from other professionals, striving towards the same goal. In cases when all participants within a project group do not collaborate as intended, or the results do not correlate with the intentions formulated at the beginning, there is probably a hidden economic reason to discover. Economic issues as well as conservation issues should be dealt with professionally. When large contributions are made for conservation projects, the results should be checked by a competent member of the board. Professionally performed conservation has to be adequately paid, and public offices at least, should choose the better offer, not the cheapest. Conservators should not offer their services for an unprofessionally low price, underbidding each other, etc.

The conservator has a personal responsibility when choosing between products and techniques. An absolutely perfect method or material does not exist, and consequently, at present the choice must be between more or less imperfect possibilities. There is constant research for better products and methods, and by being aware of positive and negative factors of a product, it becomes possible to develop and perfect it. And doing as little as possible, is most often a good recommendation.

Punic wax is one ancient product, which may be a functional alternative in conservation. It is harmless for human health and the environment, factors that should be a first priority when conserving the cultural heritage.

ABBREVIATIONS

AIC	The American Institute for Conservation of Historic and Artistic Works
CC	The International Committee for Conservation (within ICOM)
CNR	Consiglio Nazionale delle Ricerche
EDS	Elementary Diffraction Spectroscopy
FTIR	Fourier Transform Infrared Spectroscopy
ICCROM	The International Centre for the Study of the Preservation and Restoration of Cultural Property, in Rome
ICOM	The International Council of Museums
ICOMOS	The International Council of Monuments and Sites
ICR	Istituto Centrale per il Restauro
ICUG	Institute of Conservation, at Göteborg University
IIC	The International Institute for Conservation of Historic and Artistic works
NKF	Nordiska Konservatorsförbundet, regional group of IIC, of the Nordic countries
NKF-S	Nordiska Konservatorsförbundet, the Swedish section
SEM	Scanning Electron Microscopy
UNESCO	United Nations Educational, Scientific and Cultural Organization

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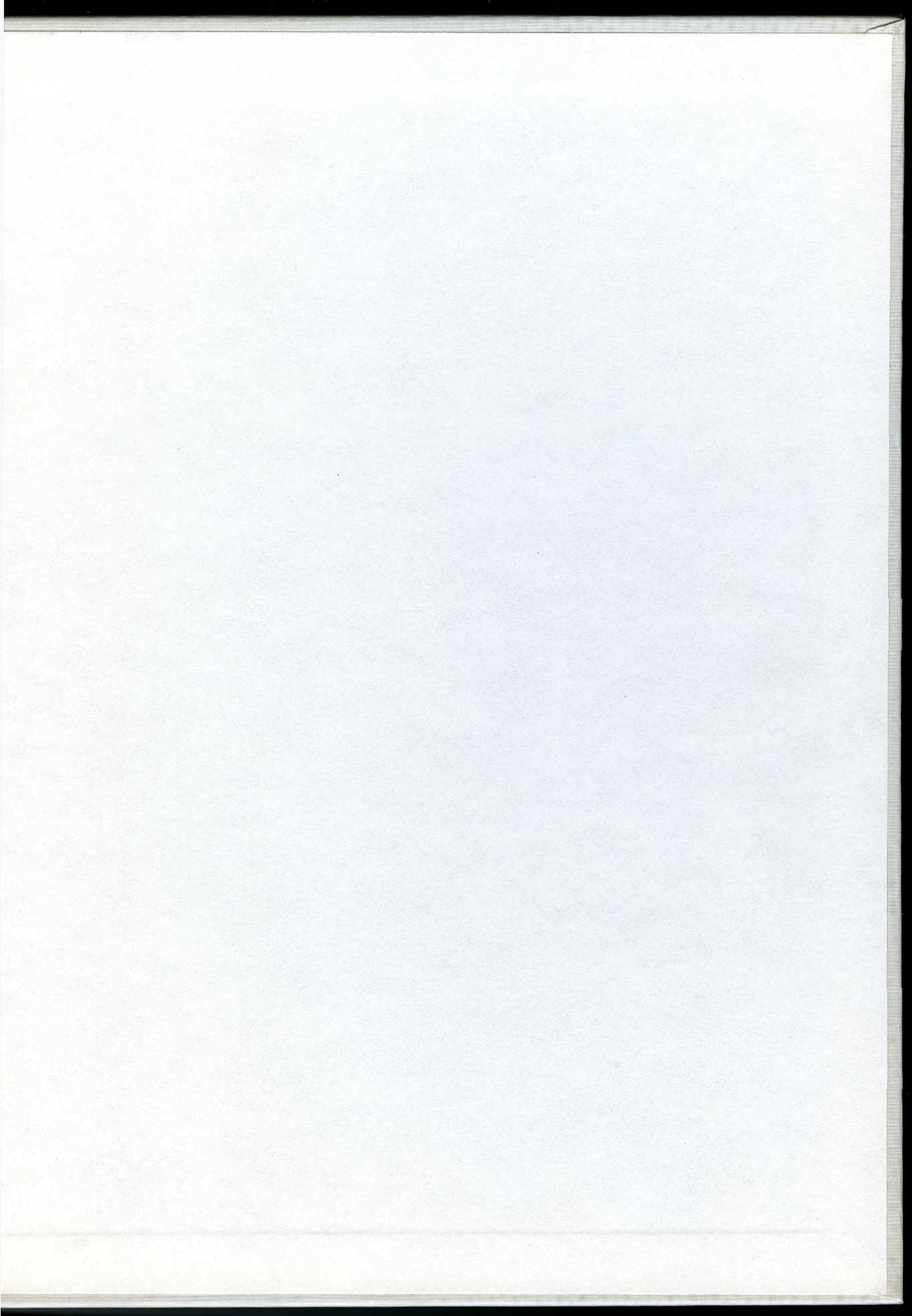
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