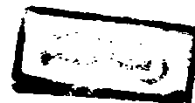


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GAMAL ABDEL - MAGUID MAHGOUB

22754

Submitted in Partial Fulfilment of
The Requirements For
The Degree of Master

631.4
G.A

1986

APPROVAL SHEET

Title : Studies on the deterioration and salinization
of some Egyptian monuments.

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Thesis

Submitted in partial fulfilment
of the requirements for the degree of

MASTER

in

Soil Science

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Date : / / 1986.



ACKNOWLEDGEMENT

The author wishes to express his deep thanks and appreciation to professor Dr. Abd-El Halim El-Damaty professor emeritus of soils, soil science department, Faculty of Agriculture Ain Shams University for his encouragement and help.

Thanks are also extended to professor Dr. Farida H. Rabie, professor of soil science, Department of soil science Faculty of Agriculture Ain Shams University for her deep interest, supervision, stimulating discussions and guidance during development of the work.

The author is greatly indebted to Dr. Shawki M. Nahkla, director general of restoration and conservation of Egyptian Organization of Antiquities for his guidance during this research, and also for Dr. Kamal Barakat, director general of research and conservation centre for this kind help.

Sincere thanks are due to all staff members of restoration and conservation of Egyptian Organization of Antiquities.

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I. INTRODUCTION

The deterioration of Egyptian temples has been of concern to mankind for a period of over 2000 years. Many studies of temple deterioration since the High Dam's construction have been conducted, especially in the Karnak-Thebes area. Despite the quantitative nature of these studies, it has not appeared possible to answer even some of the more fundamental questions, such as whether the construction of the High Dam further endangers Egyptian temples. In fact, it was stated that the Dam's construction is beneficial, because it prevents the annual inundations which damaged and salinized the temples in the past. On the other hand, progressive salinization of the land and its antiquities since the construction of the High Dam is evident in many parts of Egypt, and is a subject of concern to its Government and its Antiquities organization; consequently, a deeper understanding of the salinization processes is needed.

In recent times, the interest in the restoration and conservation of Egyptian Antiquities started with the discovery of the tomb of Nefertare in 1904 where an atelier of restoration was established to take care of this very important tomb. The discovery of the tomb of Tut Ankh A mon in 1923 with its very important royal collection ever discovered before insited

the authority of the Egyptian Antiquities department to develop a chemical laboratory to analyse and study the ancient Egyptian materials and industries mainly those of museum collections. The years 1920's and 1930's witnessed a wide scope operation of architectural restoration of ancient Egyptian temples and tombs where cement played a very important role. None of these operations took into consideration the origin and causes of deterioration of Egyptian Antiquities.

It was not until the last five years that a charter for the restoration and conservation of Egyptian Antiquities was established insisting on the role of science and technology as a basic tool for the study and restoration of Egyptian Antiquities.

Therefore, it was thought of interest to study the causes of the deterioration which took place in Karnak, and Hibis temples.

Mud-bricks are worth to be considered as the earliest building materials used in Egyptian history as, they were used since early predynastic periods.

Mud brick buildings were erected mainly in south America, Africa, the Mediterranean Region, the Middle East and India. Some ancient structures have survived where the

climate is extremely dry or where the ruins have been buried and so protected from weathering agents. Increasing awareness of the importance of the cultural patrimony has brought the attention of scholars and government officials not only to the noble stone monuments but also to the humbler mud structures which can yield a wealth of information to the expert on the every day life of past ages.

Therefore, the mud bricks of ancient buildings in different places in Egypt were also considered in this study from the stand point of clay mineral composition as well as other chemical composition. These analyses will be useful for restoration and preservation.

2. REVIEW OF LITERATURE

Since the available literature concerning the causes of deterioration of tombs and monuments are very limited, certain literature has been selected and reviewed as follows :

In the United Nations Educational, Scientific and Cultural Organization, Feilden (1979) stated on the conservation of cultural property, " of all the object of artistic and historical value created in the past, only a small fraction remains, what has survived is our cultural patrimony. Deterioration, and losses suffered by cultural property are due to natural and human forces which both often are acting together. Natural forces of deterioration include unavoidable disasters such as earthquakes, floods and hurricanes. Less drastic, but none the less damaging, are the prolonged actions of natural weathering and other environmental factors such as pollution and vibration on cultural property ".

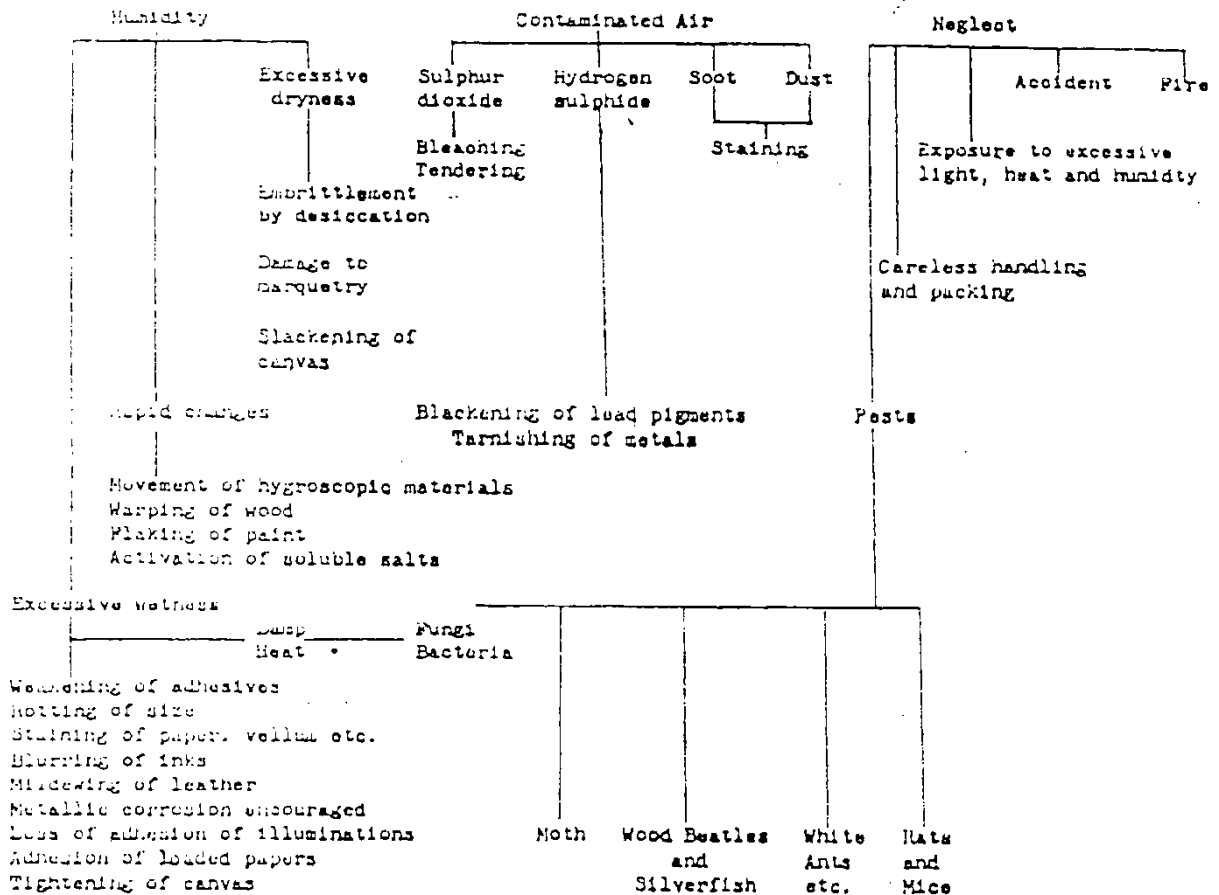
The main causes of decay and damage to cultural property are tabulated in table (1) by Plenderleith and Werner (1979), and Feilden (1979). Analysing the causes of deterioration loss, the following three questions were taken into consideration :-

Table (1) CAUSES OF DECAY AND DAMAGE TO CULTURAL PROPERTY*

EXTERNAL CAUSES OF DECAY: The SUN produces LIGHT with ULTRA VIOLET and HEAT RADIATION

<u>Climatic Causes</u>	<u>Biological and Botanical Causes</u>	<u>Natural Disasters</u>
seasonal temperature changes	animals	tectonics
daily temperature changes	birds	earthquakes
precipitation of rain and snow	insects	tidal waves
ice and frost	trees and plants	floods
ground water and moisture in soil dust	fungi, moulds, lichens	avalanches
		volcanic eruptions
		exceptional winds
		fire

INTERNAL CAUSES OF DECAY: (Note: the building modifies and protects)



MAN-MADE CAUSES OF DECAY:

neglect of preventive conservation	wars	environmental pollution	vandalism and arson
	purposeful alteration	water abstraction	theft

1. What are the natural weaknesses inherent in the component materials of the object ?
2. What are the possible natural agents of deterioration that could affect the component materials ?
3. What are the possible human agents of deterioration that could affect the component materials ?

They added that of all the factors that make up climate, water in its many forms, are the most damaging to cultural property for two essential reasons :

Hygroscopicity :-

1. Each component material is best suited to a specific and often limited range of relative humidity and temperature, this is especially, and critically, true for materials which are hygroscopic, i.e. which absorb and lose moisture relative to immediate environmental conditions.
(Such materials can be imagined as functioning somewhat like a sponge, contracting and expanding in response to their water content). This process provokes mechanical stresses manifested as warping, cracking, splitting and fracturing, and which would result in the detachment or powdering of a painted surface.

2. Chemical reactions which damage cultural property depend upon the presence of water.

Feilden (1979) referred also in his paper to a number of potentially damaging forms which can be arranged as follows :

- 1) rain
- 2) frost
- 3) condensation
- 4) capillarity
- 5) chloridation
- 6) Relative humidity and temperature
- 7) High temperature and Low humidity
- 8) Light
- 9) Erosion and wind
- 10) Tectonics
- 11) Destructive insects
- 12) Destructive animals

1) Rain :

Rain is a natural agent of erosion that, with time, can turn mountains into plains. Likewise, it can erode exposed cultural property and structures, as infiltration rain can enter structures and come into direct contact with cultural property.

2) Frost :

Rain is the most direct means by which moisture can enter porous materials, which include most building stones, mortars, wood and stucco. There, with freezing temperatures, the moisture turns to ice. Ice has a greater volume than water : as it expands it produces severe mechanical stress within the structure of a material, ultimately leading to fracturing, splitting, scaling, and powdering. The " freeze-thaw", cycle is thus, extremely dangerous for all materials capable of even slight moisture absorption. Climates with a large number of freeze-thaw cycles provoke rapid deterioration of vulnerable materials.

3) Condensation :

Condensation consists of droplets of water that collect on cool surfaces which are in contact with warm, moisture-saturated air. Thus, in its natural form, water is free to act upon any hygroscopic materials present and might provoke chemical reactions, as well as create the requisite conditions for the growth of micro-organisms and plants.

4) Capillarity :

Water can rise in porous materials such as brick, stone and mortars, just as water rises through the capillaries of

the trunk and branches of a tree. Capillarity is a critical problem because ground water inevitably contains soluble salts. These salts are carried with the water as it rises to heights as great as five meters under exceptional conditions; two or three metres are quite common. As water evaporates through the material, salts recrystallise in the pores and on the surface. As the salts solidify and increase in volume, they cause great mechanical stress within the material. This action provokes a progressive internal rupturing which can lead to the ultimate destruction of the material. The dangers of capillarity were noted as long ago as the neolithic period in the near east (6000 years B.C.), where mud brick dwelling were often built upon dense, less permeable stone slabs, an early attempt at "dampproofing" aimed at blocking the ascent of ground water.

5) Chloridation :

This process can occur when cultural property is situated near the sea or ocean. The sodium chloride, or "salt" dissolved in the water is deposited by moist winds on exposed materials. Salt is extremely hygroscopic, dissolving and recrystallizing in relation to the surrounding relative humidity. When salt enters porous materials, it induces deterioration similar to that provoked by capillarity. Furthermore, salt is itself a strong chemical reagent, affecting metals and other materials.

6) Relative humidity and temperature :

A relative humidity of more than 70 percent and a temperature of 25-30°C create optimal conditions for the growth of microorganisms, such as bacteria, mould, fungi and algae, as well as plants as lichens and mosses. All of these growths damage cultural property. Bacteria, moulds and fungi feed on most organic materials, disfiguring, weakening and ultimately destroying them if left unchecked. Lichens, algae and mosses implant themselves on building materials and sculpture, where they deposit their corrosive metabolic wastes.

Suitable relative humidity and temperature, combined with requisite levels of precipitation, can also produce favourable conditions for the growth of plants in and around cultural property. The resulting root penetration can literally push masonry apart, this is especially true in tropical zones where, for example, jungle growth has engulfed important Mayan temples in Yucaton, Mexico and Khmer temples at Ankor wat, Cambodia.

7) High temperature and Low humidity :

Although low humidity can be ideal for preserving some objects, excessive dryness can lead to the desiccation of many materials, aggravated in desert regions by the rapid