Essay

The Egyptian Monuments: Problems and Solutions

Zahi Hawass*

1 Introduction

Egypt's wealth bedazzled the world. Truly a land of plenty, her vast resources during her glorious years as the kingdom of the Pharaohs gave mankind a permanent record of the greatness of her people. The remnants that are seen today show a population that delighted in life and wanted to take that joy into the unknown netherworld.

About 450 years before Christ, a restless Greek traveller sailed from his home at Halicarnassus, on the Turkish coast. He was off to see the civilized lands he had heard so much about throughout his boyhood. This inquisitive traveller, Herodotus, reached Egypt and was impelled to stay in the country until he could see the fascinating treasures that were a daily feast before his eyes. As had the ancient Egyptians, Herodotus made this journey both on land and on the life blood of Egypt, the Nile.[1]

For a period of over a thousand years, the temples and tombs, even pyramids of the Pharaohs were completely covered with sand, which offered them a kind of natural protection. Herodotus, who wrote about the monuments at Giza plateau, never mentioned the Sphinx, because it was completely covered with sand.[2] This is important evidence to show that the Egyptian monuments were covered with sand since 500 B.C. Two hundred years ago, scholars and adventurers began uncovering the monuments from the protective sand. Since that time, many elements have contributed to the deterioration of these monuments.

2 The Causes of Decay

2.1 People Living in, Around and on the Monuments

The problem of urbanization can be seen in many places. The temple of Esna is completely surrounded by the city of Esna. The temple is located on lower ground and the city has grown up around it. None of the houses has a sewage system. Sewage is leaking down from the houses into the temple. Salt has started to appear on the lower

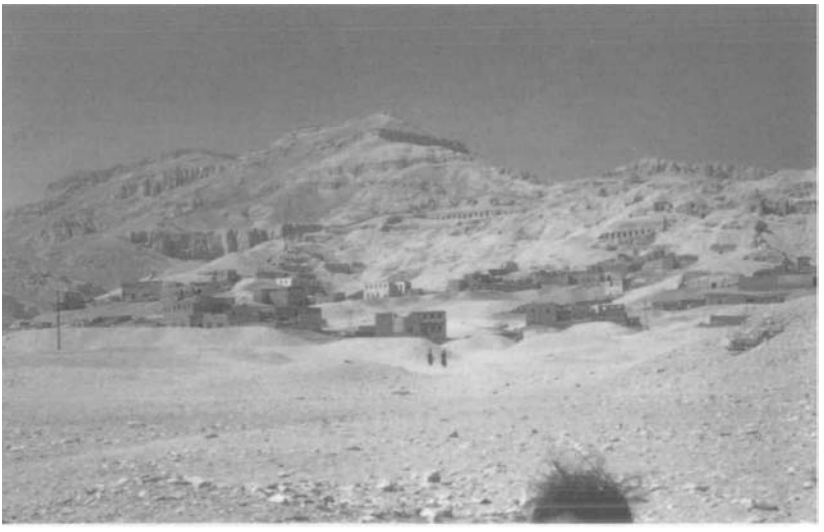
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part of the temple. The same situation has occurred in Edfu, Akhmiem and Ashmonien in Middle Egypt. Cracks have begun to appear in the walls of these temples. This caused a huge block to fall down from the top of the first pylon of the temple of Edfu.[3] The same thing has recently happened in the temple of Kom Ombo. Many inscriptions and pharaonic scenes were destroyed. The same problem has been occurring for a long time in Qurna located on the west bank of the Nile in Luxor. Many houses have also been built recently nearby the tombs of the nobles and around the tombs of dynasties IV and XI at El Taref.

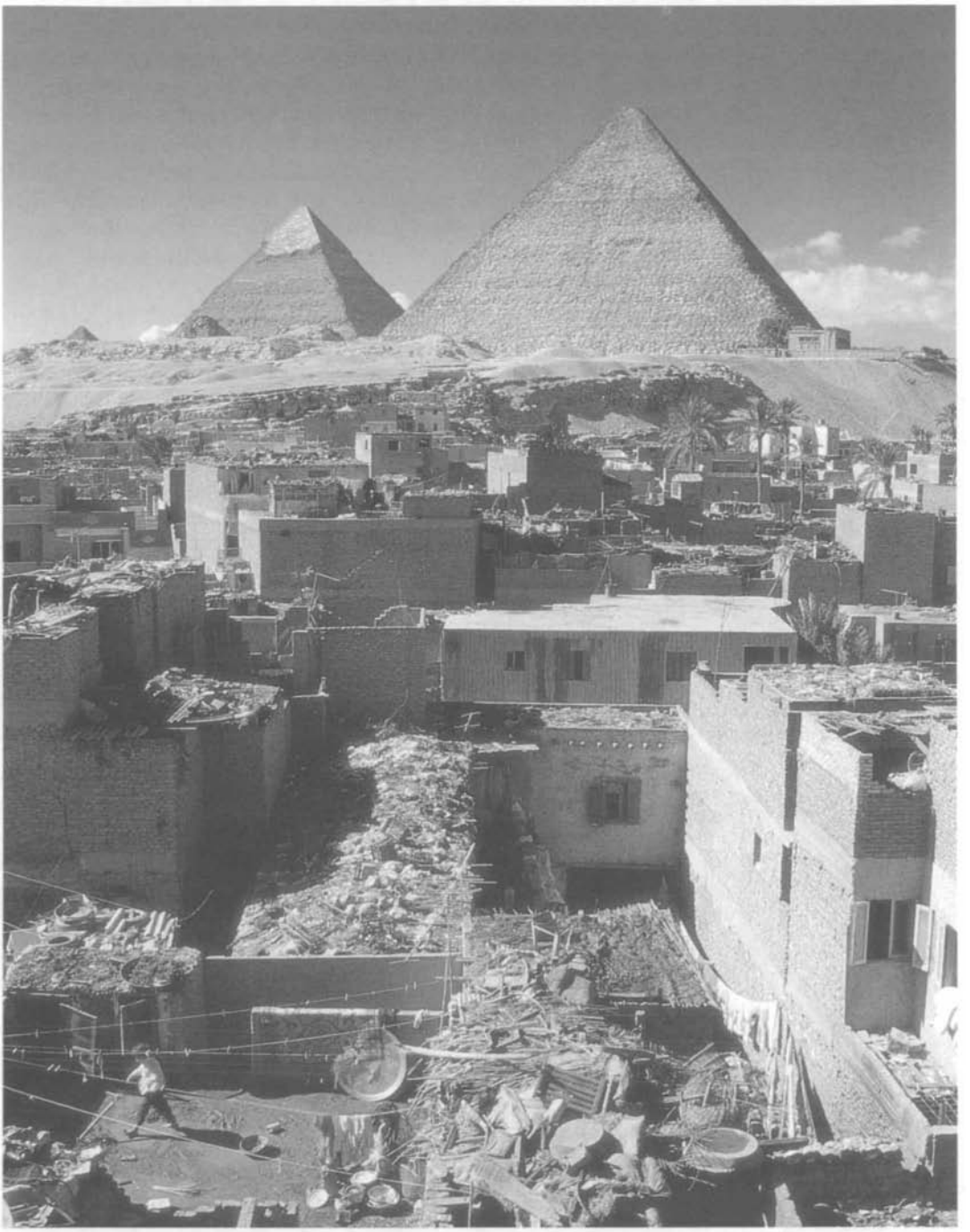
The village of Nazlet-el-Samman is located just at the foot of the pyramids. It is a village of about 200,000 people. We know that houses have been built above monuments. During the work of the sewage system for the village, we found a very large settlement of about 3km square in this area. Also found were animal bones of sheep, cattle and pigs, showing the marks of butchers' knifes. Thousands of domestic pottery sherds, some originating from Upper Egypt, give evidence of trade between Upper and Lower Egypt in this period. Pollen was found that is being analysed to shed light on the clinic of ancient Egypt. In addition, the causeway and the valley temple of Khufu was found while putting in the village sewage system. These treasures are being damaged by urbanization.

In short, the problems that come from the building of village homes include ascitic pollution, water pollution, fire and smoke from cooking, and theft.



The village of Qurna, near Luxor, is located on top of an area rich in archaeological finds.

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The town of Nazlet-el-Sammam of over 200,000 inhabitants is located near to the pyramids. An ancient settlement 3km^2, remains of a causeway and a temple have been excavated in its environs.

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2.2 The Rising Water Table

This problem is a result of the lack of sewage systems, or of leaking systems, as seen in Islamic Cairo where water can be observed flooding the streets. This water full of salt. When it comes in contact with limestone monuments, a chemical reaction reduces it to powder.

The salt crystallisation problem is observed in the monuments all over Upper and Lower Egypt.[4] Some believe that the rising of the water table came after the High Dam of Aswan.[5] It has been proved that the High Dam does not cause the rising water under the monuments in the Nile valley.

The Sphinx is a good example of this problem. The level of the water table under the Sphinx has been about 2m for a long time. The level of the water table was measured last year and found to be at 7m under the Sphinx, suggesting that the sewage system of the village reduces the level of the water table.[6]

2.3 Fluctuations in Humidity and Temperature

There are climatic elements causing damage. These include biological degradation, salt crystallization, rock swelling, rains, flash floods, wind erosion and temperature variation.[7]

The variation in temperature, especially in Upper Egypt, is severe. This change can be seen best in the area of Abu Simbel. During an 8 hour period, the temperature can change from 15 to 41 degrees.[8] There is no doubt that this vast change can affect the stone surface.

The wind is another powerful factor. The ancient Egyptians recognised this factor. Tuthmose IV built two protective walls on the north side of the Sphinx to protect it from wind.[9]



Strengthening the bedrock base of the Sphinx: stones were placed in position according to a photogrammatic map. The mortar used consisted of lime and sand.

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2.4 Human Action

Modern technology, such as the building of industrial centres near the monuments and the resulting pollution are a major problem. The factories in Helwan affected the monuments at Sakkara and Giza. There are limestone quarries near the monuments where they use dynamite. The vibration of the dynamite was affecting the body of the Sphinx. A control program for the limestone quarries has now reduced this impact.

Other elements of human action, such as wars, absence of cultural awareness and voluntary destruction from ignorance (for example the use of the pyramids as stone quarries),[10] and neglected maintenance have had an enormous negative impact.

Modern agriculture has expanded and is surrounding the monuments. Lands belonging to antiquities have been converted to agriculture. There are many examples of this in Upper and Lower Egypt.

2.5 Tourism

There is no system to integrate the income generated by tourism and, in turn, to fund the preservation of the Egyptian monuments. Tourism is very important for the economy but it is also very dangerous to the preservation of the monuments. It is a fact that each tourist who enters a tomb or a pyramid brings about 20gm of water to the monument. The great pyramid of Khufu is a good example. Humidity has risen to 95 per cent inside the pyramid. Salt accumulation of about 1cm thickness has accumulated over the surfaces of the so-called queen's chamber and the grand gallery of Khufu's pyramid. In about 500 different spots within the great pyramid, the stone had become weak and detached.[11] Some restoration has been done. Soot (black spots) was removed from the ascending passage which leads to the second burial chamber or queen's chamber by a solution composed of alcohol and water: 1:1 in equal parts. Following that, some of the areas were cleaned by using a concentration of acetone. In addition, the salts which covered the walls and the roof of this passage were cleaned by mechanical methods. Weak parts were consolidated to protect the walls of this passage from detachment by using special mortar derived from sand and araldite.

Other deteriorating parts of walls were restored by applying a suitable mortar composed of three parts sand, two parts lime powder and one part Kaolin. All the blocks were registered in the grand gallery and recorded by drawing and photographing the actual condition of each block before restoration. Where possible the loosened blocks were grouted and reattached. In the grand gallery, a total of 239 blocks were examined and repaired on the left wall.

A television monitoring system was introduced in order to control the circulation of visitors inside the Great Pyramid. Five highly sensitive television cameras were placed inside the grand gallery, the second burial chamber and the third burial chamber.[12]

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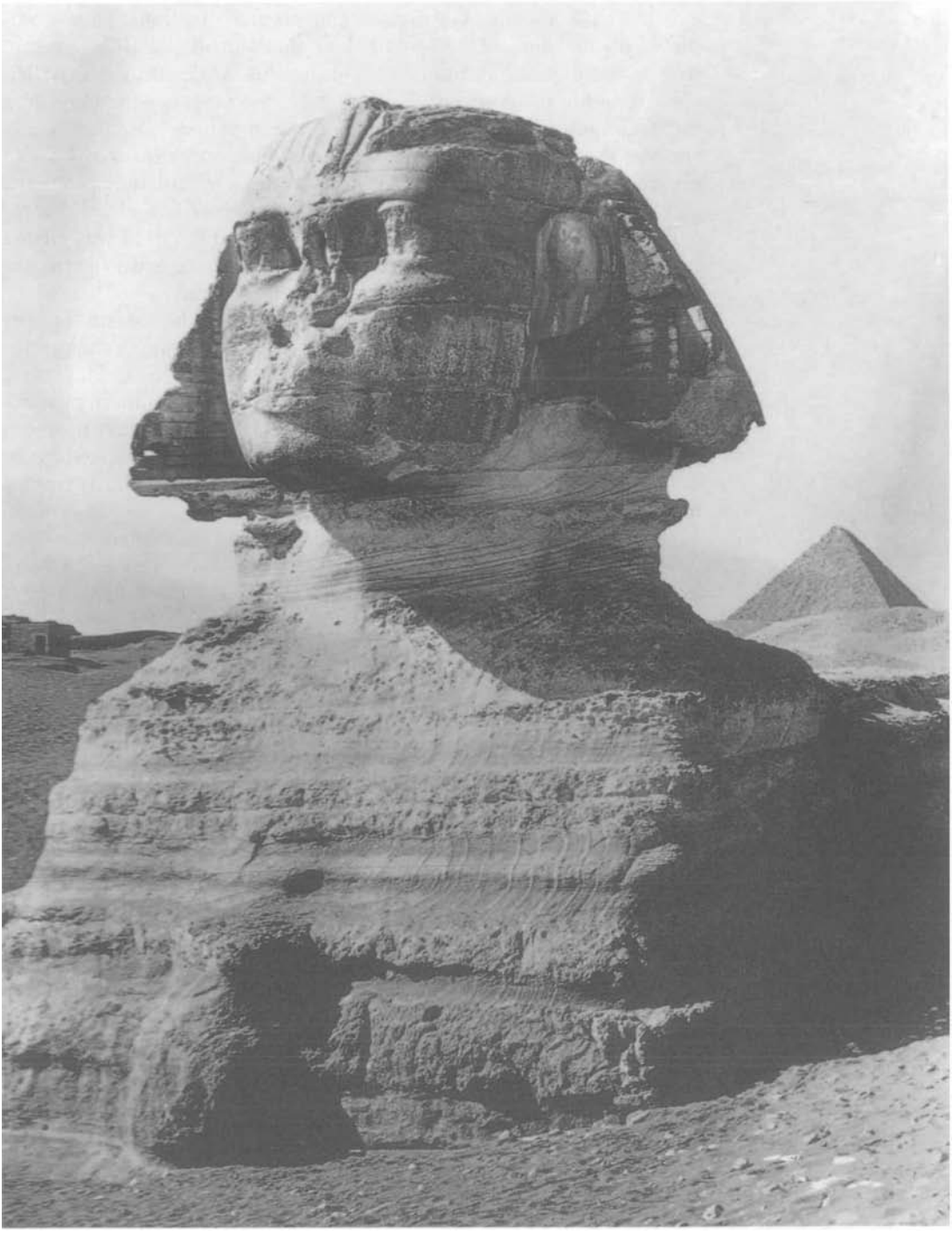


The Sphinx in 1936 after the removal of sand and the restoration of the head by Baraize.



The results of poor restoration of the Sphinx are clearly visible.

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The Sphinx in 1926 before restoration by Baraize.

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The EAO and the German Archaeological Institute have completed the cleaning of the so-called air shafts inside Khufu's pyramid to stop the increase in humidity. During this work officials installed electric lights and a security system with instruments which measure the temperature and humidity inside the pyramid. Measurements showed that humidity had increased to a dangerous level of 85–95 per cent. After studying the humidity and air circulation problems inside the pyramid, the German Institute proposed to clean the so-called air shafts to facilitate air circulation. The pyramid was closed for five days last May. After cleaning the shafts, there was a remarkable improvement in air quality inside the pyramid.[13]

Additionally, two electrical ventilation units with an air flow of approximately 400m^3 were installed to ensure the air exchange inside the pyramid. After a careful study, two electrical fans were installed inside already existing openings in the air southern channel and in the so-called Caviglia tunnel behind the exit of the northern channel. After the installation, the air is completely exchanged every one and a half hours. Now the interior temperature and humidity match that on the outside.

Over 3,000 tourists a day visit the tomb of Tutankhamen of the XVIIIth dynasty and Seti I of the XIXth dynasty. There has been deterioration in the tomb of Seti. Cracks have formed in the tomb interior and the inscription in second half of the tomb of Ramses III is now gone. Moreover, the tomb of Mentomhet is in very bad condition.

The system of Sound and Light shows in the temple of Karnak and Philae is not properly designed for the safety of the temple. The system is now being improved with new technology. Mechanical shock, such as occurs from tourist buses and cars in the sites of the antiquities sites, is very dangerous. Excessive vibration and air pollution are generated.

2.6 Inadequate Restoration

Improper restoration is the greatest danger to the preservation of the Egyptian monuments. The Sphinx is a good example. Large stones were put as a casting on the Sphinx in 1982 and 1987. Cement was used to hold the casting in place. In order to add the casting, all the ancient stones that were added to the Sphinx in Pharaonic, Saïte and Roman periods were removed. The result of this improper restoration can be seen by the damage done by workers who directly damaged the claws.[14] Salt started to appear on the new stone.

Improper and poorly designed restoration is widespread and can be seen on the temples of Edfu, Esna, Luxor, Karnak and Medinet Habu. No appropriate system of conservation is being used. Cement is still being used in the restoration.

The restoration of the temple of Hatshepsut at Deir-el-Bahri is based on imagination and not on knowledge.

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The temple of Hatshepsut at Deir el-Bahri has suffered damaged from landslides. Subsequent restoration has been based more on conjecture than informed research.

2.7 Other Factors

There are other elements affecting the Egyptian monuments, such as natural disasters (earthquake, flood), biodegradation, the action of gravity and habitation.

Many monuments are in critical condition due to the problems mentioned above. There is a list, which I call the Dangerous List, which includes temples or monuments that need immediate attention. Examples are: the temples of Edfu, Esna, Deir-el-Bahri, Luxor, Medinet Habu and the Rameseum; the tombs in the valley of the Kings, such as Ramses III, Seti I, King Tutankhamen and the nobles' tombs; the Serapeum and the interior of the Step Pyramid at Sakkara; and the tombs of Kom-el-Shekafa in Alexandria.

3 The Way Ahead

The solution for protecting and conserving the Egyptian monuments can be summarised as follows:

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3.1 Safe Zones

The first precaution is the establishment of a "safe zone" for each site or monument, providing for the control of tourism, factories, urbanisation and other activities.

The conservation measures at the Giza plateau are a good example. The EAO and UNESCO designed a master plan for the plateau. The Centre of Engineering Archaeology at Cairo University is responsible for the design of the project. The master plan includes a ring road around the plateau to route traffic. Cars and buses will not be allowed to enter the plateau. An educational cultural centre will be built for tourists and public, to enable them to learn about the monuments and their history. This project will include a place for the horse and camel drivers that are stationed in and around the pyramids. A conservation plan will be designed for the monuments at Giza. A similar plan should be made for urban renewal of houses and building around the temples of Edfu, Esna, Luxor, Karnak.

Village built around and above the monuments should be removed to other locations, such as Nazlet-el-Samman, El Ashmonien, Akhmiem and Qurna.

3.2 A General Conservation Plan

A comprehensive conservation and preservation plan that provides for an appropriate balance between tourism and preservation is badly needed. For example, under such a plan only limited visitor access would be allowed to some tombs, such as that of King Tutankhamen, and the walls of all tombs would be equipped with a protective



UNESCO experts discovered that the head of the Sphinx is very durable.

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The Sphinx in 1942 during the second world war. (Photographs by courtesy of the author)

barrier of fibre glass. The project of the Great Pyramid at Giza is a good case study that demonstrates the effectiveness of such planning.

A management plan should be designed for the tombs. For example, certain tombs should be open to tourism while others should be closed for restoration during the next year.

The painted tombs in Sakkara, Beni Hassan and the West Bank should be protected by a barrier of fibre glass. Photography with

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flash and the touching of tombs should be stopped. Certain tombs such those as King Tutankhamen, Nefertari and Khufu's pyramid should be open to vistors only with a prior reservation.

3.3 A Sound Restoration and Conservation Plan for each Site

Again, the establishment of such plans is sorely needed.

The Sphinx conservation project serves as a further case study for the alliance of technologies geared towards both conservation and restoration. The project is well managed and consists of three phases:

(i) The restoration of the southern side. This phase is already finished.
(ii) The restoration of the northern side and the chest.
(iii) Global involvement in the design of a comprehensive conservation and restoration plan, that will address in turn each of the many elements causing deterioration and will generate guidelines for access to researchers and tourism.

Since the Sphinx was uncovered by Baraize in 1926, it has (as I have indicated) been under siege from many elements, such as the rising water table, vibrations emanating from aircraft and vehicle traffic especially buses in the immediate vicinity of the area, and people living around the Sphinx, in particular the villagers of Nazlet-el-Samman and Kafr-el-Gebel. The leaking of waste water from nearby villages which lack sewage containment systems constitutes a further threat. In addition, the modern construction of the Sound and Light installations and the cutting of tunnels for cables; climatic factors, such as rain and fluctuations in humidity and temperatures; modern technology, such as factories near the monument and the resulting pollution; the practice of utilizing stop-gap and harmful methods of conservation and/or restoration, particularly where using cement and gypsum on the mother rock of the Sphinx's lion body; and the limestone quarry near the Giza plateau, which uses dynamite to pulverize lime for use in sugar factories, have all played their part.

All the above mentioned factors in the deterioration of the Sphinx are the same elements that cause damage to all the monuments of Egypt. The method of management and the conservation plan of the Sphinx and the Giza plateau is a model plan for the protection and restoration of Egyptian monuments.

The Egyptian monuments need an urgent plan to attain the preservation of this unique civilisation. Expertise from all over the world should co-operate with us in the protection, study, preservation and the restoration of these ancient sites. Egypt believes that the Egyptian monuments belong not to Egypt alone, but to the people all over the world.

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Notes

1 For the history and archaeology of Egypt see, B G Trigger, et al. *Ancient Egypt: A Social History.* Cambridge University Press 1986, K W Butzer, "Archaeology and Geology in Ancient Egypt" *Science*, 132 (1960), pp 1617–24; J Baines and J Malek. *Atlas of Ancient Egypt*, Oxford, 1984.

2 Herodotus. Translated by A de Selincourt; Herodotus; *The Histories*. Penguin Classics, Harmondsworth, 1972.

3 See N Herz, "Geological Sources of Building Stone", E Robertson, "Physical Properties of Building Stone", D E Winkler, "Problems in the Deterioration of Stone" in *Conservation of Historic Stone Buildings and Monuments*, National Academy Press, Washington, 1982.

4 H Fahmy et al, "Environmental Protection of the Egyptian Cultural Heritage", Unpublished paper (1992).

5 *Ibid.*

6 K L Gauri, "Deterioration of Stone of the Great Sphinx" NARCE 112 (19981), pp 35–47; idem, "Weather in Deserts as Exemplified by the Great Sphinx of Giza" Geol Soc Am Abstracts with programs (1981; idem "The Deterioration of Ancient Stone Structures in Egypt" prospectus et sauvegarde des sauvegarde des antiquites de l'Egypte" *BdE* 88 (1981); idem, "Selection of stone for repair of the Great Sphinx," *NARCE* 1/6 (1981–82), idem, "Geological study of the Sphinx" *NARCE* 127 (1984), pp 24–43.

7 See note 4.

8 *Ibid.*

9 Z Hawass. "History of the Sphinx Conservation" in *Book of Proceedings of the EAO* 1992, pp 175–176; K L Gauri, "Weathering and Preservation of the Sphinx Limestone" in *Book of Proceedings of the EAO* 1992, pp 55–108.

10 See note 4.

11 W F Petrie, *The Pyramids and Temples of Gizeh* edited with a chapter by Z Hawass London, 1990, p 102–104.

12 *Ibid.*

13 For the function of the air-shafts, see Z Hawass, "The Funerary Establishments of Khufu, Khafra and Menkaura During the Old Kingdom," Ph.d. dissertation. Ann Arbor, Mich. 1987, chapter I; I E S Edwards, "The Air Channels of Chephren's Pyramid", in *Studies in Ancient Egypt, the Aegean, and the Sudan: Essays in Honor of Dows Dunham*, Boston, 1981, pp 55–57. I would like to thank my friend Prof Rainer Stadelman for his co-operation in this project.

14 See note 9.

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