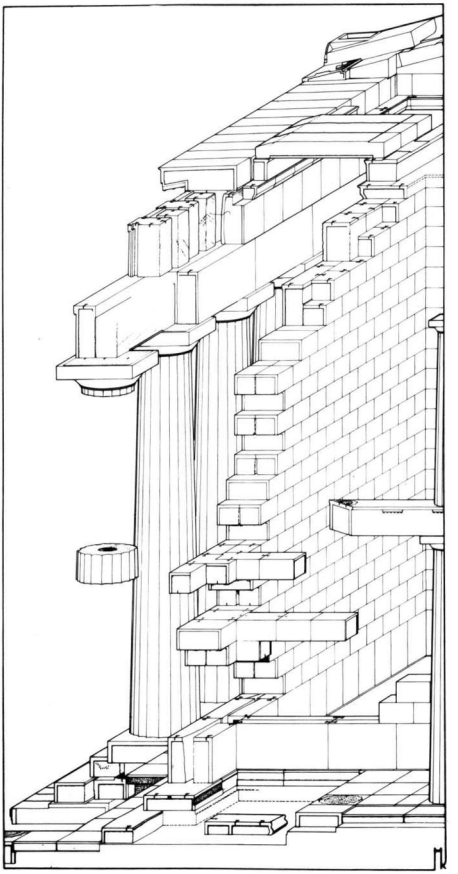
THE ACROPOLIS AT ATHENS

CONSERVATION RESTORATION AND RESEARCH 1975–1983



MINISTRY OF CULTURE
COMMITTEE FOR THE PRESERVATION
OF THE ACROPOLIS MONUMENTS

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CONSERVATION RESTORATION AND RESEARCH 1975-1983

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Preface

Shortly after Greece became an independent state the new Greek government and the newly-founded Archaeological Society began to concern themselves with the protection and display of the monuments on the Acropolis. Work started in 1834: certain areas were cleared off, later structures demolished, some work of consolidation and restoration was carried out. Throughout the 19th century Greeks and foreigners continued this work almost without a break, reaching a high point in 1885-1890 with the great excavations of the Acropolis that brought to light the unique finds now housed in the Acropolis Museum. The extensive restorations carried out at the end of the 19th and beginning of the 20th centuries gave the Acropolis monuments the appearance they have today.

Problems relating to the state of preservation of the Acropolis monuments began to be noticeable as early as the mid-40's. Specialists were seriously worried over the first signs of trouble, fractures and breaks and changes in the surface of the marble. During the following years a series of reports made by specialists and technical advisors and the report made in 1971 by Unesco experts made it plain that the situation was rapidly deteriorating and that a crisis was imminent. The Acropolis Ephorate attempted to deal with the immediate dangers threatening the monuments, using the limited technical and financial resources at its disposal. By 1975, however, it had become evident that a large-scale intervention would be necessary, the requirements of which went far beyond the capacities and competence of the Ephorate. Therefore, acting on the proposal made by G. Dontas, then Ephor of the Acropolis, the then Minister of Culture and Sciences C. Trypanis, supported by the then Prime Minister C. Karamanlis set up a working group composed of specialists, archaeologists, architects, civil engineers and chemists, whose task was to study, plan, supervise and carry out the work required for the conservation of the Acropolis monuments. Since the members of the Working Group for the Preservation of Acropolis Monuments are specialists in so many different fields, the problems can be comprehensively dealt with. Precautions have been taken to ensure that decisions concerning intervention are taken on as objective a level as possible, first by making decisions collectively, then by setting up a procedure whereby the study and planning phases are checked and tested in many different ways in the Working Group itself, in international scientific meetings and in the top ranking advisory committee on archeological problems of the Ministry of Culture. The question of intervention was given special emphasis because of the unique value of the Acropolis monuments. During the period 1975-1977 the Working Group concentrated mainly on fact-finding. The problems affecting Acropolis monuments were recorded and studied in depth; the worst problems are due to rusting iron attachments used in 19th-20th century restorations and to the physical, chemical and biological changes on the marble surface brought about by the rapid increase in atmospheric pollution in the immediate vicinity of the monuments during the last thirty years. There are also problems of static sufficiency, protection against the effects of earthquakes, and the wearing down of the rock floor by thousands of visitors.

In 1977 the Working Group, which became the permanent *Committee for the Preservation of the Acropolis Monuments* within the framework of the new administrative regulations of the Ministry of Culture and Sciences published the *Study for the Restoration of the Erechtheion,* the monument posing the most difficult problems. In December 1977 this study was presented at the *International Meeting on the Restoration of the Erechtheion,* held in Athens, where it was approved by Greek and foreign experts: archaeologists, architects, specialists for anastylosis, civil engineers, seismologists and chemical

engineers. Work began on the Erechtheion in 1979 and still going on is sheduled to be completed at the end of 1985. According to the proposal set forth in the Study the previously reerected parts of the building were dismantled and given conservation treatment. The rusted clamps were removed and replaced by titanium clamps; where necessary restorations were carried out in new marble and the reerection of the building began. The use of titanium positively eliminates the problem of cracks and fractures in the marble. How best to preserve the surface of the marble exposed to the corroding influence of the polluted atmosphere and rain is still an open question. Scientists continue working on this problem and, in the meanwhile, temporary measures have been taken to protect the architectural sculpture by transferring it to the museum or sheltering it *in situ*.

From 1977 onwards the Parthenon has been systematically studied and investigated and in 1983 *Study for the Restoration of the Parthenon* was published. This study, too, was submitted to international criticism at the *Second International Meeting for the Restoration of the Acropolis Monuments: Parthenon*, held in Athens, September 1983. A work site with modern equipment has already been installed at the south side of the Parthenon and the architectural members that belong to the Parthenon, formerly scattered all over the Acropolis, are collected there. The dismantling of the Parthenon will soon begin and the entire operation of saving the building is scheduled to take ten years. Studies on the conservation of the Propylaia and temple of Athena Nike have not yet been completed and small-scale interventions are carried out only where necessary.

The work on the Acropolis has naturally interested and stirred people all over the world. The Hellenic State, being well aware of its great obligation to protect these unique monuments, is allocating all of the funds needed to preserve and restore the Acropolis monuments. In 1977 the International Contribution to the Acropolis sponsored by Unesco ensured worldwide participation and in 1983 the E.E.C. undertook to cover a greater part of the expenses of the work on the Parthenon.

Right now and for the following ten years the Acropolis will give the impression of being a huge building site, with the monuments partly disassembled, scaffolding everywhere, machines and workmen, presenting a picture doubtless similar to that obtaining in the age of Pericles when the unique architectural complex was created. Most of the marble workers come from Greek islands where there is an age-old tradition of working marble; they now continue the labours of their ancestors, using the same methods and the same tools, not indeed to create but rather to save a masterpiece which belongs not only to the Greeks but to all humanity. We all hope that in the future the Acropolis monuments will stand restored and secure in an atmosphere which will have regained its former purity and translucence, qualities closely linked to the character of classical Greek architecture.

EVI TOULOUPA
Ephor of Acropolis

Introduction

From its inception the Committee for the Preservation of the Acropolis Monuments made plans to assemble as much information as possible in order to create a sound scientific base for its work. It therefore arranged to have data collected and stored in an archive and to be disseminated through publications, newspaper articles and lectures. The present exhibition was organized within the framework of that concern.

This dual effort on the part of the Committee is in accord with international standards and also with well-established modern practice. The last article of the Charter of Venice states that setting up a public archive is an essential prerequisite; furthermore, over a hunderd years ago Boito had already sought to have all information concerning an operation on a monument made public, Moreover since nowadays it is generally accepted that public concern and general agreement create the most favourable atmosphere in which to protect and conserve monuments, all of those working with the monuments are at pains to create these conditions on two levels: for the scientific community and for the general public.

Any information about interventions on the monuments of the Athenian Acropolis is welcome on both levels because of its outstanding importance. Thus, on the occasion of the Twelfth International Congress of Classical Archaeology held in Athens in September, 1983, it was deemed advisable to convene the Second International Meeting for the Conservation of Acropolis Monuments at which the *Study for the Restoration of the Parthenon* was presented and discussed and the work of the Committee was made known through an exhibition held in the National Gallery from the 12th of September to the 30th of October, 1983.

The exhibition aims to teach and inform the viewer about the Acropolis conservation project; by presenting original works it goes beyond the purely documentary aim, thus acquiring a richer more complex scope. In addition to the information needed to document the scientific and technical aspects, the exhibition presents original, artistically executed plans and hitherto unknown ancient sculptures and architectural members of great archaeological and aesthetic value. Without altering the theme of the exhibition this display allows us to present new discoveries about the architectural sculpture, a subject inseparably linked to ancient Greek architecture and especially to the classical monuments of the Acropolis. In this way the visitor who normally would not be interested in problems of restoration comes to realize that the technology on display is actually serving the ideals of protecting and restoring inspired artworks.

A great part of the exhibition is devoted to a detailed presentation of the questions confronting the Committee and the technical staff. The problems, involving both the monuments and the natural rock, are so unusual that special research is required in order to find the answers. Techniques of recording and diagnosing the cause of damage are an important part of the exhibition. Some of these techniques are familiar to those working in this field and others are new and pioneering, e.g. the use of gamma rays to track down damage in marble architectural blocks. The method adopted on the Acropolis for creating an archive for all kinds of ancient marbles is another exhibition theme.

The exhibition sets forth traditional and contemporary techniques of intervention, the principles governing the project and the means used to carry them out. The archaeological research that has been carried out on the Acropolis and is still in progress is of basic significance; the goal of this research is to identify thousands of scattered fragments of architecture and sculpture so that they may provide precious evidence to be used in the restoration of architecture or sculpture groups of vast significance for ancient art.

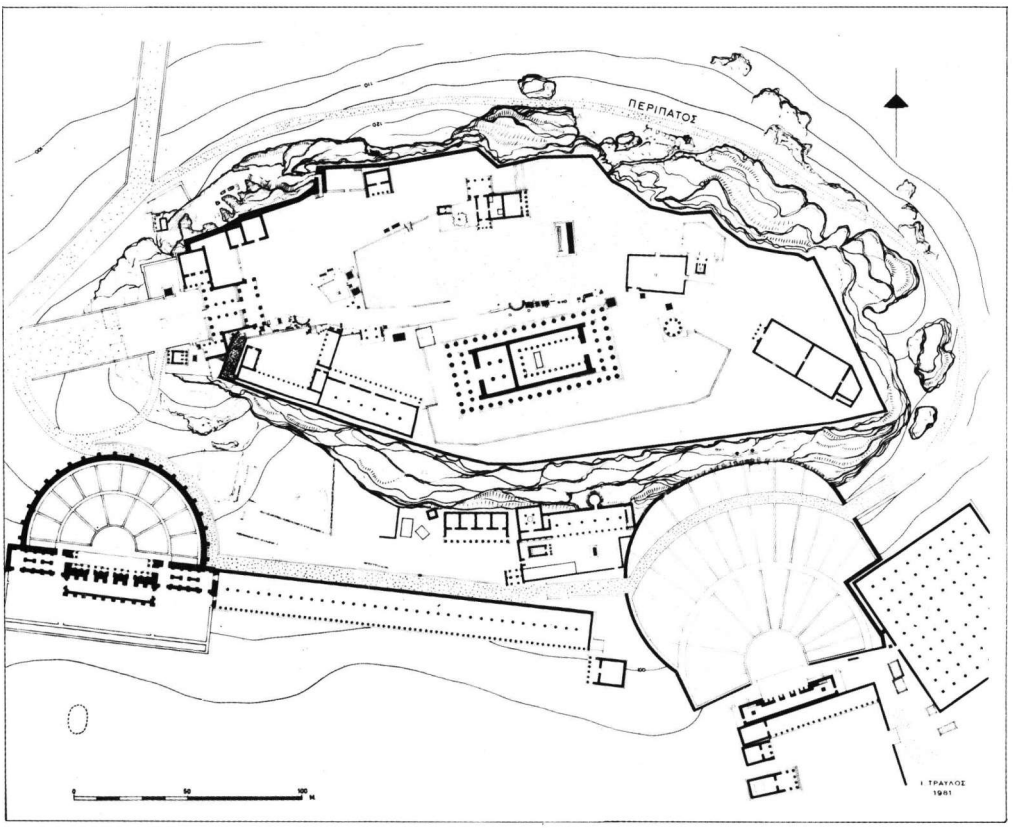
The exhibition is disposed in eleven units presenting various aspects of the conservation and preservation project. The first unit presents earlier work carried out on the Acropolis monuments from 1833 to 1975. Without knowledge of this background it would not be possible to understand current problems and the ways of dealing with them, the subject matter developed in the following ten units.

Other resources have been mobilized in order to make the object of the exhibition intelligible: plans and drawings, photographs and captions, models of reconstructed buildings and of the technical apparatus employed by the ancient Greeks. There is a documentary film on show and an audiovisual presentation with slides and music.

Thus it is hoped that visitors will be able to understand the complex, specialized work in progress on the Acropolis of Athens and to gain a well-rounded impression of the endeavours being made to preserve for future generations the most striking and complete ancient monumental complex still existing in our own times. An architectural treasure that belongs not only to the Greek patrimony but also to the worldwide cultural heritage.

Athens, April 1985

CHARALAMBOS BOURAS
Vice - Chairman of the Acropolis Committee



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Interventions on the Acropolis: 1833-1975

The end of the Greek War of Independence left Athens completely in ruins and most of her ancient monuments had been largely destroyed. The Turkish settlement up on the Acropolis, with its houses and gardens as we see them in pictures of the 18th and 19th century, had been reduced to a heap of ruins in the midst of which the Parthenon, the Erechtheion and the Propylaia stood out; they too had suffered heavy damage during the two sieges of the Acropolis. Christopher Neezer, the Bavarian officer to whom the Acropolis fortress was handed over by the Turks in April, 1833, describes the devastation on the Acropolis as follows: "I entered the Acropolis and saw heaps of jumbled marbles. In the midst of the chaotic mass of column capitals, fragments of columns, marbles large and small, were bullets, cannon balls, human skulls and bones, many of which were near the slender Caryatids of the Erechtheion."

Recognition of an independent Greek state by the Protocol of London in 1830 was a landmark in the history of the ancient monuments. The new state was oriented towards the West which was considered to be heir of the ancient greek spirit and was a magnet for the Greek intellectual diaspora. Greece now entered the mainstream of contemporary European thought and for the first time efforts were made to protect and display the antiquities.

By the mid-18th century Europe has developed an interest in Greek classical antiquity, an interest aroused by the first scholarly publications of Greek monuments, by the great archaeological discoveries in southern Italy and by the creation of archaeological collections that were for the first time open to the public. J.J. Winckelmann, imbued with the ideas of the Enlightenment, introduced the first critical treatment of the development of ancient art, thus founding the science of archaeology. Winckelmann proclaimed the unrivalled perfection of classical beauty and called upon his contemporaries to investigate and imitate Greek art. Looking at artworks from an rationalistic and critical standpoint led to a consideration of contemporary artistic creation as separate from and independent of artworks in the past; this in turn made people aware of the necessity of preserving the older works. Interest naturally turned to the ruined monuments of classical antiquity. Efforts to reerect them began in the first thirty years of the 19th century, generally using only the preserved ancient material with the idea of restoring their intrinsic ideal beauty.

The classicizing movement was brought to Greece by the many architects and archaeologists who came to Athens, the new capital of the Greek state, during the period of the Regency and the early years of Otto's reign. Many of them had a hand in building the new city in the neoclassical style; they offered their talents to the newly established Archaeological Service and devoted themselves to scholarly research and to putting the ancient monuments on display, particularly the splendid ruins of the Acropolis.

In the spring of 1833 work began on the Acropolis in a general climate of enthusiasm and unbounded admiration for antiquity. The first Greek archaeologist, Kyriakos Pittakis, conducted a small-scale excavation in the Parthenon with funds raised from private contributors. In the following year the excavation was continued and a beginning was made in the Propylaia. Pittakis also began to collect the scattered fragments of sculpture and architecture lying around on the Acropolis amidst the ruins.

From July-September of 1834 Leo von Klenze, the famous architect of the Bavarian court at Munich, visited Athens; his brief stay proved decisive for the fortunes of the Acropolis monuments. Von Klenze, one of the leading personalities of romantic classicism, submitted three memoranda to the Regency and Otto which set forth for the first time the guidelines for rebuilding and excavations on the Acropolis. Von Klenze made the following proposals

in his memoranda:

1. To remove the fortifications that have no archaeological, structural or artistic interest and especially those which are in imminent danger of collapsing, as for example the fortifications in front of the Propylaia.
2. To clear and rebuild the Parthenon, to continue the excavation in an area of twenty feet all around the building and to put the disiecta membra in order. The sculpture to go either in the mosque in the Parthenon or in the Theseion; the architectural blocks needed for the rebuilding should remain nearby. Architectural blocks that are not of use for rebuilding but which have their own intrinsic value are to be picturesquely grouped in marble piles on the Acropolis, so that the Acropolis would preserve the appearance of a picturesque ruin. The other architectural material lying around on the ground to be removed from the Acropolis and sold as building material.
3. The reerection of the Parthenon to begin at the north side which is more visible from the town and the palace. In principle only ancient column drums to be set up again. If in the course of reerecting the columns it turns out that one or two column drums are missing, they may be replaced by new drums made of marble but there should be no attempt to make the new additions look old. Whatever architraves, triglyphs, metopes and cornices have survived are to be set in place above the columns in such a way so as to preserve the picturesque character of the ruin. One should continue in the same way throughout the building, reerecting the cella walls insofar as the ancient blocks are to hand. On the south side the missing columns may be left out without impairing the impression of the whole. The spiral stair belonging to the Christian church should be demolished and replaced, if a means of access to the superstructure is needed, with a light stairway inside the building.
4. After rebuilding the Parthenon the area west of the building where the museum is to be built should be cleared of ruins. The Erechtheion and the Propylaia to be reerected in the same way as the Parthenon. The ancient ground level should be kept as it is with the remains of retaining walls, bases and foundations.

Von Klenze not only made out a program for excavations and rebuilding; he also conceived and carried out the plan of removing the military garrison from the Acropolis which now began to take on the character of an archaeological site. Von Klenze entrusted the supervision of the work to the young archaeologist Ludwig Ross together with the architects Stamatios Kleanthis and Eduard Schaubert and made out a budget for three years' work on the Parthenon. Von Klenze also studied the architecture of the Parthenon and conducted a small excavation on the north side of the Parthenon and in the Propylaia. On the 10th of September, 1834, before von Klenze left Athens, there was a festive ceremony on the Acropolis; resetting a column drum in place in the north colonnade symbolized the inauguration of the restoration campaign. Otto sat inside the Parthenon on a throne decorated with olive, myrtle and laurel branches; his presence and the splendour of the ceremonies expressed the desire of the state to protect and display the ancient monuments, which were identified with the rebirth of the nation.

The peroration of von Klenze's address to Otto reflects the spirit of admiration for antiquity and purism which was to characterize all of the operation undertaken on the Acropolis in the 19th century: "All of the vestiges of barbarism must be eradicated from the Acropolis and from all of Greece and the remains of the glorious past shall shine with new splendour as a firm base for a glorious present and a glorious future." As the remains of later structures were being removed from the Acropolis a beginning was made of reerecting the ancient monuments. According to present-day criteria these operations were a matter of trial

and error, unskillful and detrimental to the ancient material; they were done, nevertheless, in the spirit of a time in which theoretical principles of restoration had not yet been formulated and the results of restoration depended on the sensitivity and discernment of whomsoever did the work.

Towards the end of December 1834 work began on the Acropolis with a fresh impetus under the direction of L. Ross, E. Schaubert and Chr. Hansen who replaced Stamatios Kleanthis. Ross informs us that from the beginning of January, 1835, eighty workmen were employed on the Acropolis to demolish the Turkish rampart in front of the Propylaia between the Agrippa Monument and the Nike Bastion and to remove the fillings around the Parthenon where part of the crepidoma of the earlier temple came to light and sculpture and inscriptions were found. Demolishing the rampart in front of the Propylaia revealed many architectural members belonging to the building, inscriptions and many steps in the Roman stairway leading up to the Propylaia. But all eyes were fastened on the souththern end of the rampart which had been built out of marble taken from the temple of Athena Nike when the Venetians were besieging the Acropolis in 1687. The finds surpassed all expectations and led to a partial rebuilding of the exquisite Ionic temple.

Ross writes as follows: "After we had started demolishing the battery in the first days of April 1835 we soon came upon the remains of the Nike temple in the east or earlier side and therefore we had this section broken up first. At the same time we reached the temple foundations at the south end of the battery; we found three steps, the whole cella socle and two column bases at the southeast corner, one of them with a piece of the column shaft still in place: and now there is reason to hope that this lovely piece of architecture may be partially reerected. Consequently the work was eagerly continued and by July 1835 we had pretty nearly all of the remains of the temple together in the area in front of the Propylaia except for a few pieces which seem to entirely missing as may be easily understood. The reerection of the temple was begun in December 1835 and was almost finished by May 1836. Pentelic marble was used for new column drums which were inserted in the three broken column shafts and for a new column base; poros limestone was used for new blocks replacing missing or fragmentary blocks in the cella wall." The north and east sides of the temple were reerected to the height of the architraves and the other two sides remained half-finished. The temple of Nike was the first classical monument in Greece to be completely reerected, a clear example of classical beauty which far exceeded the classicists' fairest visions. In 1835 Ross also worked on the Erechtheion where he excavated the North Porch.

From July of 1836 onwards, after Ross resigned, Kyriakos Pittakis became the official director of operations on the Acropolis by royal decree. Pittakis, an Athenian, had for many years been deeply attached to the Acropolis monuments which he had endeavoured to preserve during the War of Independence and to which he now devoted himself with rare tenacity up until the time of his death in 1863. In the beginning Pittakis was assisted by two architects. E. Schaubert and E. Laurent and by the Swiss sculptor Imhof helped by Andreoli, the Italian; from 1842 on Pittakis worked together with the Archaeological Society and the other great Greek archaeologist of those days, A. Rizos-Rangabé.

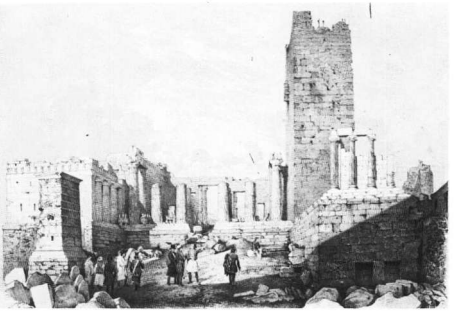
Pittakis did many different kinds of work on the Acropolis concerning himself with all of the monuments and the surrounding area. He continued both the work of demolition, removing upper levels of fill, and the excavations begun by Ross. He began with the Propylaia where in 1836 he took down the remains of the mediaeval palace, the Frankish vaults in the Pinakotheke and the Turkish vaults in the central building, and he dug out the floor of the building. In the two following years he excavated at the Erechtheion and the area between the Erechtheion and the Parthenon. Inside the Erechtheion Pittakis excavated down to the floor level of the Christian church, finding tombs in the south aisle and the huge cistern in the western chamber; he also excavated at various points around the Erechtheion where he unearthed the body and fragments of Caryatid 6 and the head of Caryatid 5. In 1838/39 there were excavations in the Propylaia east porch and the area east of the Propylaia was cleared as far as the west side of the Parthenon where important finds were made: fragments of sculpture, inscriptions and thirty statue bases. The area east of the Erechtheion was cleared and excavations in the pronaos of the Parthenon turned up inscriptions and reliefs. In 1844/45 work was resumed in the Erechtheion and the remains of the Turkish gunpowder magazine were removed from the North Porch. Excavations were also carried out in the area south of the Parthenon where inscriptions and frieze blocks were found and in the western approach to the Propylaia where a quantity of inscriptions turned up. In 1848/49 the

excavations proceeded northeast of the Propylaia as far as the Erechtheion. Pittakis' last large-scale excavations on the Acropolis were carried out in 1856-1860 when the southeast corner of the Parthenon was cleared for the site of a museum and areas inside the Propylaia, Parthenon and Erechtheion were excavated. The large cistern at the west side of the Parthenon was demolished and the stepped rock-cut retaining wall for the terrace west of the Parthenon was found. After all of this work Pittakis thought that excavations on the Acropolis were finished and done with. As a matter of fact, as Kavvadias later wrote about the excavations of 1856-1860 "the later structures were sufficiently cleared away, there were a great many finds and virtually the entire central part of the Acropolis had been cleared down to the rock floor." Pittakis also carried out extensive rebuilding and conservation projects; from 1837-1840 the following work was done on the Erechtheion: sections of the south and north walls were reerected; part of the southeast pier and an attached half-column on the west side; the other half-columns were consolidated; the columns of the North Porch and the southwest corner were consolidated; Caryatid 5 which had been mended up by Imhof was set back into place. In 1842-1845 Pittakis, working together with A. Rizos-Rangabé, carried out a rebuilding project on the Parthenon: some columns were reerected in the north and south colonnades and 158 blocks lying on the ground were set on the north and south walls of the inner building. The remains of the mosque, which had been built inside the Parthenon in the late 17th century, were removed. In 1843-1844 Pittakis finished rebuilding the temple of Athena Nike by completing the west and south walls, reerecting almost all of the architraves and the ceiling beams and ceiling coffers of both porches; he also made the floor waterproof and fenced off the monument. In 1850 Pittakis repaired and restored a part of the stairway leading up to the Propylaia beside the Nike temple, following a plan drawn up by the French architect Desbuisson. In 1854 he had the crepidoma of the Pinakotheke repaired. In rebuilding ancient monuments Pittakis simply used the ancient blocks lying around on the ground in a haphazard manner, without bothering to determine the exact original position of each block. He used iron fastenings and filled up the empty spaces between the blocks with ordinary bricks; he braced the columns with heavy iron rings.

Pittakis' main concern during all these years was collecting and saving the material lying around on the ground and the finds from the excavations. As early as 1833 Pittakis had begun to create the first archaeological collection in the Propylaia. During the following years he continued to collect pieces of architecture and sculpture which he had stored in the four classical buildings and in later structures which were still standing on the Acropolis.

Pittakis and his work in general, not only what he did on the Acropolis, received much more criticism than most of his contemporaries, Greeks and foreigners. Even his collaborator, the Constantinopolitan scholar A. Rizos-Rangabé accused him later on of being crude and unmethodical. These criticisms came from cultured circles, the educated classes in direct contact with Europe and mirror the conflict which arose in Greece, in the period of Otto's reign (1833-1863) between those westerners and their self-taught, somewhat provincial Greek colleagues. Judged by present-day criteria Pittakis' operations on the Acropolis are, no doubt, a far cry from scientific ethics and procedure, but his unique efforts in collecting and saving widely scattered ancient material will remain a precious contribution forever. Thanks to Pittakis' fanatical zeal a quantity of antiquities that otherwise would have been irrevocably lost have been saved and handed down to later generations for study and research. Even in rebuilding Pittakis did anticipate modern practice in some ways at a time when the principles of restoration had not yet been conceived. For example, he maintained respect for the original material by joining fragments together, scrupulously avoiding restorations with entirely new blocks and many of his rebuilt sections were provided with inscriptions giving the dates of his work.

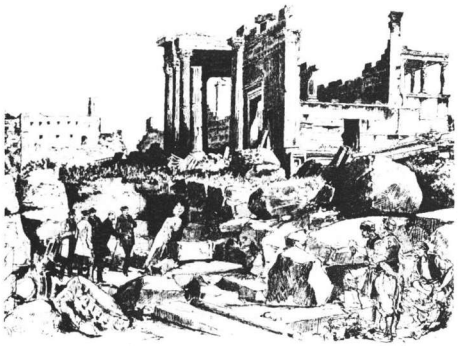
In Pittakis' time French archaeologists and architects, most of them pensionnaires from the French Academy in Rome, (Prix de Rome) were investigating, excavating and reconstructing Acropolis monuments. In 1846/47 the architect A. Paccard restored the Caryatid Porch with the aid of contributions from France; he put up columns to replace unsightly brick and masonry props between the Caryatids, which up to that time had supported the superstructure; Caryatid 6 was restored by the sculptor Andreoli and set in place; the Caryatid in the British Museum was replaced by a terracotta cast; the podium and architraves were clumsily repaired with new blocks in a way that was harmful to the ancient structure. In 1852/53 the archaeologist E. Beulé excavated west of the Propylaia. At the end of his investigations that led to the discovery of the Late Roman gate, which is now known by the name of its

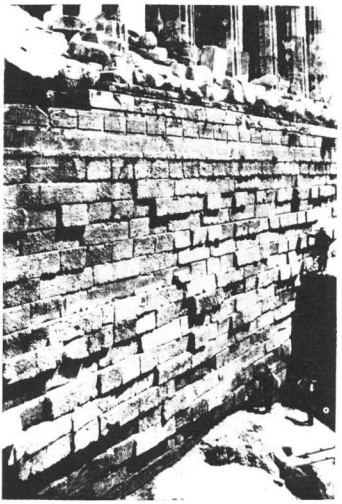


excavator, the greater part of the later fortifications on the western approach to the Acropolis had been cleared away. In 1862 the German archaeologist C. Bötticher was working on the Acropolis. He removed remains of the church apse from the Parthenon cella and excavated in and around the Erechtheion, going down to the rock floor and finding architectural blocks, fragments of the Erechtheion frieze and inscriptions. A year later the government decided to build a museum designed by the Greek architect P. Kalkos in the area southeast of the Parthenon. Construction started in 1865 and was finished in 1874.
The two most important interventions on the Acropolis between 1870 and 1885 were consolidation work carried out in the Parthenon and the demolition of the Frankish Tower. In 1870-1872 the following work was done on the Parthenon under the supervision of P. Eustratiadis, General Ephor of Antiquities: the lintel of the west door and the blocks above were reinforced by means of iron rods and a brick arch and rough masonry of stones and bricks; the Italian Martinelli carried out conservation work on the west frieze *in situ*. In 1875 H. Schliemann gave the funds with which to demolish the Frankish Tower "which was concealing part of the Propylaia west wing and marring the harmonious lines of the entire Acropolis." This undertaking was animated by a spirit of purism which went far beyond even von Klenze's proposals according to which the tower was to be preserved as a picturesque feature of the mediaeval fortifications of the Acropolis. The demolition of the tower aroused heated controversy in educated Athenian circles. In the second half of the 19th century in Greece there emerged a trend towards appreciating the mediaeval past as an inalienable link in the historical continuity of the nation and this led to taking a stand against annihilating the last significant mediaeval remains on the Acropolis. Between 1875 and 1885 there were small scale excavations and exploration, the most important of which were R. Bohn's investigation of the Propylaia and Athena Nike temple in 1880 and an excavation in the area between the museum and the east side of the Parthenon started by the Archaeological Society in 1882 and broken off a year later. These were the prelude to the final excavations of the Acropolis in 1885-1890 that yielded such astonishing unforeseen finds.

The large-scale excavation campaign on the Acropolis began northeast of the Propylaia on the 11th of November, 1885. The excavations were conducted by the Greek Archaeological Society, with a subsidy from the state, under the direction of P. Kavvadias who was, at that time, General Ephor of Antiquities. From March 1886 onwards G. Kawerau was the excavation architect. Kavvadias' programs had been planned in advance: excavations down to the rock floor all over the Acropolis; the rock floor and the preserved remains to be drawn up and, where necessary, photographed; then the excavated area is to be filled in with earth and with shapeless stones lying around in order to restore the ground level of classical times; noteworthy remains on the rock floor are not to be covered over but left visible; all of the later structures still remaining to be removed; all of the valuable architectural material to be arranged in marble piles; the material belonging to each of the four classical buildings to be picked out and placed near the building from which they come; the buildings are to be freed of extraneous material. Kavvadias unswervingly carried out this program without a break until 1890.

In 1886 the whole area from the Propylaia to the Erechtheion was excavated; there were many finds of terracotta figurines, pottery, sculpture, inscriptions. On January 24-25, 1886, fourteen of the famous archaic korai emerged near the southwest corner of the Erechtheion, tangible





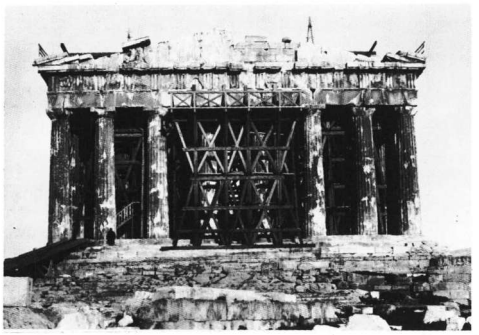
evidence of the Persian destruction on the Acropolis. Other exciting discoveries of those years were the classical stairway in the North Wall, the foundations of the Old Temple of Athena, and the first architecture and sculpture from the archaic poros limestone *oikemata.*
In 1887 the excavations continued east of the Erechtheion exposing the whole area down to bedrock as far as the southwest corner of the museum. In the course of this work the stair leading down to the Erechtheion North Court was constructed; the underground Turkish powder magazine called "Tholos" which had served as a storeroom for antiquities was demolished; the remains of the Mycenaean palace were found and also the crepidoma of the temple of Roma and Augustus, remains of Mycenaean walls and the *ergasterion* east of the museum.

In 1888 there was a excavation under the museum floor where the continuation of the Mycenaean circuit wall was found. The main excavation was in the area between the southwest corner of the museum and the east side of the Parthenon where the so-called "poros layer" with its masses of archaic poros limestone sculpture and architecture was unearthed. The excavation proceded to the area between the Parthenon and Acropolis south wall, reaching a depth of 10-14 metres, revealing the twenty-two courses of the Older Parthenon foundations at the south side and, further to the west, the foundations of the Chalkotheke.
In 1889 the excavation continued west along the south wall as far as the Propylaia; foundations of the buildings in the sanctuary of Brauronian Artemis were uncovered. In the same year the central area was cleared; various scattered pieces of architecture north of the Parthenon were put in order; excavations were made in the Parthenon opisthodomos at points where the floor slabs were missing in order to investigate the masonry of the foundations of Athena Nike. At the beginning of 1890 the area around the Propylaia was cleared as far as the Beulé Gate where the last remains of the Ottoman period were demolished. By February 1890 the Acropolis excavations had been completed. Filled with pride Kavvadias was able to announce in the *Archaeologikon Deltion:*
"In this final form Greece bequeaths the Acropolis to the civilized world - a testimony to the Greek genius, a venerable monument cleansed at last of all barbaric remnants, a unique repository of exquisite works of art from the ancient world, a constant inducement for all civilized peoples to work together in friendly emulation and apply themselves to the noble task of furthering archaeological studies."

The excavator's aims were fulfilled. The magnificent finds from the excavations enriched the Acropolis Museum and the National Museum and stimulated research not only on Acropolis monuments but also on all of ancient art.

In 1894 the Acropolis monuments, especially the Parthenon, were injured by a strong earthquake which led to the decision to mount a rescue operation. From 1894 to 1898 when the work began there was controversy as to the extent of the work to be carried out on the Parthenon and how it was to be done. An international committee was organized made up of the architects L. Magne, J. Durm and F. Penrose who drew up the first analytical reports concerning the problems affecting the Parthenon and the method of dealing with them. The exchange of views on the question of restoring the Parthenon led to some basic decisions, such as that reconstruction would be ruled out and that the operations would be confined to consolidating the structure. In certain cases ancient blocks would be replaced and new material added. The work was to be done "according to the ancient method" using iron clamps and dowels sheathed in lead or cement mortar.

In 1898 work began on the Parthenon under the supervision of the civil engineer, N. Balanos, and went on until 1902. Conservation was carried out on the capitals and architraves of the west porch, the backers of the west frieze, on the capitals and architraves of the west colonnade, on both corners of the west pediment and on the northeast corner of the east pediment which were taken apart and set back in place.



During the following years N. Balanos proceeded to work on the other Acropolis monuments. From 1902-1909 Balanos did extensive work everywhere in the Erechtheion. In the North Porch, all of the architraves, the greater part of the frieze and the cornices were put back into place and the roof was rebuilt; on the west side most of the entablature was repaired; work was done on the east side; most of the south wall was reerected; in the Caryatid Porch clumsy and faulty parts of Paccard's operations were corrected, the Caryatids were given conservation treatment and all of the ceiling coffers were put in place.

From 1909 to 1917 Balanos worked on the Propylaia: in the east porch the architraves were set in place; the northeast corner was reerected; the northern part of the coffered ceiling was rebuilt. In the central passage the southeastern Ionic column was reerected and also the top course of the door wall which enabled him to rebuild the southeast corner of the ceiling.

In 1921 Balanos proposed rebuilding the Parthenon north colonnade with the entablature, using the ancient material lying around on the ground with the addition of new column drums to be made with a core of poros limestone sheathed in reinforced cement. This proposal gave rise to much discussion amongst archaeologists and architects in Greece and abroad. Reactions varied between outright rejection of the proposal on the basis of aesthetic and historical criteria to acceptance with reservations and observations concerning the necessity for fuller documentation before the operation in order to determine the correct locations for the disiecta membra, and questions about how much was to restore and what material was to be used. In the end Balanos' proposal was approved.

Work started in 1923 and by 1933 the following had been accomplished: the whole north colonnade and part of the south colonnade rebuilt and restored; repairs carried out on the east pediment and the east porch; the arch inserted in the west doorway in 1872 was taken down and it was replaced by a lintel of reinforced cement; during the Pittakis - Rangabé operations the inside north and south walls had been faced with bricks which were now removed.

Except for the colonnades Balanos used Pentelic marble in piecing together ancient blocks and for completely restored blocks. He used iron clamps both for fastening ancient fragments together and to attach new marble repairs to ancient fragments; the iron clamps, either crudely sheathed in lead or not sheathed at all were covered with cement mortar. In many cases very long thick iron beams were embedded in ancient blocks for static reasons.

Balanos was working at a time when a new debate on the problems of restoring monuments had arisen in Europe.

As early as 1883 C. Boito, an Italian engineer, had formulated the first principles of scientific and judicious conservation of monuments; he maintained that respect for the historical character of a monument requires that it not be altered; that conservation and repair is needed rather than rebuilding which should be done only where absolutely necessary, using as few new additions as possible; that added new material must be clearly distinguished from the ancient fabric; that every phase of the operation should be recorded; and that there should be a scholarly publication at the end. These theses, later augmented and elaborated according to new desiderata that had in the meantime emerged, were to become the basis of the Charter of Athens in 1931, the first formal, internationally valid document on restoration.

These new concepts, reflected in the discussions and clashes which preceded the two projects for rebuilding the Parthenon, obliged N. Balanos - together with P. Kavvadias and the German architect W. Dörpfeld (who was at the time the investigator of Acropolis monuments par excellence) - to formulate, at least theoretically, guidelines before starting *anastylosis.* It was the first time that this had been done in Greece and the guidelines were as follows: to collect the preserved architectural blocks, to mend them up or repair them in a suitable manner and reset them in place. New material to be used only where absolutely necessary.

Balanos, however, often did not practice what he preached. Consciously continuing the work of nineteenth century classicism and wishing "to provide a more complete picture (of the monuments) as if they had undergone less devastation" and to extol them "by restoring a part of their former grandeur" he proceeded to rebuild large parts of the buildings using the available ancient material without going to the trouble of finding out where each block belonged. He also pieced together architectural blocks (column capitals and ceiling coffers in particular) by joining ancient fragments of uncertain provenience; he did not even hesitate to cut down the broken fragments in order to obtain flat surfaces for the forcible joins, thus displaying an indifference to ancient architecture which had disastrous consequences. Ancient architectural blocks were further marred by many new cuttings especially by deep cuttings which removed a great quantity of the ancient marble in order to insert iron clamps and beams.

Today's all critical assessment of Balanos' work stresses the unlimited use of iron which rusted and swelled in a

very short time as the atmospheric conditions deteriorated, thereby shattering the marble and inflicting terrible damage. In using iron to fasten blocks or fragments together Balanos should indeed have paid more attention to the damage in the Caryatid Porch caused by Paccard's use of iron components, which Balanos had had to replace with brass, and he should have listened to those voices (a small minority) who opposed the use of iron. The criticisms of Balanos' work are justified in this respect.

Balanos should not be blamed, however, for using reinforced concrete for large sections of the monuments and for creating new bearing systems. Balanos, who was a graduate of the famed Ecole des Ponts et Chaussées, was simply following the best contemporary practice and he applied the technology of the time in a way that was most impressive for the level of technical expertise in Greece at that time. At the international conference ICOM at Athens in 1931 Balanos' work on the Acropolis met with a consensus of approval; Article 4 of the Charter of Athens, drawn up during the conference, proclaimed the reliability of the new technique of reinforced concrete and confidence in its effectiveness as applied to *anastylosis.*

Balanos restorations were the last drastic operations on the Acropolis and they gave the Acropolis the form it has today. The only large - scale operation in the following years was the second rebuilding of the temple of Athena Nike in 1935-1940. This intervention was necessitated by the discovery, determined by research carried out in 1934, that both the temple foundations and the foundations of the Nike Bastion were in an alarmingly poor state of

preservation. The preliminary dismantling of both temple and bastion made it possible to carry on archaeological investigations inside the bastion, leading to the discovery of the remains of earlier cults. Up until 1939 Balanos was in charge of the operations where he followed the same technical procedures as before. In 1940 Balanos was succeeded by A. Orlandos who had studied the architecture of this exquisite temple in depth. In the earlier operations of 1834/35 and 1843/44 wall blocks and architraves had been wrongly laid; these and other errors Orlandos was able to correct.

Orlandos, a pioneer in the field of Greek architectural history, directed work on the Acropolis for the next twenty years. The following work was done on the Propylaia under his supervision: rebuilding of the southwest wing in 1947-1957 in the course of which the last remains of the Frankish Tower were removed and the southwest column, the neighbouring anta and the central pier were reerected; the architrave was reset in place with the aid of a non-oxidizing steel bar; in 1956 the poros limestone foundations of the Pinakotheke walls were consolidated. The presentday ascent via a ramp was laid out on the basis of recent finds by American scholars. Orlandos planned to restore the ceiling of the Parthenon west colonnade in marble. A proposal repeatedly under review from 1942 to 1960; from time to time it was approved as in 1950, when the ceiling beams and coffers were carved, and again in 1960, but it was never carried out. A. Orlandos, the last one to carry out interventions according to puristic ideas, began in 1953 to demolish the christian spiral stair in the Parthenon but this work was rapidly stoped. In 1960-1964, in order to protect the building from rain water, he had the side doors of the christian church sealed off and he restored the floor paving in marble and the crepidoma in poros limestone.

By the 1940's the first disastrous consequences of the ill-considered use of iron in Balanos' restoration had already become evident. In the following decades the monuments deteriorated rapidly as new sources of trouble were added on to the primary problem of rusting iron. The new problems were static sufficiency; physical, chemical and biological changes in marble surfaces due to atmospheric pollution; antiseismic protection. Beginning in 1965 the Archaeological Service attempted to cope with the situation by means of the usual procedures for conservation and preservation, such as reattaching fragments with brass clamps and Meyer's stone cement, sealing up joints with cement mortar, replacing the visible iron clamps with brass ones and draining off rain water. By 1975 everyone had become aware of the fact that these methods were not sufficiently effective and that a more drastic intervention would be necessary. The Greek government established an interdisciplinary organization, The Committee for the Preservation of Acropolis Monuments, which continues efforts to save the monuments on the Sacred Rock.

MARIA CASANAKI, FANNY MALLOUCHOU

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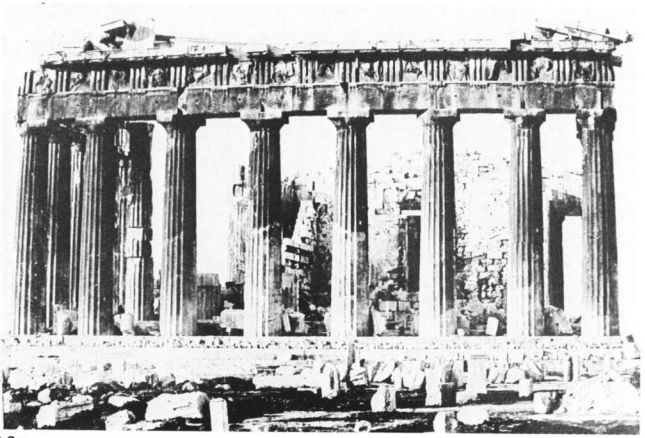


I.3a

I. Historical photographs

1 a. General view of the Acropolis from the northwest. The scaffolding on the Propylaia was put up for Balanos' restoration.
Photographic archive B. Boissonas.

2 a. Propylaia.
View taken from the east before the Frankish tower was demolished in 1876.
N. Balanos archive (Greek Archaeological Society)

b. Propylaia
View from the southeast before Balanos' restoration.
Photograph collection, German Arcaeological Institute, Athens

c. Propylaia
View from the southeast after Balanos' restoration.
Photograph collection, German Archaeological Institute, Athens

d. Propylaia
View from the east after Balanos' restoration.
Photograph collection, German Archaeological Institute, Athens

3 a. Parthenon
View from the east. The photograph, taken before 1860, was presented by the photographer N. Panayotopoulos and preserves invaluable information about architectural and archaeological features now lost. Negative: 27x37 cm. The following details are of special interest:

1. The west door before the brick arch was added in 1872.
2. The lowest part of the apse of the Christian church which remained in place until 1862 when it was demolished.
3. Architectural members of the east porch lying where they were when they fell to the ground; many of these have now been identified.
4. The rate of weathering. By comparing the weathering then with the weathering now it is possible to estimate the rate at which the surfaces are being corroded.
5. The condition of the pediment after Elgin's operation and before later restorations.
6. The crepidoma used to exhibit the sculpture collection at a time before the Acropolis Museum (put up in 1868 by P. Kalkos) had been built.
7. The wall-paintings of the Christian church still clearly visible on the inside of the west wall.

b. Parthenon
The interior of the building after Balanos' interventions in 1926-1927.
Photograph collection, German Archaeological Institute, Athens

c. Parthenon
View from the northwest before the north colonnade was rebuilt.
Photograph collection, German Archaeological Institute, Athens

d. Parthenon
View after the north colonnade was rebuilt (1923-1930).
Balanos archive (Greek Archaeological Society)

4 a. Erechtheion

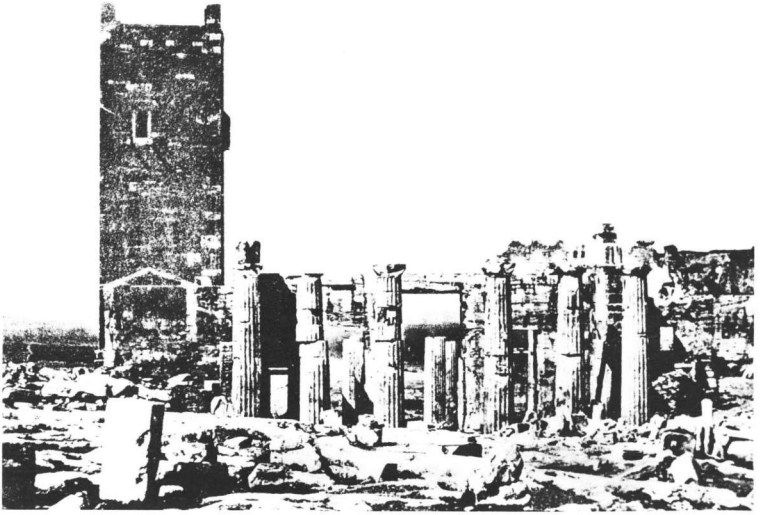
1. The Caryatid Porch after Paccard's rebuilding (1864)
2. The Caryatid Porch after Balanos' rebuilding (1908)

Balanos archive (Greek Archaeological Society)

b. Erechtheion
Rebuilding of the Caryatid Porch by N. Balanos (1908)
Photograph collection, German Archaeological Institute, Athens

c. Erechtheion
View from the southwest before Balanos' rebuilding.
Balanos archive (Greek Archaeological Society)

d. Erechtheion
View from the southwest after Balanos' rebuilding (1902-1909)
Balanos archive (Greek Archaeological Society)



I.2a

I.2d

I.3c

I.3d

I.4c

I.4d

II.2c

II. Consolidation of the Acropolis rock Setting up walkways on the Acropolis

II. Consolidation of the Acropolis rock. Setting up walkways on the Acropolis.

From the beginning the program of the Acropolis Committee included an intensive study of the entire Acropolis rock mass, diagnosis of the causes of deterioration and taking steps to cope with them. The Rock was seen as a monument in itself, as the natural pedestal for the architectural ensemble and as preserving evidence for age-old settlements and cults. The Committee adopted the hard-and-fast rule that in no case whatsoever should the rock formation be changed in any way. This guideline had not been followed in the past. During the 1930's N. Balanos constructed massive walls to buttress the rock slopes in danger of collapsing. This operation not only changed the rock formation but also obstructed further observation of progressive deterioration. In 1976 a special study of the hydrogeologic and seismological behaviour of the Acropolis rock showed that fears about instability and erosion from underground water sources were unfounded. A preliminary geotechnical study carried out in 1977 revealed that the condition of the rock mass as a whole is generally satisfactory and stable; it did, however, designate 22 areas around the Acropolis slopes that are in danger of landslides and require immediate consolidation.

Pieces of rock loosen and create the danger of landslides because the top layer of limestone and the underlying layers of conglomerate and marl are eroded and undermined. This process is hastened by the action of plant and tree roots and by the unchanneled rainwater running off the slopes.

The work of consolidating the Acropolis rock in the 22 unstable areas began on the North Slope in 1977 and continues without a break until the present time. The consolidation work has two phases, first temporary buttressing and then the final treatment. In order to gain access to the cliff a stepped adjustable scaffolding was constructed. All the areas where consolidation was carried out were drawn up at a scale of 1:20.

During the first phase the parts of the rock in danger of falling are contained by means of wire netting; earth, roots and any material causing the rock to disintegrate are cleared away. The cracks are also cleaned out and filled in with mortar based on highly durable cement. In order to channel off the rainwater terracotta drainage pipes are installed in the crevices before they are sealed off. The crevices are then covered with white cement mortar gradually adjusted to the colour of the rock.

The final consolidation of unstable rock is done by means of anchoring in the mass of rock. An electrically operated rotating drill is used to open up the holes in which the anchors are installed. The drill can bore to a depth of 35 metres and is made fast on the scaffolding and on the rock face. While the hole is being drilled samples are taken in order to test the rock. By observing the speed with which the cutting edge of the drill bores through the rock and by studying the cores it is possible to determine how much the rock has disintegrated and the mechanical strength of the various types of stone. The static study is based on these results. After the hole has been drilled tests are made to determine if the stone is watertight. Whenever considerable seeping is determined, cement is injected thereby rendering thes one watertight and improving its mechanical properties.

The data required for the static study are derived from this investigation. The most suitable treatment for Acropolis limestones is a combination of anchoring at specific points and anchoring along the entire length, using rods of ribbed steel that adheres two and a half times better than

smooth steel. The anchoring is done under tension so that consolidation is in operation from the beginning. The anchoring rod with a cone at the tip is inserted down the hole; the cone is unscrewed from above, opens out and gets a firm grip on the rock at a point where it is sound (anchoring at a specific point). The anchor plate is screwed on at the surface and the anchor rod placed under tension. The anchor head and rod are made of an alloy of stainless steel with chrome, nickel, molybdenium and titanium in proportions of 18/10/2/0.5. The resistance of such alloys to oxydation, when they are under pressure, has been tested and it has been found that they do not oxydize in cases of minor cracks. The ends of the rods are fitted with sockets so that they may be linked and reach the desired depth. The space between the rod and the rock wall is filled with cement mortar which insures anchoring along the entire length and helps protect the anchor from corrosion.

The Acropolis Committee is not only carrying out an investigation of the stability of the rock mass but also is facing the problem of protecting the top of the plateau and putting in order the architectural blocks lying all over.
The way the Acropolis looks today with the foundations of classical buildings left visible above ground and hundreds of architectural blocks scattered over the whole area is the result of the systematic excavations of the Acropolis at the end of the 19th century. The removal of much of the earth fill covering the natural rock. laying bare virtually the entire surface of the rock, exposed archaeological features of great interest to various forms of deterioration. Ancient cuttings in the rock floor, made as beddings for bases or foundations, and the marks of ancient walkways threated to disappear under the footsteps of the thousands of visitors tramping over the Acropolis every day.

The program for protecting the rock surface aims to save these invaluable ancient traces and cuttings, to facilitate circulation of visitors around the Acropolis and to make the archaeological area easier to understand. The traces of the ancient paths and gathering places on the Acropolis have been determined in a study (1977) which proposes that they be approximatively reestablished. The ancient paths have now been freed of the heavy architectural members which have been photographed, drawn up and arranged in marble piles. Two walkways have been created for visitors; one, five metres wide, goes from the Propylaia entrance at the northeast corner of the Parthenon, and the other, three metres wide, goes parallel to the west side of the temple (1978). In June 1981 the footholds of the Mycenaean ascent at the Nike bastion were covered over. After the completion of this program, which will not appreciably alter the present appearance of the area, visitors will be able to view the monuments under considerably more favourable conditions.

The ancient Peripatos was studied and a plan to restore it was worked out; this work has not yet been completed. The Peripatos was a very old road about 1100 metres long circling the Acropolis at the base of the rock. An inscription of the 4th c. B.C. carved on a boulder at the north east corner of the rock preserves the name of the road and its length in stades:
[τ]οῦ περιπάτο[υ] / περίοδος / π[έντε] σ[τάδια] πόδες ΔΠ III
The Peripatos, which linked the sanctuaries founded on the upper slopes, joined the Panathenaic Way where it ended at the entrance to the Acropolis.

1. Geological study
The geological strata of the Acropolis rock. Epicentres of earthquakes and their intensity in Attica and surrounding areas.
Study carried out by the Institute of Geological and Mining Research, 1976.

2 a. Consolidating the Acropolis rock
1. Rock heavily undermined by erosion in danger of breaking off at the southeast corner.
2. Limestone boulders broken off from the main mass of rock on the northeast slope ("Anaphiotika") before intervention.

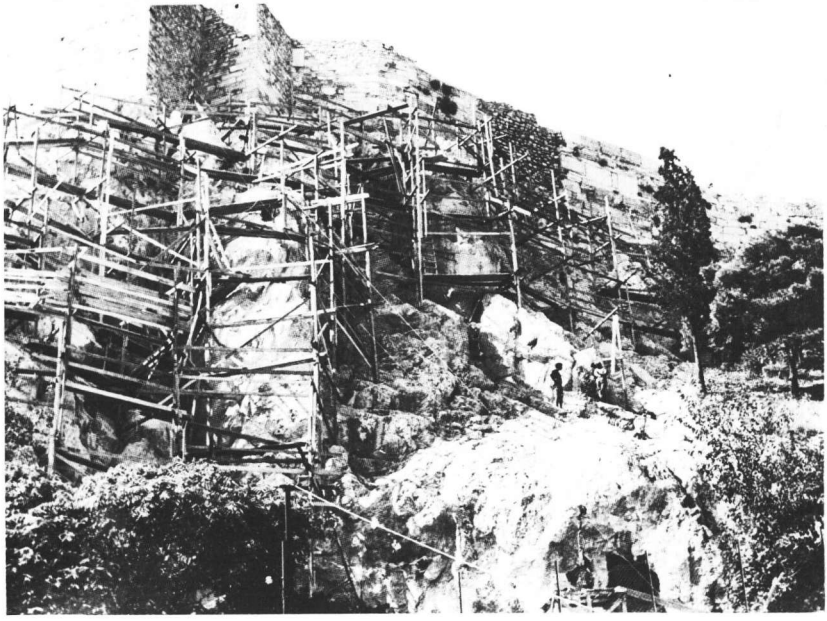
b. Consolidating the Acropolis rock
1. Unsafe rock temporarily secured with wire cables.
2. Sections of detached rock on the north slope at the entrance to Mycenaean Spring House.

c. Consolidating the Acropolis rock
1. The drill made fast on the scaffolding during boring operations.
2. Anchoring rod with the anchor head about to be placed in the drilled hole.
3. Two four-metre anchor rods connected by a muff.
4. The anchor plates after putting the anchors under tension. The wire cables used as temporary safety measures will be removed afterwards.

d. Consolidating the Acropolis rock
View of the work site

3 a. Acropolis
The Acropolis and the Peripatos in the 2nd century A.D.
Study by J. Travlos (1981)

b. The Acropolis walkways
1.2. The central walk before and after it was covered over with a thin layer of mortar.
3. The central passage of the Propylaia being covered over with a boardwalk.
4. Transporting scattered architectural blocks on the Acropolis.



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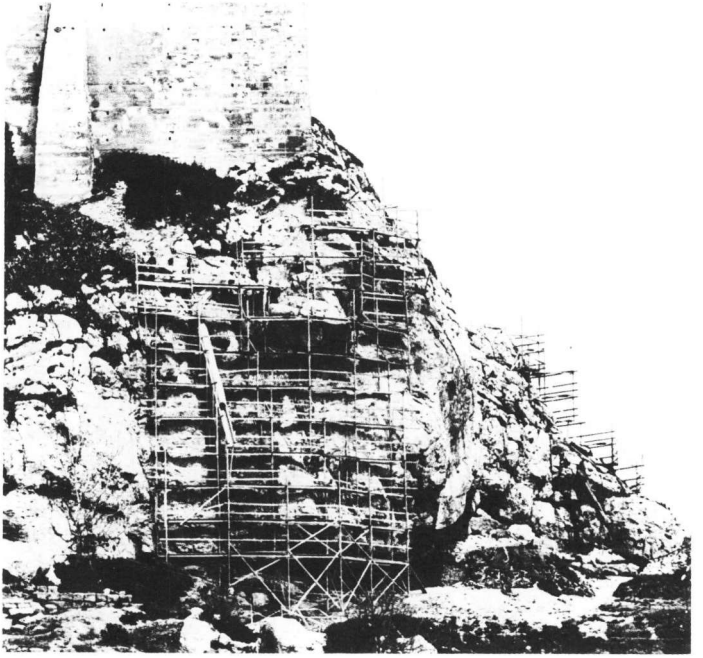

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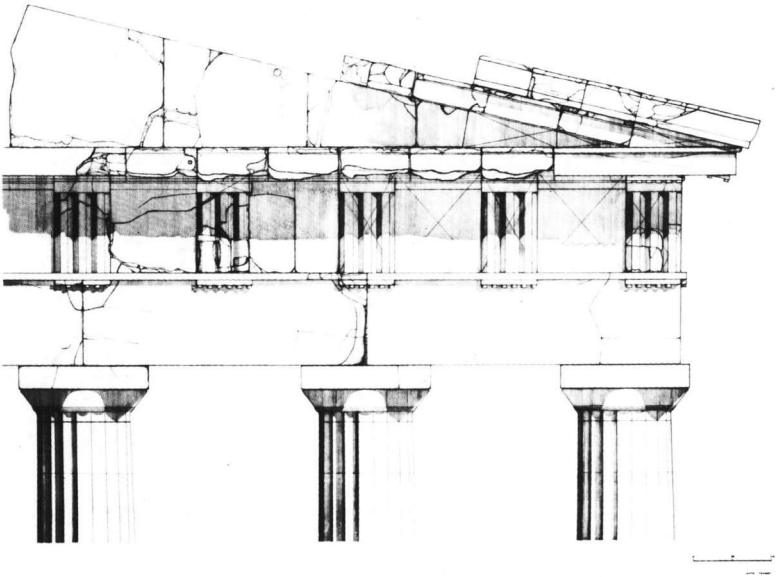

III.12

III. Documentation

III. Documentation

Directly after the Acropolis Committee was founded in 1975 it launched a wide-ranging program of documenting the status quo, aiming at complete knowledge of the monuments before any intervention whatsowever was carried out. The program comprised: detailed measurements and plans and drawings; photography and photogrammetry; description of the condition of the monuments as they are today; a standard system of recording all infromation; a card file of the bibliography; collecting and classifying photographs and drawings in archives and libraries. The program also provided for: static analyses and testing for strength and stability; use of gammaray photography and ultrasonics in order to determine the precise positions both of the iron attachments embedded in the buildings and of internal cracks; laboratory research on the phenomena of chemical and biological changes affecting marble surfaces; laboratory determinations of the strength of marble. This research produced a wealth of data and we may say today that our knowledge has attained significant advances in all of these fields.

The current project of measuring and recording the Acropolis buildings aims principally at providing the background of practical information required for the intervention; the project also contributes to archaeological and architectural investigations. Two essential guidelines have been adopted since this documentation is the basis of all work of consolidation and restoration and there is a greater need of accuracy in recording details: a) A fixed system of coordinates to be used in measuring. In this way the exact position of each architectural member or whole structures may be determined, thus ensuring reversibility of the restoration on the documentary level. It also makes it possible and periodically to check spots or areas where deformations are developing (geometric changes, mechanical changes, deterioration of the surface). b) Providing for the greates possible accuracy in measuring and reducing the margin of error to the minimum. Measurements are taken with all care and precision in the shade, checking to see that the taped measures are under fixed tension; various methods are employed to suit the individual peculiarities of the architecture to be recorded.

The work of recording the Erechtheion began in 1977. For the fixed system of coordinates a three-dimensional grid with units of one meter was used; it is based on fixed trigonometric points on the Acropolis rock. The grid was established by means of topographical methods and high-precision instruments (spirit level, theodolite). The same methods were used for work on the Propylaia which began in 1979.

Photogrammetry was used for the interior surfaces of the Erechtheion south and west walls where the type and extent of the damage could not be gauged by means of classical methods. Photogrammetric recording gave the general morphology of the surface and the damage from fractures; however, finishing touches were added by means of conventional measuring systems in order to supply specific information such as determining contours, the position of the joints, preserved original surfaces and restorations, signs of later operations. This experience taught us that the potentialities of using photogrammetry for recording ancient monuments ought to be investigated, a method which up until now has produced satisfactory results in plotting the contours of ancient sculpture, in surveying archaeological areas and in recording architecture of later periods. In 1971 and 1974 French specialists did he first photograpmmetric recording of Acropolis monuments. The drawings are kept in the Institut National Géographique in Paris.

The project of recording the Parthenon began in 1979 and is now in progress. The Parthenon floor provides the fixed system of coordinates used in measuring, i.e. the lines of

the outer edges and the joints of the colonnade stylobate and of the cella stylobates and toichobates. This system was preferred because it was found that no precision instruments could produce a system of lines finer and straighter than those of the Parthenon itself. On the basis of this system the original geometry of the superstructure was calculated by means of direct accurate measurements.

In recording complex Parthenon forms, such as sculpture or fragmentary column drums, three different systems were used: a three-dimensional orthogonal coordinate system, orthographic projection and the stereopantograh, a new articulated instrument by means of which not only outlines but also all contour lines may be drawn to varying scales. The interior structure of the great temple was also investigated and it was possible to measure blocks and parts of the building in inaccessible places by means of mirrors and steel wire. From the summer of 1983 onwards electrically operated endoscopes were used.

Special tracing paper was used for plans and drawings, non-expanding so as to avoid alteration in scale and waterproof to eliminate irreparable distortion from water. The accuracy of the grid was maintained by using non-expandible perforate metal sheets. A scale of 1:50 was mostly used for general plans and drawings; section plans and details were drawn up at scales ranging from 1:20 to 1:1. Measuring and drawing up details were done at the same time on the site, thus ensuring a high degree of accuracy.

Since up until now no adequate record of the Acropolis rock floor had been made, a detailed record of the rock surface inside the circuit of the Acropolis wall was deemed indispensable. In 1976 the topographical survey was carried out by staff of the National Pōlytechnic University of Athens. Horizontal measurements done by triangulation and vertical measurements done with the level were integrated in the official topographical grid of the country; a network of fixed points was established and the ground plan was drawn up at 1:100.

Recording and documenting the Acropolis wall is a part of the project. This wall, which served both as precinct and fortification wall, is all the more valuable because of the great quantity of material from archaic Acropolis structures built into it, a circumstance which makes the lack of adequate measurements and plans all the more noticeable. The project provides for investigating the building periods of the wall, locating and studying the poros limestone and marble blocks reused in the walls, and examining the static sufficiency of various sections. In 1980 parts of the north wall were recorded.

In 1978 the work of drawing up and recording the Theatre of Dionysos, the oldest in the world, on the south slop of the Acropolis began and is still in progress. The project for the theatre includes recording the auditorium, the orchestra and the retaining walls and the definitive study which will deal with all the problems of conserving the monument.

In the course of investigating the static sufficiency and means of protection from earthquakes it became evident that it would be necessary to examine the internal conditions before beginning any kind of intervention. We needed a method that would allow us to assess internal damage and the causes of diminished static strength without harming the building. The current methods of radiography and ultrasonics were employed for this purpose. Radiography consists of taking photographs by means of gamma rays with cobalt as the radiation source; radiography was applied to marble for the first time. The gamma rays pass through the architectural members and produce a kind of X-ray image in which it is possible to make out cracks and internal breakage and also iron attachments

embedded in the marble. Radiography was carried out in the Erechtheion on the central section of the south epistyle of the Caryatid Porch and on the south and west walls.

In applying the radiography method to marble it was found that the maximum thickness penetrated by gamma rays is 65 centimeters. For this reason the method of ultrasonic measurements was used on the Parthenon to examine the mechanical properties of the opisthodomos epistyle blocks and to estimate the depth of the cracking. The method is based on measuring variations in velocity or echo of transmitted supersonic waves. The data produced by applying these two non-destructive methods are used to make drawings showing structural features, geometric changes and structural damage. This survey allows us to understand and evaluate the structural condition of the buildings and constitutes the basis of the reports on static sufficiency and protection against earthquakes.

Photography is widely used for documenting reports and the work of restoring the Acropolis monuments. Photography contributes greatly to a diachronic study of the monuments. Old photographs, collected from various archives and libraries, provide valuable information concerning the earlier states of preservation, especially before the restorations carried out at the beginning of the 20th century; by comparing earlier photographs with recent ones we may follow the course of various phenomena, e.g. cracking and surface deterioration. While operations are under way every phase is thoroughly photographed: dismantling, conservation and reerection. The structural, architectural and archaeological evidence that comes to light during the dismantling process, along with the surfaces previously hidden from view, receive particularly careful photographic documentation. Conservation treatment given to isolated blocks is also recorded. Maintaining the principle that every intervention should be reversible depends largely on the photographic records.

Photography is also used in making a file of scattered architectural and sculptural material and photography is an auxiliary aid in drawing up certain sections of buildings exhibiting fortuitous damage. Low level aerial photography from a balloon has been carried out for the first time by the staff of the Photogrammetry Laboratory of the National Polytechnic University at Athens. The results were not entirely satisfactory. These aerial photographs, nonetheless, were used in combination with the basic topographical plan by P. Kavvadias and G. Kawerau to create a photomosaic of the Acropolis area at a scale of 1:200.

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Analytical documentation of conservation and restoration and keeping the records in an archive open to researchers is in accord with Article 16 of the Charter of Venice. The Acropolis Committee attached special importance to creating an archive which would be qualitatively and quantitatively complete, including full documentation of the existing state of the monuments and the current operations.

From the beginning, all of the newly produced records were classified and filed in the archive, i.e. plans and drawings, inventory of the architecture, rough drafts and original manuscripts of general or specialized studies concerning restoration, the day-books of the various projects. The archive comprises a photography department, slide collection and both films and videotapes. It was also tried to collect copies of plans and photographs, everything having a direct bearing on the Acropolis project, from other archives, photograph collections and libraries.

A library was also built up comprising special monographs, a file of the sources, bibliography on the history, architecture and earlier restorations of Acropolis monuments, scholarly articles and publications, and a department for press clippings and articles on current work on the Acropolis appearing in newspapers and magazines.

1 a. Topographical work on the Acropolis
Photogrammetric recording of the Acropolis and the immediate vicinity.
Copy from the Institut Géographique National in Paris-Unesco, 1971

b. Southeast slope of the Acropolis
Topographical measurements based on the plan by I. Bandekas. Network of fixed points used in surveying the Theatre of Dionysos and vicinity.
Reproduction; scale 1:200
Measurements made by K. Cazamiakis and G. Vasilaras

2 a. Erechtheion
Method of marking off the measurement grid in relation to fixed trigonometric points on the Acropolis rock. Use of polar coordinates.
China ink; 1.06x0.55 m.; scale at 1:75 and 1:250
By A. Papanikolaou (1976)

b. Erechtheion
1-4. Method of marking off the measurement grid in squares 1.00x1.00x1.00 m.
China ink, 0.21x0.29 m.
By A. Papanikolaou (1977)

3. Erechtheion. Caryatid Porch
Drawing of south façade based on three-dimensional grid with units 1.00x1.00x1.00 m.
Pencil drawing; 0.83x1.16 m.; scale 1:10
By E. Moutopoulos (1975)

4a. Erechtheion, Caryatid Porch
Recording the upper surface of the ceiling coffers with grid units 1.00x1.00x1.00 m.
Pencil drawing; 0.85x0.52 m.; scale 1:10
By E. Moutopoulos (1976)

b. Erechtheion. Caryatid Porch
Recording the lower surface of the coffered ceiling using grid units 1.00x1.00x1.00 m.
China ink; 0.90x0.58 m.; scale 1:10
By A. Papanikolaou (1976)

5 a. Erechtheion. Caryatid Porch
Ceiling coffers. Drawing of iron rods inserted during Balanos' restoration, using data derived from radiography.
Pencil and China ink; 0.89x0.55 m.; scale 1:10
By E. Moutopoulos and A. Papanikolaou (1978)

b. Erechtheion. Caryatid Porch
Radiography carried out on the coffered ceiling.
By L. Hadziandreou and G. Ladopoulos of the Demokritos Nuclear Research Centre (1976-77)

6. Erechtheion. Caryatid Porch
Recording the podium on a three-dimensional grid 1.00x1.00x1.00 m.
Pencil drawing; 1.15x0.82 m.; scale 1:10
By E. Moutopoulos (1975)

7. Erechtheion. South wall
Photogrammetric survey of the westernmost section of the interior.
China ink; 0.76x1.15 m.; scale 1:10
By A. Papanikolaou (1976)

8. Erechtheion. South wall
Drawing of the westernmont section of the interior on the basis of the photogrammetric survey supplemented by observations made on the spot.
Pencil drawing; 0.86x1.16 m.; scale 1:10
By E. Moutopoulos (1976)

9 a. Erechtheion. South wall
Disfigured blocks analytically measured from a vertical plane parallel to the wall.
China ink; 1.05x0.57 m.; scale 1:25
By A. Papanikolaou (1976)

b. Erechtheion. South wall
Drawing of the west block of the wall crown
China ink; 1.16x0.54 m.; scale 1:2
By M. Korres (1975)

10. Propylaia
1-2. East front, elevation and section through the axis. Actual state. Visual recording on the basis of plans by R. Bohn. Balanos' restorations are indicated.
Reproduction; 0.88x0.40 and 0.88x0.52 m.; scale 1:50
By A. Papanikolaou and A. Tzakou (1975)

11. Propylaia. East porch
A section of the floor.
China ink; 1.14x0.83 m.; scale 1:10
By V. Karkanis (1975)

12. Propylaia. East porch
Coffered ceiling. Horizontal geison.
Pencil; 0.80x1.10 m.; scale 1:10
By A. Tzakou, P. Moutopoulou (1983)

13 a. Propylaia. East porch
Section of entablature, west side.
China ink; 1.14x0.46 m.; scale 1:10
By A. Tzakou (1980)

b. Propylaia. East porch.
Recording the upper surface of the entablature (2nd epistyle from the south)
China ink; 1.22x0.50 m.; scale 1:10
By A. Tzakou (1980)

14. Propylaia. East porch
The ceiling coffers.
China ink; 0.80x0.70 m.; scale 1:10
By A. Tzakou (1982)

15. Parthenon
1. Section of the west frieze
2. West pediment group, Cecrops and his daughter
China ink; 1.00x0.35 and 1.00x0.47 m.; scale 1:100
By A. Papanikolaou (1976)

16. Parthenon. East pediment
The south wing of the pediment, actual state
China ink; 1.06x0.80 m.; scale 1:10
By M. Korres (1980)

17. Parthenon. East pediment
Geometric changes in the geison blocks at the south end of the pediment
China ink; 1.10x0.84 m.; scale 1:20
By M. Korres (1980)

18. Parthenon. Program 1. Restoring the east façade
Restoring the southeast column to its original position. Study of the basic mechanical system of transposition and restoring the column to its original position. Plan and elevation from the north.
China ink; scale 1:10
By M. Korres (1981-1982)

19 a. Parthenon
Plan at the level of the orthostates.
China ink; 1.20x1.50 m.; scale 1:50
By M. Korres (1978-1982)

b. Parthenon
Plan of the superstructure. Present condition
China ink; scale 1:100
By M. Korres (1980)

20 a. Parthenon. East colonnade
The horizontal geison
China ink; 1.08x0.63 m.; scale 1:10
By M. Korres (1981)

b. Parthenon
Restoring ceiling beams of the north colonnade.
China ink; 1.10x0.35 m.; scale 1:20
By M. Korres (1976)

21. Parthenon
Epistyles at the southeast; measurements taken before and after the earthquake of February 2nd 1981.
China ink; 0.64x1.03 m.; scale 1:20
By M. Korres (1980-1982)

22. Parthenon
Southeast corner at the level of the cornice blocks.
China ink; scale 1:10
By M. Korres

23 a. Parthenon
The west door wall before and after Balanos' restoration.
China ink; 0.58x0.39 m. and 0.58x0.39 m.; scale 1:50
By M. Korres (1980)

b. Parthenon
Recording the northeast corner. Changes and distortions are indicated.
China ink; 0.55x0.55 m.; scale 1:20
By M. Korres (1981-82)

c. Parthenon
Securing the northeast corner of the entablature after the earthquakes of 1981

24 a. Parthenon. Western colonnade
Column from inner colonnade drawn by means of a stereopantograph
China ink; 1.03x0.73 m.; scale 1:2
By M. Korres (1978)

b. Parthenon
The stereopantograph used to record column drums
Study for the construction of a stereopantograph.
By M. Korres and B. Karkanis

25. Parthenon. Western colonnade
Section of third column from the north showing shell and bullet marks
Pencil; 0.65x0.90 m.; scale 1:4
By M. Korres

26 a. Acropolis North Wall
Surveying a section of the North Wall from the northwest corner as far as the classical stairway and postern.
Building phases of the wall are indicated.
Reproduction; 0.80x0.26 m.; scale 1:200
By Th. Papathanasopoulos (1981)

b. Acropolis North Wall
1. Section of the North Wall from the North Wall Building (so-called Arrephorion) to the Turkish buttress which was rebuilt in the last century. Later additions to the wall are visible.

2-3. The North Wall above the caves of Pan and Apollo with the scaffolding set up for the survey and study.

4-5. The north toichobate of the Northwest Building. Typical disintegration of poros limestone blocks.

27 a. Acropolis North Wall
A section of the wall with later additions. Numbering the wall courses. Divergence from vertical plane. Built in marble fragments and the remains of the Mycenaean wall.
Reproduction; 0.60x45 m.; scale 1:25
By Th. Papathanasopoulos (1982)

b. North Wall of the Acropolis
Classical postern gate and stair, north side
Section A-A
China ink; 0.60x0.40 m.; scale 1:25
By Th. Papathanasopoulos (1982)

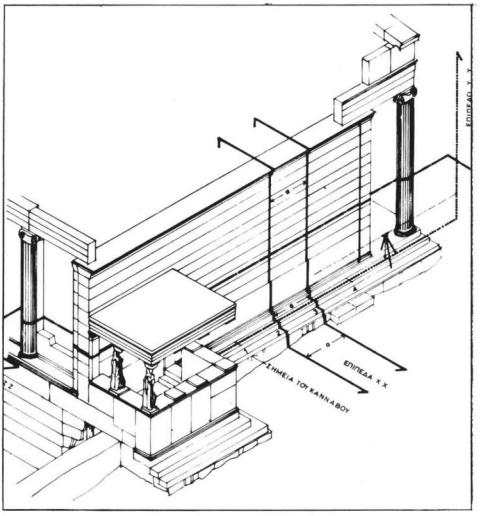
c. Acropolis North Wall
Classical postern gate and stair, west flank
Section B-B
China ink; 0.44x0.54 m.; scale 1:25
By Th. Papathanasopoulos (1982)

28 a. Theatre of Dionysos
A section of seats in the auditorium
China ink; 0.54x0.89 m.; scale 1:20
By W. Wurster and K. Cazamiakis (1978)

b. The Theatre of Dionysos
Aerial photographs taken from a balloon for the surveying project

29 a. The Theatre of Dionysos
The orchestra
Reproduction; 0.69x0.47 m.; scale 1:20
By W. Wurster and K. Cazamiakis (1978-1979)

b. The Theatre of Dionysos
Surveying the theatre



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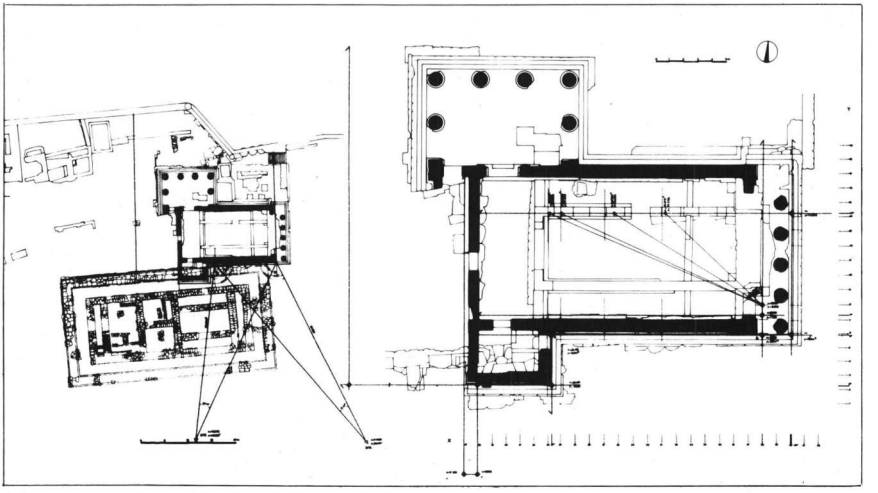
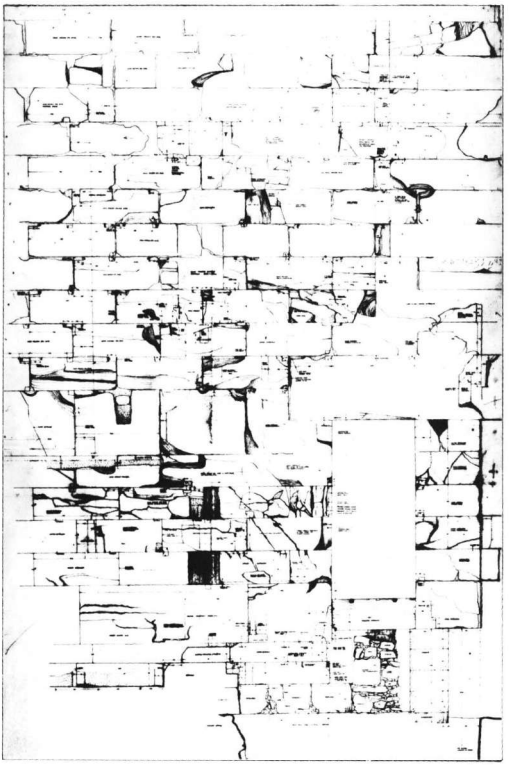


III.2a



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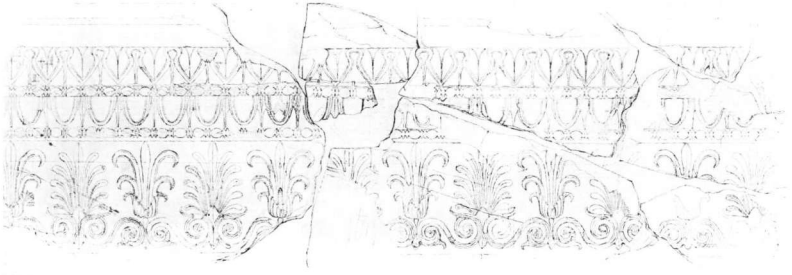

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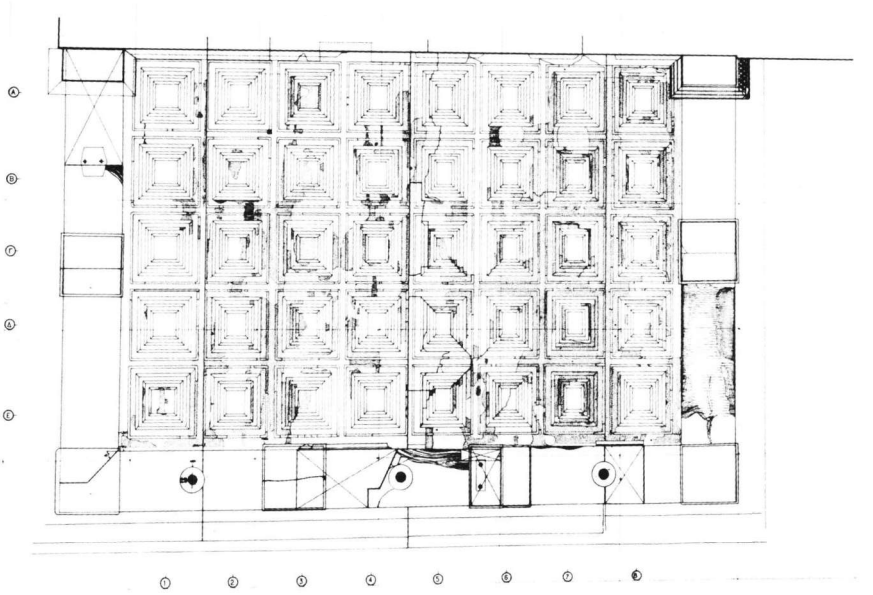

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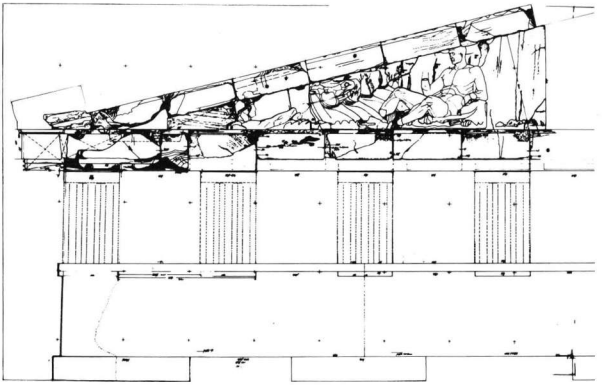

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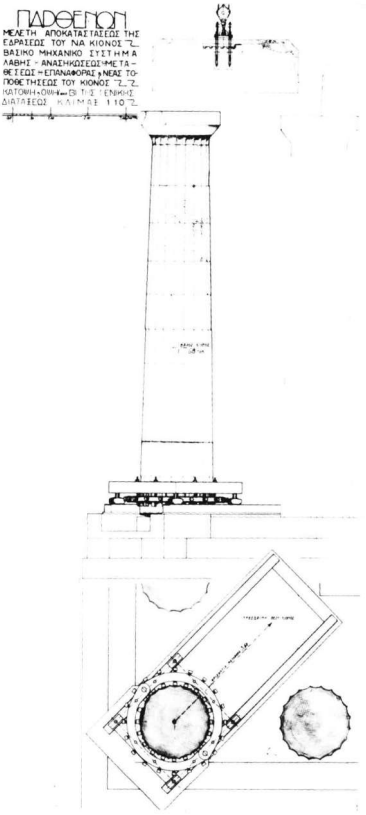
ΠΑΘΕΠΙΣΤΗΜΙΟ
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ΕΒΡΑΙΚΗΣ ΤΟΥ ΝΑ ΚΙΟΝΟΣ
ΒΑΣΙΚΟ ΜΗΧΑΝΙΚΟ ΣΥΣΤΗΜΑ
ΑΛΒΗΣ - ΑΝΑΣΗΚΩΣΕΩΣ ΜΕΤΑ -
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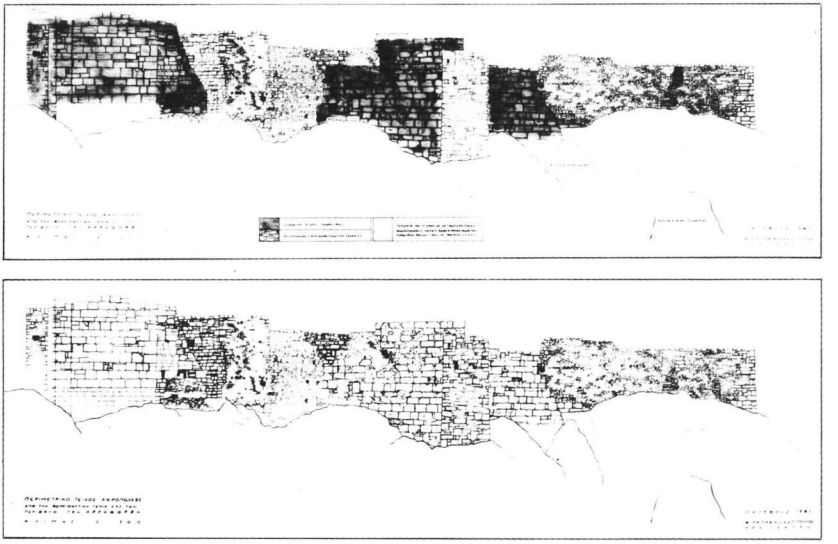
III.18



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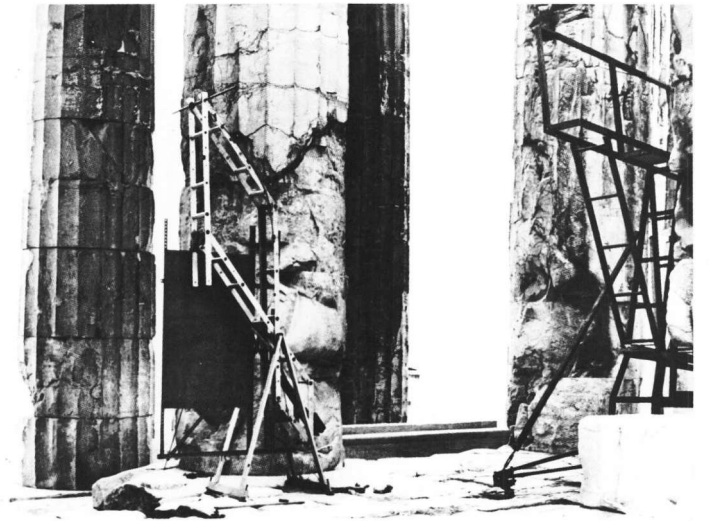

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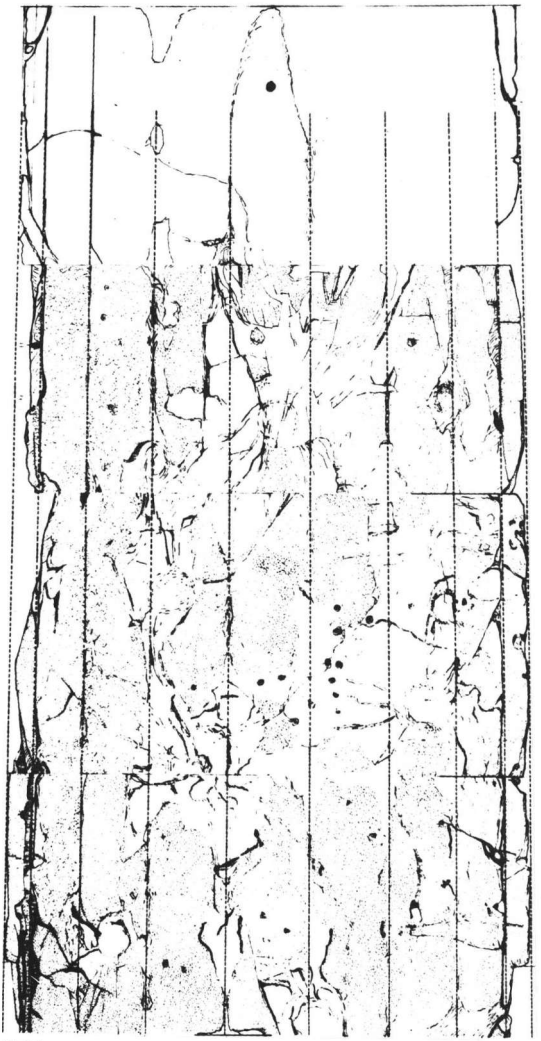

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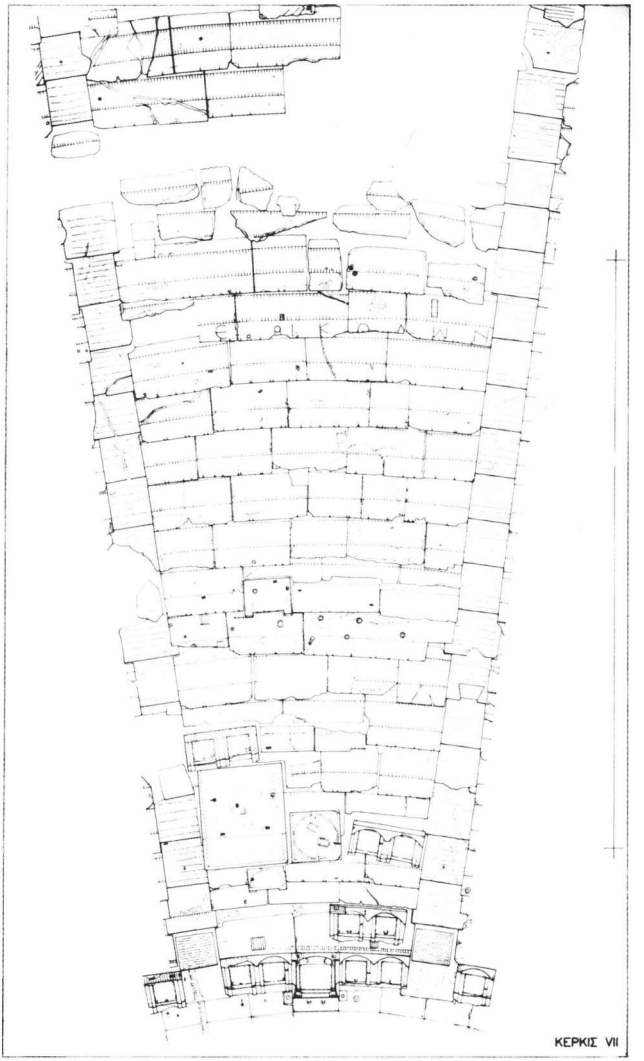

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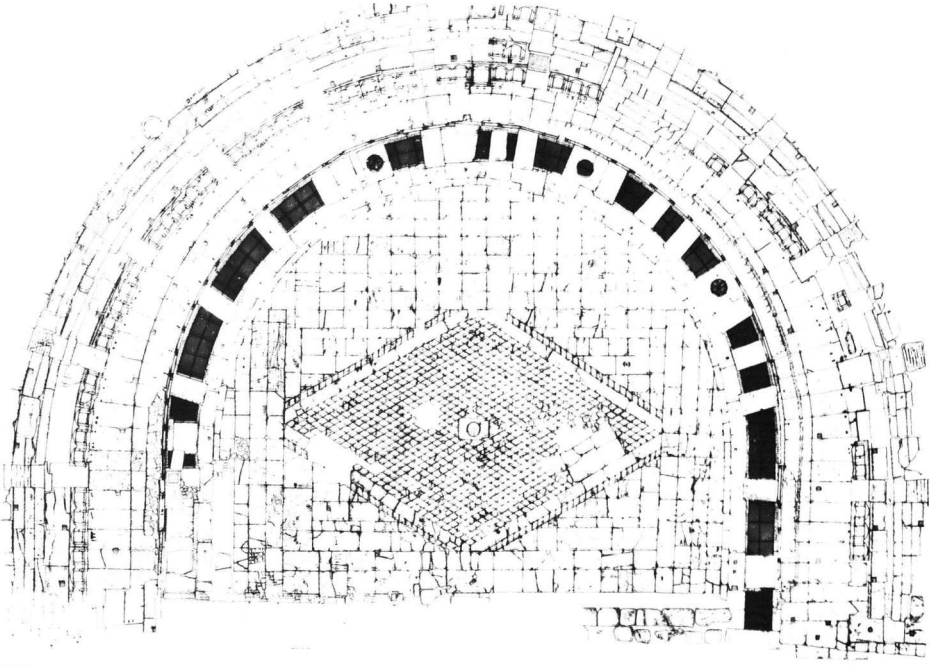


III.29a

1983

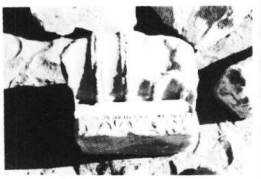
Αριθ. 1847

φ. 143-1 (25-5-83)

Αριθ. 1847

φ. 143-2 (25-5-83)

Αριθ. 1847



φ. 143-3 (25-5-83)

IV. Architectural material scattered about the Acropolis

IV. Architectural material scattered about the Acropolis.

The demolition of mediaeval and later structures and the first excavations which started in 1834 brought to light considerable remains of architecture and sculpture deriving from Acropolis monuments; they had either been reused as building material in later structures or had been buried in the earth. K. Pittakis was the first to concern himself with collecting and storing these antiquities and he also brought antiquities from the lower town up to the Acropolis in order to protect them.

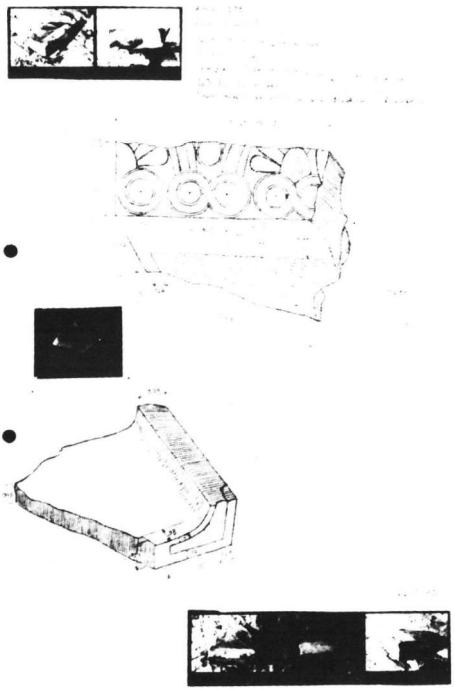
The large-scale excavations of the Acropolis from 1885-1890 turned up many more architectural and sculptural remains which, after the excavations were over, were more or less haphazardly placed in piles or in built-up rectangles wherever there was room for them on the Acropolis. The easily identifiable fragments were sorted and separate piles were made for Parthenon marbles, for Propylaia marbles, for blocks from the poros limestone archaic temples, and for Roman, early Christian, Byzantine and later material. There were also, however, piles of undifferentiated material and some of the finds remained scattered about on the Acropolis. Although some changes were made during the restoration carried out by N. Balanos, and in later years by the Acropolis Ephorate in general the situation remained much as it was until very recently.

In recent years study of a portion of this material has shown how important it is for archaeological research and for the restoration project. Some of the architectural blocks and fragments yield completely new information about known and unknown monuments and about their historical vicissitudes. Certain fragments derive from sections of classical buildings that were either restored or unknown up until now and may contribute to the interpretation and the reconstruction of the monuments; some of the rediscovered blocks may even be restored to their original places during the work of restoration. In addition the architectural disiecta membra, particularly those of the classical period, are interesting in themselves, yielding evidence of unique architectural forms and individual structural functions. If we take into consideration that this architectural material, which is so valuable not only as scientific evidence but also in respect to aesthetic value and educational significance for the history of art, is aimlessly strewn about the Acropolis, lying around within reach of visitors, exposed to extreme danger of deterioration and damage, it is clear that inventorying this material and putting it in order is an urgent necessity. The main aims of the new arrangement are to protect the blocks from damage and to display them in such a manner so that their forms and functions may be intelligible to a wider public. The new arrangement will also have good side effects, in that a good deal more of the Acropolis rock floor will be visible and it will be easier for visitors to circulate. Practical reasons also dictate the clearing away of disiecta membra from certain areas: room is needed for the Parthenon project work site.

The work began in 1977 and continues up until the present. The condition of the Acropolis rock floor has been extensively recorded; topographical plans have been drawn up at a scale of 1:100 and a plan of the disiecta membra on the Acropolis at a scale of 1:200, based on G. Kawerau's plan of 1885-1890 and the photographs made from a balloon in 1976. Then the marble dumps began to be taken apart one after another. The method of registering and inventorying the disiecta membra was worked out with especial care. Each block was numbered with indelible ink and drawn up in perspective on an inventory card. The inventory card has the inventory number, detailed measurements, general photos and photos of details done to scale, a complete description and information about the origin of the block and any unusual features it may have. The blocks that have been indentified are assigned to the monuments to which they belong; a large number of identified blocks and fragments have already been used in the Erechtheion project and many others will be of use in the Parthenon and Propylaia projects. The remaining material is arranged in chosen areas on the Acropolis according to chronological order and by categories (sculpture, architecture etc.). Plans are being made to remove the material which does not belong on the Acropolis.

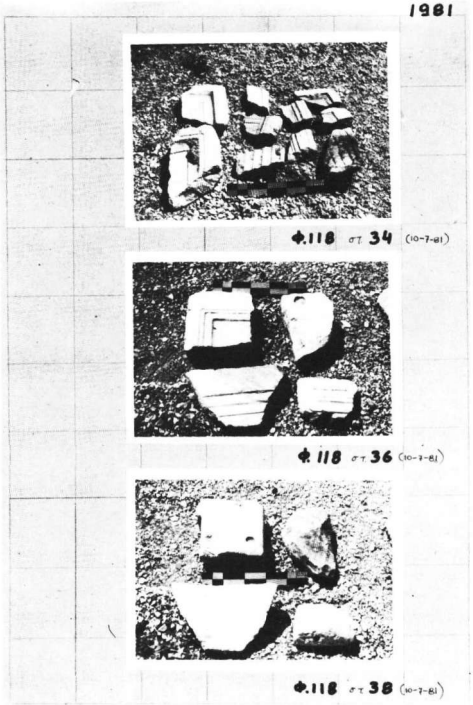
1a. Acropolis. Scattered pieces of architecture
Inventory cards

b. Acropolis. Scattered pieces of architecture
Plan of the Acropolis showing the positions of the marble dumps where architectural blocks are recorded.
Reproduction; 0.86x0.38 m.; scale 1:400
Drawn by J. Travlos and A. Tanoulas (1977)

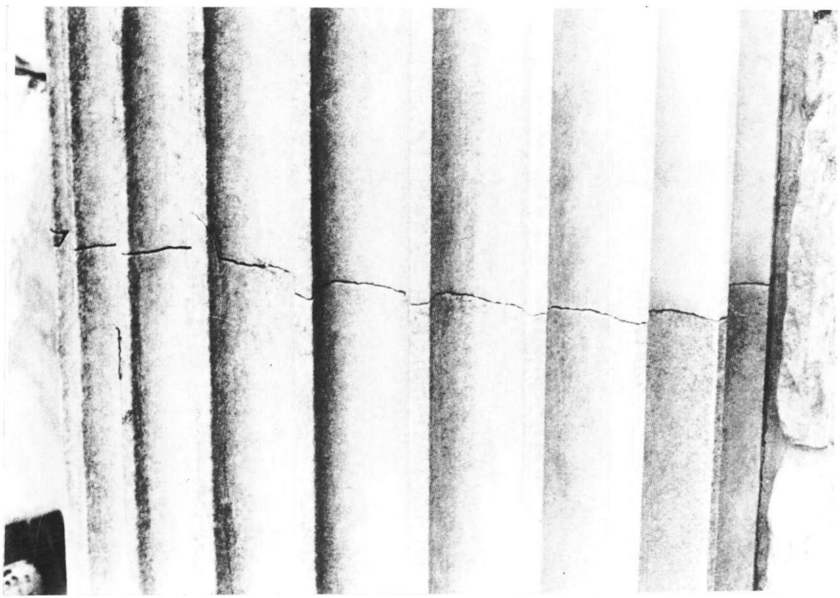


2 a. Acropolis. Scattered pieces of architecture
How the photographs of scattered architectural blocks are filed.

b. Acropolis. Scattered pieces of architecture
1. Temporary boardwalk for moving scattered pieces of architecture
2. Method of transport



IV.2a(3)



V.2b

V. The physiochemical problems Structural damage

V. The physiochemical problems. Structural damage

The two main causes of the serious problems affecting the Acropolis monuments today have been determined in the course of recording, studying and analyzing all of the injurious factors; they are 1) rusting iron clamps embedded in architectural blocks, particularly those used in recent restorations, and 2) chemical changes in the surface of the marble caused by atmospheric pollution which has recently been increasing by leaps and bounds. The rise of atmospheric pollution in the immediate vicinity of the Acropolis is due to the fact that Athens has been transformed into a huge metropolis with a concentration of major industrial establishments in the Attic basin.

These basic problems are interlinked with the further problems of static sufficiency, resistance to earthquakes and surface changes due to physical and biological factors.

Ancient buildings are constructed of stone blocks laid in horizontal courses with no bonding agent (dry masonry). Perfect jointing and foundations resting on bedrock ensured stability. The building was made additionally secure against earthquakes by means of iron clamps and dowels placed in cuttings carved in the blocks. Under normal conditions these fastenings were not subjected to strain; their shape and size were designed in such a way that in cases of catastropihc loading the clamp, not the marble, is subjected to strain. The ancient builders made the iron fastenings rustproof by pouring molten lead around the iron in the space purposely left between the cutting and the iron fastening, thus sheathing the iron and protecting it from rust. The extremely thick lead sheathing was also able to absorb the strain of any changes in the elasticity of the iron.

In recent restorations of Acropolis monuments, especially those undertaken by Balanos (1898-1933), iron components were used to fasten, consolidate or reinforce architectural blocks with no previous study of their morphology cross-sections and properties. The iron was haphazardly covered with lead or cement mortar. Water seeping in and the Attic sea air caused the iron to rust and swell, producing mechanical stresses which in many cases strained the marble beyond the breaking point, leading first to cracks, breaks and displacements, so that later on pieces broke away and fell off the building. Thus fifty years after Balanos' operations the very materials used with the idea of strengthening the monuments and ensuring them a long life have turned out to be main threat and cause of great damage.

Fractures in Acropolis monuments were first noted in the 50's. During the following decades the situation was dramatically aggravated with the sudden rise of atmospheric pollution and the effects of sulfur oxide on the iron which had already rusted. From around 1970 onwards large fractures were observed particularly in the Propylaia ceiling coffers, in the Erechtheion north and south porches and in the cornice at the northeast corner of the Parthenon.

Intensive study of the damage began in 1975 beginning with the Erechtheion and later including the other monuments. All visible breaks were recorded in drawings and photographs and efforts were made to locate the iron fastenings installed during previous restorations, the existence of which was either not knwon or a matter of conjecture. The necessity of investigating the conditions inside the walls led to the diagnostic phase of the study, to the use of radiography and ultrasonics, non-destructive methods which enable one to find out what conditions obtain inside walls without taking samples or partially dismantling the building. This investigation showed that architectural blocks had internal cracks which, as a rule, started at the surfaces in contact with rusted iron and which were not visible from the outside.

These studies demonstrated the extremely critical condition of the Acropolis monuments. Clearly, drastic measures were urgently necessary. The only way to stop the iron rusting is to emove all of the iron fastenings incorporated in the buildings, even those which are apparently in good condition; the inevitable consequence was that the archi-

tecture containing iron, particularly the restored portions, would have to be dismantled.
After conducting laboratory research and experiments the chemists suggested replacing the rusted iron attachments with titanium components. Titanium was judged to be the most suitable metal for this purpose for the following reasons: it is virtually non-oxydizable even in sea air; of all the metals that have been experimentally tested in buildings titanium has the lowest coefficient of thermal expansion, approaching that of marble; it has many good mechanical properties. The work on the Erechtheion beginning in 1979 involved dismantling previously restored sections of the building, which revealed the full extent and seriousness of the damage from rusting iron, and proved that dismantling is necessary and that the drastic method chosen is the right one.
The static sufficiency of the building was also studied intensively; it is linked to the other problems of rusting clamps, cracks and breaks in the marble and the resulting disturbance to the structure as a whole.
In antiquity the static function of buildings was simple.

The vertical bearing members were columns and walls which support the horizontal members (beams, epistyles). The general use of the isostatic system and the perfection of the structure, especially the flawless dressing of the contact surfaces were factors contributing to the high all-over strength of the buildings. Static sufficiency was also secured by setting the foundations on firm ground or, more usually, on bedrock which quite often was cut down in order to give the lowest foundation course a firm grip. Because of the way they were constructed ancient buildings behaved like rigid structures when there were earthquakes; they swayed with the ground.
Now that the ancient monuments are in ruins their static function has altered to a high degree. The resistance of the buildings or the preserved parts thereof is much diminished just as the simple static model of the original construction turns out to be extremely complex due to the various geometric changes to which it had been subjected. As a result, calculations made to test static sufficiency and the study of behaviour during earthquakes and protection against earthquakes is particularly complicated even in the case of a single column or part of a wall. The analytic static computations aim at assessing the amount of stress and the safety factor in cases of permanent dead loads tilting and loating through wind or earthquake. The proposal has been made to test a model of the Parthenon on an earthquake table in order to study protection against earthquakes. The reports on improving static sufficiency and antiseismic protection are governed by the same theoretical principles that apply to interventions, i.e. concern for the structural characteristics and behaviour of the building; prudence regarding the extent of the intervention or reinforcing; and the requirement that the operation be reversible.

The deterioration of the surface of architectural members and especially of architectural sculpture poses another serious threat. The original surface of the brilliant strong Pentelic marble is continally wearing away and crumbling. The effects of weathering, the action of wind and rain and carbon dioxide, the damage inflicted on the surface of the marble were observed long ago. As early as 1905 the Archaeological Congress had made a proposal for protecting the Parthenon west frieze *in situ*. Since that time the metamorphosis of Athens into a metropolis and the uncontrolled irrational development imposed by the rhythm of modern life have drastically altered the situation. The smog produced today by factories, automobiles and central heating systems pollute the erstwhile crystalline atmosphere of the capital. The smog contains large amounts of sulfur dioxide which in the presence of moisture erodes the surface of the marble, turning it into a more or less thin film of gypsum. The acid pollutants which are dissolved in rain water, i.e. sulfur dioxide (SO_2), sulfur trioxide (SO_3) and nitrogen dioxide (NO_2), attack exposed marble surfaces, turning the marble (limestone)

into calcium sulfate (plaster) or calcium nitrate. The gypsum is in turn dissolved by rain and the attack continues on the new marble surface with emerges. This acid attack is extraordinarily devastating to architectural sculpture because loss of detail results immediately. When surfaces are protected from rain the sulfur dioxide (SO_2) in the atmosphere produces a reaction termed sulfation. The sulfur dioxide (SO_2) takes effect in two stages: first it quickly oxydizes by catalysis into SO_3; the second phase is a slow reaction of the SO_3 with the calcium carbonate (marble). Particles that are either in suspension in the air or have settled on the marble surface complete the process of deterioration.

Some years ago the staff of the physiochemistry laboratory at the National Polytechnic University of Athens began investigating the reaction of marble to sulfur oxides. They observed that where surfaces are protected from rain the gypsum layer remains on the surface of the marble forming a crust which in due course cracks and flakes off. This gypsum crust preserves the details of the sculpture which the marble beneath loses. The process continues due to the diffusion of calcium ions which migrate from the interior of the marble mass via the gypsum layer towards the outside corrosive environment with the resutl that a new crystalline gypsum crust forms on top of the firtst gypsum layer. The discovery of the mechanics of sulfation, confirmed by laboratory testing, elucidated the phenomenon whereby sculptural details are preserved on the gypsum crust and made it imperative to find a way of consolidating the valuable layer. In connexion with this research data was systematically collected on the effects of acid rain and sulfation on the Caryatids (1976-1977), the Parthenon west pediment figures of Cecrops and his daughter (1976-77) and the Parthenon west frieze (1976-1983); they were compared with earlier copies and photographs. This analysis showed that deterioration has accelerated during the last years and that th rate of acceleration corresponds one to one with the drastic increase in atmospheric pollution. The effects of coating the marble with an organic or inorganic substance were then tested. Experiments demonstrated that the diffusion of calcium ions even continues right through the coating, i.e. inserting a coating between the marble and the polluted atmosphere does not put a stop to the reaction. As the thickness of the gypsum layer increases the coating will at some point split off. For this reason the using of the protective substances that are known at present must be tuled out; they were in any case problematical because application was a non-reversible process and because it was not possible to predict how they would behave in the long run.

Efforts were then made to find a way of converting the gypsum back into calcium carbonate. It has been tried to reverse the process of sulfation by the action of a carbonate solution on the gypsum crust. The product of the reaction is calcite which adheres more closely to marble and has better mechanical properties than gypsum; it faithfully preserves sculptural details.

Experiments continue in the laboratory of the National Technical University of Athens with the aims of improving the mechanical properties of the calcium carbonate layer and determining the procedure for applying the method to large surfaces.

The marble surface also suffers from changes brought about by colonies of microflora and microfauna (sulfur-oxydizing bacteria). Research carried out by Italian scientists with samples taken from the Parthenon west pediment Cecrops and a Parthenon column demonstrated that the bacteria can be destroyed with antibiotics to be used in a non-aqueous solution. As for the problem of changes in the colour of the marble due to soot deposit, a study is being done on ways of cleaning the surface with substances which harm neither the marble nor the gypsum film.

1a. Erechtheion. Caryatid Porch
1. The architraves of the west side showing the severe damage to the upper surface caused by rusting iron clamps.
2. Architrave split by a crack caused by the iron support installed by Balanos as a reinforcement.
3. Coffered ceiling, second coffer from the east. The severe damage is due to the rusting iron components embedded in the marble. Sheathing the iron with lead during the restoration in 1908 did not stop the iron from rusting.
4. Coffered ceiling, the second coffer from the east. Removal of the heavily rusted iron installed in 1908.

b. Propylaia East Porch
1. The ceiling, showing typical damage caused by rusting iron attachments.
2. Details of the ceiling.

2 a. Physiochemical phenomena. Rusting iron. Documentation.
1-2-3. Development of a fracture in an architectural block caused by an embedded iron component that rusted.
4. Diagram showing the rusting process over 142 years.
Study conducted by the team of chemists from the National Technical University of Athens: N. Beloyannis, E. Papakonstantinou, D. Charalambous.

b. Erechtheion. Physiochemical phenomena. Rusting iron.
1-4. Examples of fractures caused by rusting iron in the marble of the podium and architraves in the Caryatid Porch.

3 a. Erechtheion. West wall
1-2. Reattaching an engaged Ionic column with cement.
3-4. Testing the titanium reinforcement for bond strength in the laboratory.
Study by K. Zambas

b. Erechtheion
Compression strength of prismatic speciments with a joint at angle to the direction of the compressive force. Static analysis using three dimensional finite elements mesh.
Study by K. Zambas

4. Parthenon
Testing earthquake resistance
Study by K. Zambas

5 a. Mechanism of marble sulfation
1.a. Galvanic cell according to Wagner
b. Proposed galvanic cell
2. a-d. Evolution of the sulfation process. Solid state diffusion of calcium ions and electrons through the layer of gypsum.
3. Sulfation in the presence of a plastic coating.
(γ) Gypsum formation inside the plastic and on the surface.
(δ) Gypsum formation on the surface only.
(ε) Consequences of the sulfation process. The plastic breaks and the process is accelerated.
4. (ε) Graph showing evolution of the phenomenon.
Study by the team of chemists at the National Technical University of Athens

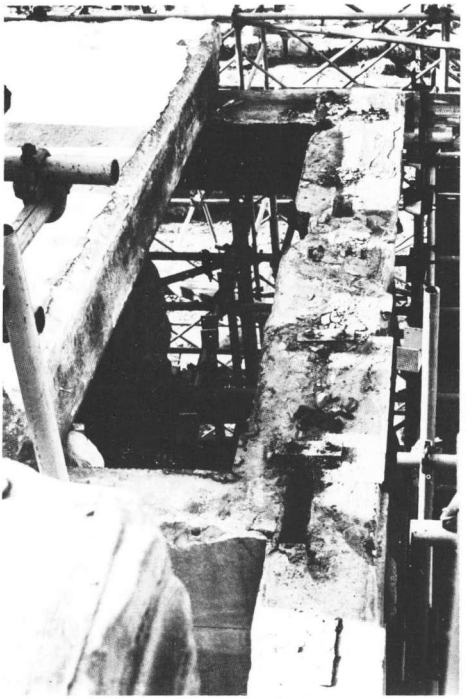
b. Mechanism of marble sulfation
Reversal of the sulfation process. At lower left: calcium carbonate; upper right: gypsum
Study by N. Beloyannis

c. Erechtheion. Chemical attack on the Caryatids
1. Side view of a Caryatid. Surface attacked by acid rain; sulfation of the surface of the marble front and back.
2-3. Photographs taken in 1955 and 1965 showing the amount of deterioration in a decade.
Study carried out by the team of chemists from the National Technical University of Athens

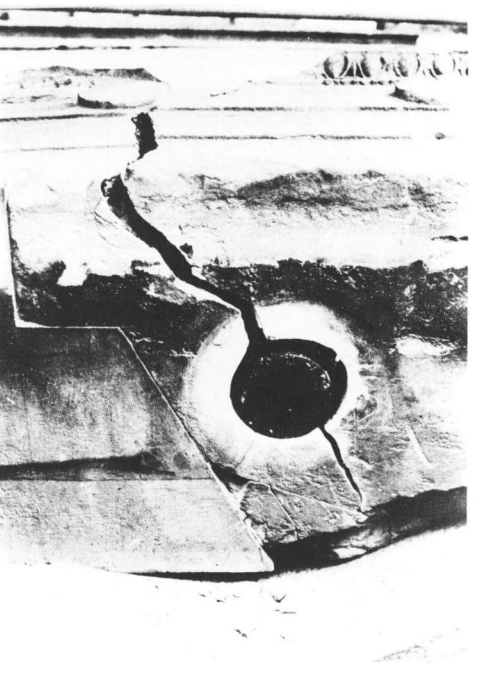
6. The mechanism of marble sulfation
Electronic microanalysis of the surface of the gypsum inside the plastic layer
Study carried out by the team of chemists from the National Technical University of Athens

7. Parthenon
Pictures of a section of the west frieze taken in 1976 and 1983, showing increase in soot deposit.
Study carried out by the team of chemists from the National Technical University of Athens

8. Parthenon
Pictures of a section of the west frieze taken in 1976 and 1983, showing increased danger of fragments breaking off.
Study carried out by the team of chemists from the National Technical University of Athens

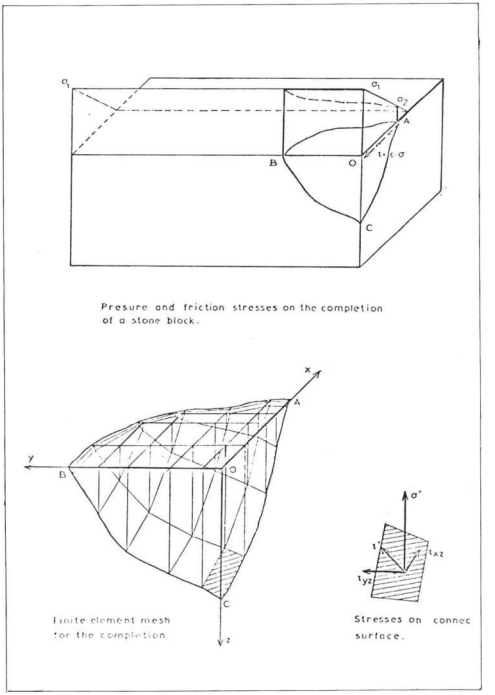


V.1a(1)

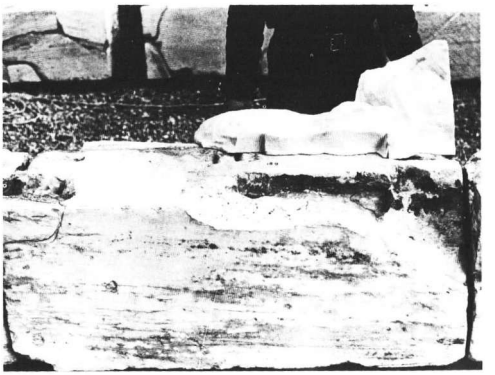


V.1a(2)

V.1b(2)

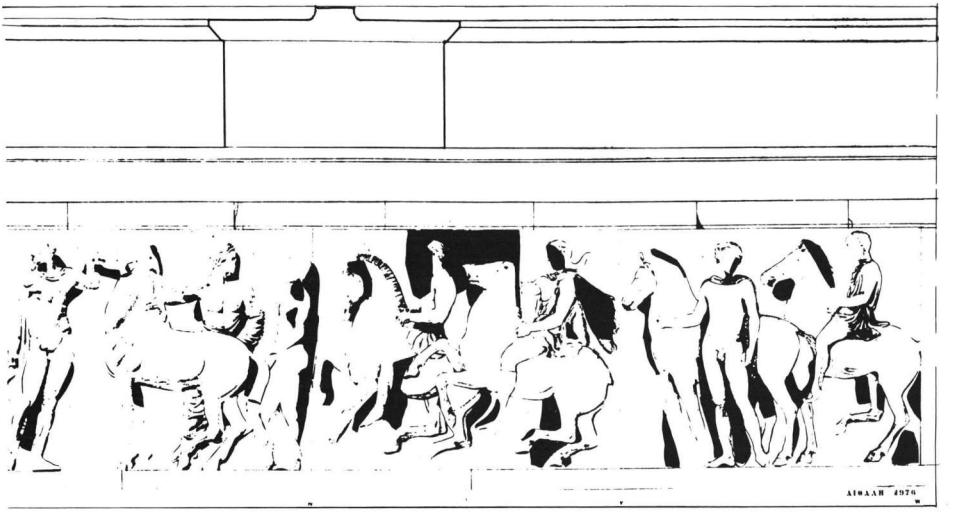

σ1
σ2
A
B
O
C
Presure and friction stresses on the completion of a stone block.
x
y
z
A
B
O
C
Finite element mesh for the completion.
σ'
τxz
τyz
Stresses on connec surface.

V.3b(2)



V.3b(1)

V.5c



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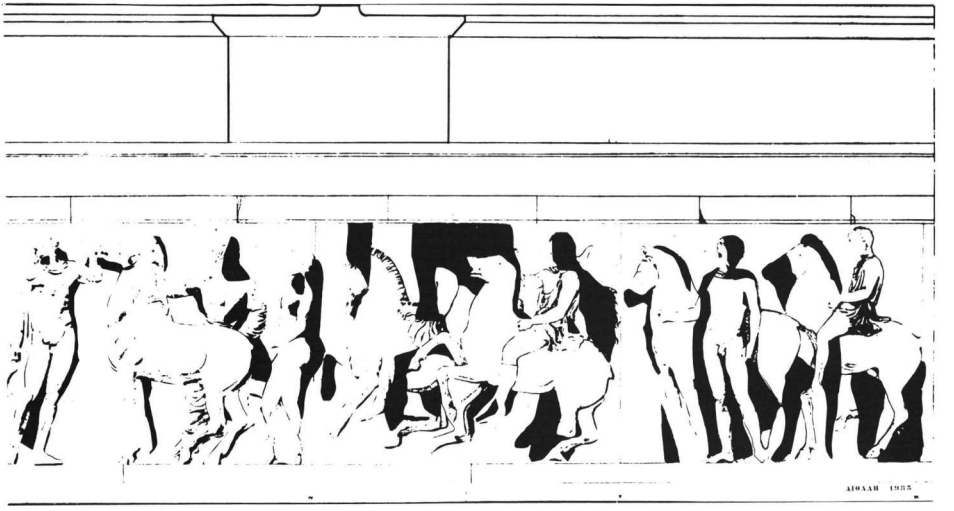
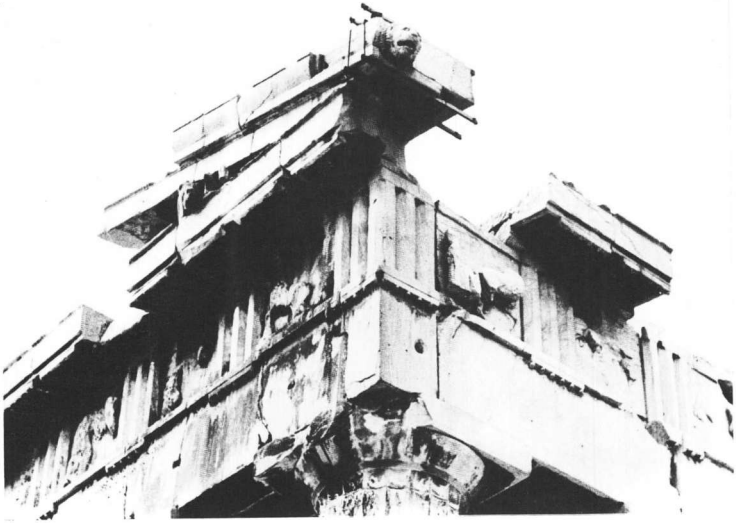
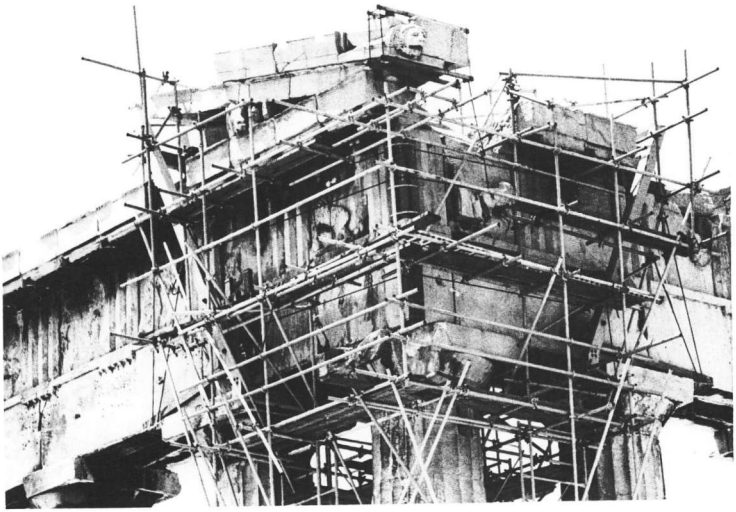


V.7(2)



VI.2c(1)



VI.2c(2)

VI. Temporary measures for protecting the monuments

VI. Temporary measures for protecting the monuments

In 1975, directly after it was founded, the Acropolis Committee decided on a series of precautionary measures in order to cope with the most pressing problems. Preventive action was taken in order to protect the architecture most exposed to danger from greater damage.
The architectural sculpture is most threatened by atmospheric pollution and was urgently in need of protection.

Thus the first efforts were in this direction. As a first step the effect of acid rain and sulfation on the surface of the sculptures was systematically recorded and the causes of the phenomena were investigated. Next, research was carried out on methods to protect the marble surface effectively. Laboratory experiments were run to test a method of protection by means of polymers. It turned out, however, that they do not meet the safety standards required of the substance to be used to coat the sculpture. For the present the only feasible solution for the most endangered sculptures is to place those that can be moved in the roofed area of a museum, and to shield those that cannot be moved with protective wooden roofing.

In 1977 the Cecrops and Pandrosos group and Callirrhoe (the southernmost corner figure) were lowered from the Parthenon west pediment and moved to the Acropolis Museum where the group was placed in a special glass compartment with nitrogen atmosphere. Copies made in the British Museum were put on the pediment. The west frieze of the Parthenon is now under a light wooden shelter to protect the surface of the marble from acid rain and ice (1976-1977). In 1976 a wooden shed was erected in the Erechtheion South Porch for the interim protection of the Caryatids until 1979, when they were moved to the Acropolis Museum. One hopes that the sculpture will be in the museum only temporarily and that the solution of the problem is not far off, now that research is concentrating on the discovery of coatings that will effectively protect the marble surfaces.

The first steps have been taken to lessen the pollution at a local level: mazut, a highly viscuous fuel oil, may no longer be used for central heating in buildings within a radius of 500 m. from the Acropolis and automobiles are not permitted to park in the immediate vicinity of the archaeological area. Atmospheric pollution, the greatest threat to the ancient monuments, will also be reduced in other ways: cars are no longer allowed to circulate in the Plaka area northeast of the Acropolis and it has been decided to pipe gas to the buildings there; the factories polluting the atmosphere are being encouraged to move elsewhere and the State Gas Works has already moved; other measures are being studied on the level of government policy. Another series of preventive measures aims at protecting the floors of ancient buildings from the wear caused by the footsteps of an ever-increasing number of visitors. In 1978 the central passageway through the Propylaia was covered over by a stepped wooden ramp and access to the other parts of the building has been closed off. Visitors may no longer enter the Parthenon, a temporary measure until one finds a way of allowing the visitors to walk around inside without inflicting damage as they did in the past.
Temporary remedies have been applied in respect to urgent static problems. Metal braces are temporarily propping and securing the southeast corner of the Parthenon and a part of the cornice in the opisthodomos, two sections which have been threatening to collapse ever since the earthquake of February 1981. In 1983 the Propylaia received a temporary system of supports until the definitive operation on the ceiling coffers of the East Porch and Ionic passageway shall have been completed. These preventive measures are immediately reversible, the materials are resistant for long periods in the open air and efforts are made to keep the first-aid operations as inconspicuous as possible so as not to spoil the view of the buildings.

1a. Erechtheion
Temporary wooden covering to protect the Caryatids (1976)

b. Parthenon
Temporary wooden covering to protect the west frieze in situ (1976-1977)

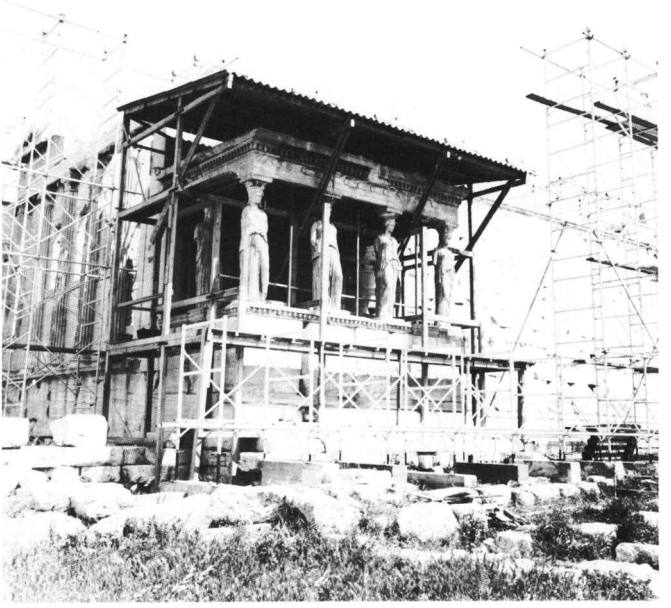
c. Parthenon. west facade
Removing the figures of Cecrops and his daughter from the pediment (1977). Preparations for transport.

d. Parthenon. west facade
Scaffolding erected for removal of the Cecrops group from the pediment.

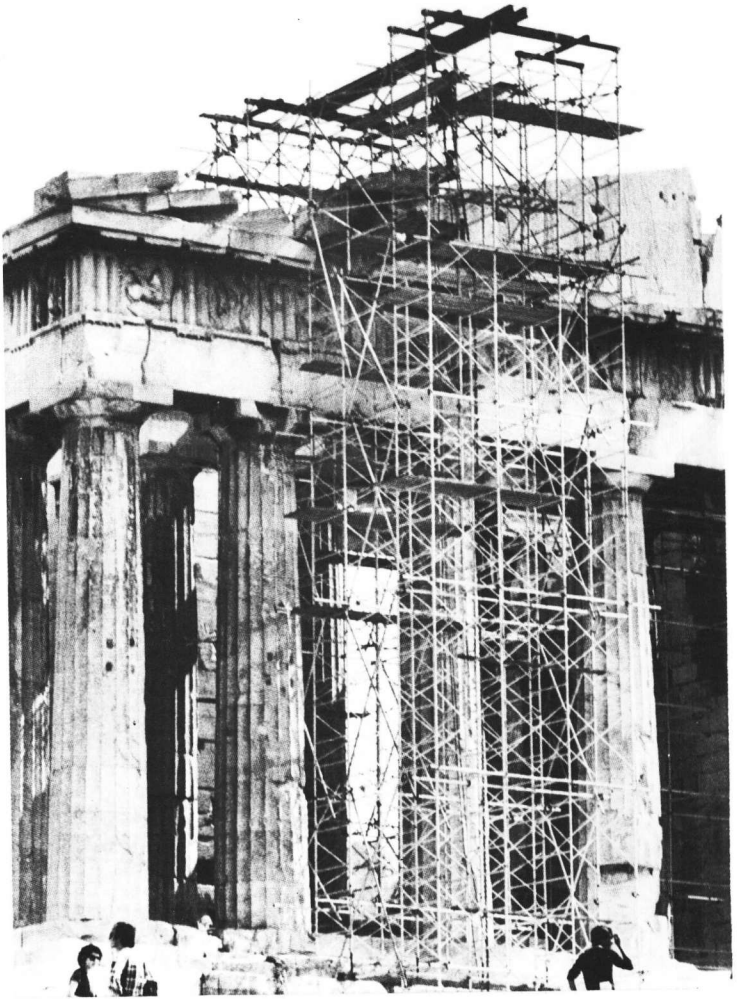
2 a. Propylaia. East Porch
The ceiling before and after installation of underpinning (1983).

b. Propylaia
Covering the central passage with a protective boardwalk (1978)

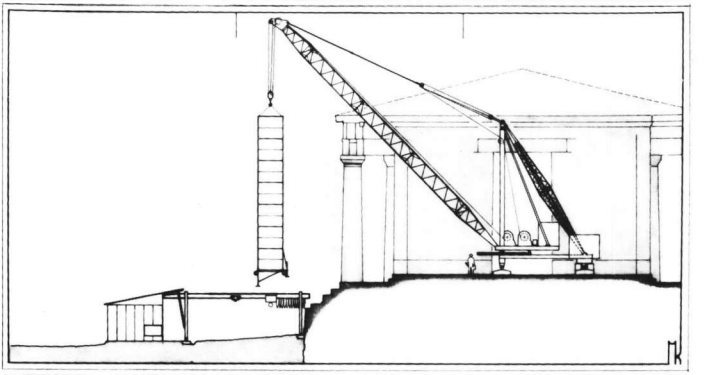
c. Parthenon
1. The northeast corner after the earthquakes of February 24th and 25th, 1981
2. Temporary measures for protecting the northeast corner (1981)



VI.1a



VI.1d



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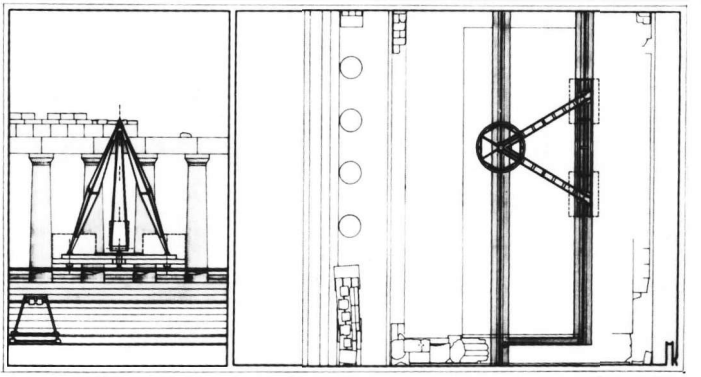


VII .5(2)

VII. Setting up the work site

VII. Setting up the work site

The study on installing the work site around the monuments for the duration of the restoration project is part of the general study that precedes the operation and examines all the problems pertaining to the monuments. In drafting the study of the work site and choosing between alternatives, the following factors were taken into account: strict safety requirements; the desirability of making the installations as inconspicuous as possible; the peculiarities of the terrain and the special technical problems of the project. The main aim of the study is, indeed, to produce smoothly functioning procedures and the criteria are feasibility and economy. The study, which includes a complete set of drawings illustrating the various proposals in detail, was first approved by the Acropolis Committee and then submitted to the Central Archaeological Council of the Ministry of Culture for final approval.

The mechanical equipment of the work site includes hoisting systems for lowering architectural blocks to the ground and machinery to transport the blocks to the workshops for conservation treatment. The marble-working areas are fitted out with both traditional and modern equipment; there are storerooms for equipment and material and an area for storing, studying and conserving architectural blocks.

The type of machinery used for hoisting and transport is adapted to the individual conditions of each monument.

Four hand-operated portal cranes were used in the Erechtheion; they were supported on metal scaffolding with bearing capacities of 10, 5, 3.5 and 1.3 tons. The scaffolding was made of cast pipes and frames specially treated and painted so as to be rustproof. Their underpinning was supported on small prefabricated bases of reinforced concrete. Each portal crane is on two metal beams at the highest level of the scaffolding and moves lengthwise from east to west. With this system every part of the building requiring conservation was accessible. This method was chosen because of the great differences in ground level in the area of the building. Two wooden sheds east and northwest of the Erechtheion house workrooms and storerooms for equipment and material. The ground around the building has been strewn with gravel to facilitate depositing dismantled architectural blocks on the ground and shifting them before and after conservation treatment. The Erechtheion work site was completed at the end of 1978 and the first actual restoration work began in 1979.

Similar scaffolding and portal cranes were used for the small-scale operation on the architrave of the Propylaia east porch in 1981-82. A wooden shed on the northeast side of the building housed the workshop where the architectural blocks from the Propylaia were restored.

In choosing the type of crane to be employed for the Parthenon project the following considerations were taken into account: local conditions and the size of the building; the duration, scope and requirements of the project; and, in particular, how it would affect the appearance of the Acropolis and the Parthenon, essential features of the Athenian landscape. After intensive investigation and comparison of various hoisting systems (ordinary supporting scaffolding, portal cranes of the type used for the Erechtheion etc.) a revolving crane of the stiffleg derrick type was chosen, with additional improvements due to increased safety requirements; the crane runs on tracks, has a range of 27 m. and a hoisting capacity of 12 tons at 20 m. This crane, which will be placed inside the building and folded up into a horizontal position at the end of the working day, is able to reach every part of the building

scheduled for intervention and is able to deposit loads outside the building. The crane was constructed by the French firm of Haulotte in Chamberry in 1982-1984; it was brought to Greece and will soon be installed in the Parthenon. A low portal crane with a hoisting capacity of 12 tons has been selected for moving scattered or dismantled architectural blocks on the ground; it has already been installed south of the temple along its entire length. The mechanical equipment for the Parthenon work site also comprises light scaffolding made of Dural which may be shifted around at will to the inaccessible parts of the superstructure to facilitate work there. The area south of the Parthenon has been chosen for the work site; it was used for similar purposes in ancient times. The laboratories for conservation, facilities for the staff and the storerooms have already been set up. The same area is used for moving blocks around the depositing them on the ground.

A lift to be installed at the southeast corner of the Acropolis was the subject of a special study. Hoisting huge stones and heavy loads into the Acropolis has always been a serious problem. During the whole period of Balanos' restorations large blocks of marble were hauled up to the Acropolis in wagons running on sloping tracks passing through the Propylaia. Various temporary installations for hauling loads were used for subsequent restoration work. At the beginning of the 50's an aerial cable was installed at the southeast corner of the Acropolis which was replaced by a hand-operated winch. In 1979 this was replaced with another lift with an electrically operated winch of limited bearing capacity (1.5 tons) by means of which marble and other material used in the Erechtheion project were transported.

It was plain from the very beginning of the current project that a modern lift with greater lifting capacity would be needed. After investigating various possibilities, always bearing in mind the visual and archaeological limitations imposed by the site, a crane was chosen in this case, too, rather than a "classical" lift. Thus, in 1984 an electrically operated folding crane was constructed at the southeast corner of the Acropolis; it has a hoisting capacity of ten tons and runs on tracks, depositing the load in a special wagon. Railroad tracks link the depot with the various work sites.

1. Erechtheion
Study for the works site
General perspective view of the works site for the Erechtheion
Pencil and markers on rice paper; 0.84x049 m.
By M. Korres (1978)

2 a. Erechtheion
Installing the works site. Assembling the scaffolding for the portal crane and the wooden prefabricated work rooms.

b. Erecththeion
Study for the works site. Proposal for removing the ceiling coffers, epistyles and sculpture from the Caryatid Porch.
China ink; 0.21x0.30 m.
By A. Papanikolaou

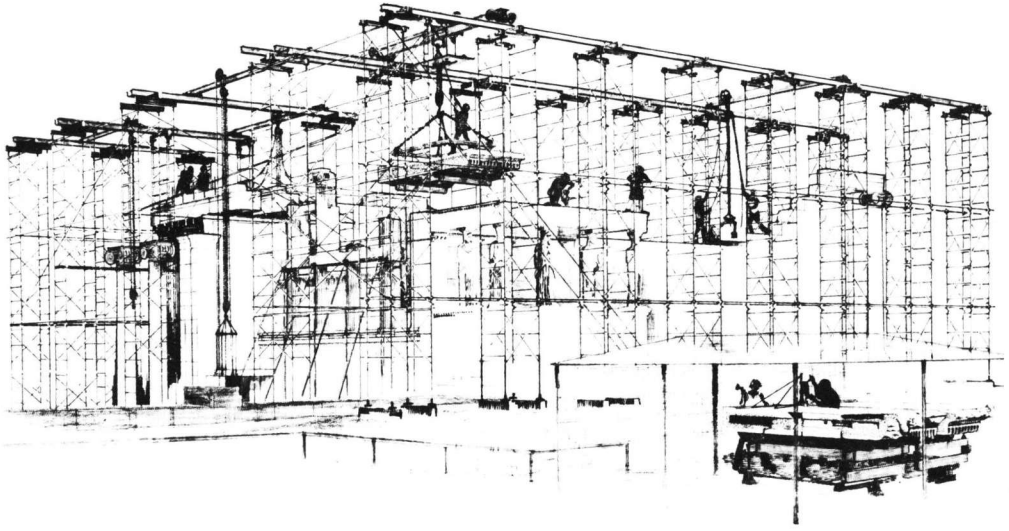
3 a. Parthenon
General bimetrical view of the works site
China ink; 1.06x0.28 m.; scale 1:200 - 1:400
By M. Korres (1981-1982)

b. Parthenon
Installing the portal crane at the works site

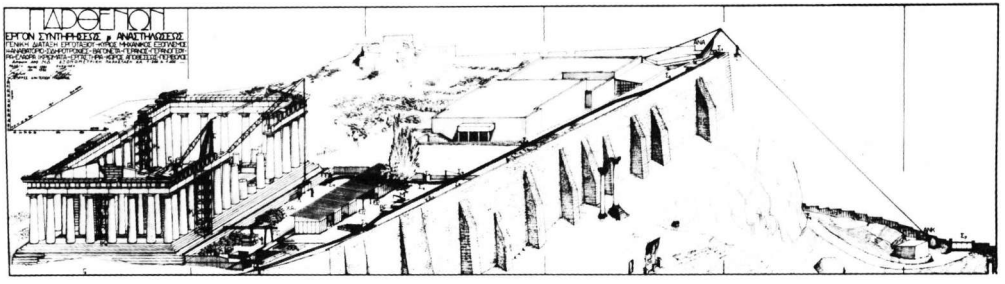
4 a. Parthenon
General plan of the works site
China ink; 1.05x0.63 m.; scale 1:100
By M. Korres (1981)

b. Parthenon
General cross-section of the works site
China ink; 0.84x0.56 m.; scale 1:100
By M. Korres (1981)

5. Parthenon
Drawings of the crane at the works site
China ink; 0.57x0.65 m.; scale 1:100
By M. Korres (1983)



VII.1



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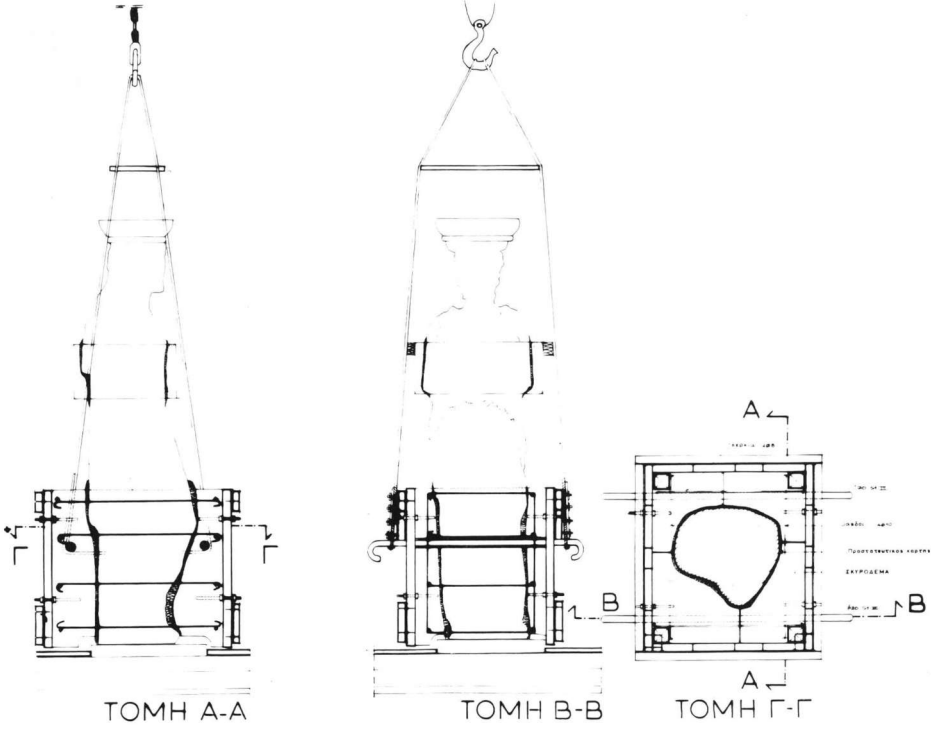

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VIII. Intervention

VIII. Intervention

The first investigations conducted after the Acropolis Committee was founded in 1975 showed that drastic intervention was now an unavoidable necessity. But the decision to carry out drastic interventions on unique monuments of worldwide cultural significance involves assuming great responsibility. Awareness of this responsibility led the Acropolis Committee to examine both the aims and the method of intervention and to search for controls which would reduce the margin of error in dealing with the special problems posed by the ancient buildings.

The work on the Acropolis is being carried out in accord with the Charter of Venice (1964), an internationally accepted set of standards for restoring monuments. Collaboration among scientists, as stipulated in Article 2 of the Charter, is ensured by the fact that those responsible for the preliminary study and those who will be evaluating that study have a wide range of specialized skills. The basic principles observed in working up the preliminary studies and in carrying them out are as follows: preserving the monuments as scientific and historic documents as well as works of art (Article 3); preserving the settings of the monuments (Article 6); respect for the original fabric of the monuments; writing up an archaeological study before each intervention (Article 9); using modern technology in tandem with traditional methods (Article 10); concern for all the phases of a monument (Article 11); replacements of missing parts must be harmoniously integrated with the whole and the new material must be clearly distinguishable from the original (Article 12); architectural blocks previously removed from the building should be replaced (Article 15); precise documentation before intervention and during the course of work; and full publication of the project after it is finished (Article 16).

Experience gained over many years of restoring classical monuments in Greece has led to formulating five additional principles applicable to the Acropolis project. These principles, which derive indirectly from interpreting the principles of the Charter of Venice, but are mainly dictated by the fact that Greek classical architecture is made up of structurally autonomous architectural members, are as follows:

1. Reversibility, a precautionary measure so that the building may be returned to its previous state as it was before the operation. This is achieved by keeping interventions to a minimum and by exhaustive documentation before any change is made.
2. Preservation of the autonomy of architectural members and keeping in mind their simple static function (respect for the original state of the monument)
3. The operation should be restricted to those parts of the monument that have already been restored so as not to interfere with the sections of the monuments still in their original state (respect for the original).
4. The monuments to be made self-conserving by restoring the ancient material (increasing the static sufficiency).
5. The changes in the appearance of the monument should be kept to a minimum, which is most important for monuments as well-known as the Acropolis buildings, symbols of the classical spirit all over the world.

The Acropolis Committee has secured maximum objectivity at the decision-making level by instituting a procedure whereby the proposals for each part of the project are reviewed three times: after the studies have been approved by the Acropolis Committee they are submitted to criticism in the course of international meetings of specialists and final approval is given by the the Central Archaeological Council, the top-ranking advisory board of the Ministry of Culture which clears the way to translating plans into action.

Because the Erechtheion was in an advanced stage of deterioration the first efforts of the Acropolis Committee were directed to a study of ways and means to cope with the problems besetting that building. The *Study for the Restoration of the Erechtheion*, based on the principles reported above, was completed by the end of 1977 and in December of that year it was submitted to international criticism in a meeting of specialists held in Athens. The study was unanimously approved by Greek and foreign experts and characterized as "a model for future restoration." The study comprised the following research: all of the alterations which the Erechtheion has undergone during its entire history, both physical changes and those

inflicted by men; tracking down information about previous restorations, how they were done and what materials were used, by consulting publications and material in archives and also with the aid of modern technology; architectural, static and physiochemical problems were intensively analyzed. The results of this exhaustive analysis demonstrated that the previously restored sections of the building would have to be dismantled. The study made, therefore, the following recommendations: taking down everything restored by N. Balanos, i.e. the ceiling of the North Porch, the west façade, the east, south and north walls and the Caryatid Porch; removing the iron attachments and replacing them with titanium clamps; replacing the iron supporting elements used in Balanos' restorations with titanium; putting the building back together again after restoring some of the blocks with new marble in order to satisfy the requirements of static sufficiency.

By early 1979 the work site had been set up around the Erechtheion and work started in June. By the end of 1979 the following had been dismantled: the southwest corner epistyle, four courses of the south wall, the North Porch ceiling coffers, the southeast corner epistyle, the three blocks on the frieze and the corner horizontal geison, the coffered ceiling and the epistyles of the Caryatid Porch.

The second half of September and October were spent on the operation of moving the five Caryatids from the building to the museum, since that proved to be the only way of protecting the sculpture from heavy damage as a result of increased air pollution. The statues were transported in cars running on tracks laid down between the Erechthion and the museum. The lower part of each statue up to a height of 80 cm. was encased in a container filled with reinforced cement poured in sections, the sculpture having previously been covered and protected from contact with the cement. The upper part and the most sensitive point, the neck, were protected by a layer of fine plaster.

Cement copies have been placed on the building.
The work of dismantling the building went on uninterruptedly and the following have already been taken down: the south wall as far as the orthostates; the ceiling of the Caryatid Porch and crowning moulding of the Caryatid base; the west wall as far as the stylobates of the half-columns; the ceiling, cornice blocks and some of the frieze blocks of the North Porch; the north wall above the north doorway and the rest of the wall.
The working procedure is as follows: after blocks and architectural members are numbered dismantling begins. The corroded clamps are removed and the blocks are lifted down to the ground where skilled marble workers using delicate instruments clear out the remains of clamps and mortar and clean out the cuttings. In order to secure static sufficiency the blocks are repaired with new marble. The supplementary pieces of new marble are fitted exactly to the broken surfaces of ancient blocks by using a pointing device, the instrument used by sculptors for transferring measurements when making a marble copy of an original. Thus the additions in new marble fit into the ancient breaks perfectly; the ancient blocks are not damaged and the desired reversibility of the process is ensured. The supplementary piece is affixed to the ancient marble by means of thin titanium rods, 2-10 mm. in diameter, placed in the new marble perpendicular to the surfaces to be joined. This visible means of attachment means that if the missing piece of ancient marble were ever to be found it could be returned to its original position. On the other hand when two ancient fragments join they are attached invisibly; the titanium clamps are embedded in the ancient marble. The fragments are glued together with liquid cement, using white cement purified of all sulfur compounds.
Special importance is attached to documenting all phases of work: day-to-day records are kept; the project is photographed and filmed; and an inventory card is made out for each block that is taken down and given conservation treatment. The original state of the object, the changes wrought by time and the hand of man and the details of the current treatment are recorded on the inventory cards with drawings and written descriptions.
The reassembling of the Erechtheion is in progress and the following have already been put back into place: ten courses of the south wall; the half-columns of the west wall and the walls in between as far as the lintels of the windows; the north wall above the north door; the ceiling of the South Portch. The Caryatid Porch is finished and the restoration of the rest of the building is in progress.

The process of dismantling previously reconstructed sections of the Erechtheion turned up new evidence for the original construction and for the original positions and form of the blocks which, in turn, means that in certain cases the ancient blocks can be put back where they belong. While the two long walls, north and south, were being reassembled an analytic study of the original positions of the blocks was carried out with the aid of an electronic computer and many mistakes from previous restorations by Pittakis (1837-1843) and Balanos (1902-1909) were corrected. The same thing happened during replacement of the North Porch ceiling coffers when the original ceiling construction was restored. In other cases, nevertheless, it proved preferable to repeat Balanos' restorations even though the errors of previous restorations had now been pinpointed; for example in reassembling both the geison of the south side of the South Porch ceiling and the west wall we repeated Balanos' arrangement in order to avoid recutting the ancient blocks and in resetting the west wall we were not able to determine what block went where because they had been altered beyond recognition in earlier reconstructions. Various architectural blocks which were in the Acropolis museum storerooms or scattered around on the ground have now been identified and restored to their original places. The Erechtheion project calls for setting up a copy of the northeast column of the East Porch and the corner geison above. The entire project is scheduled for completion by the end of 1985. Final publication of the project is to follow immediately.

In 1981—1982 a small-scale intervention was carried out in the Propylaia. The preliminary study was made, the work site set up, and the epistyle block above the 2nd intercolumniation from the south and the neighbouring blocks were taken down from the East Porch. The epistyle block, frieze, frieze backer and two cornice blocks were moved down to the ground and given conservation treatment. Missing fragments were restored in new marble attached by means of titanium rods and liquid cement; two pieces of the epistyle block were joined. The section of the building affected and all the phases of the project were documented with photographs and drawings and, lastly, the blocks were put back in place.

In 1983 the *Study for the Restoration of the Parthenon* was completed and published. The study includes a full analysis of the architecture, a concise survey of the history and vicissitudes of the Parthenon over the centuries, all interventions carried out up until 1983, the current proposals for intervention with an analysis of the principles and aims governing the proposals, and an account of the mechanical equipment to be employed. The study has one appendix on types of corrosion and methods of protecting building materials and a second on the problem of earthquake resistance. The study was presented to Greeks and foreigners at the *Second International Meeting for the Restoration of the Acropolis Monuments: Parthenon*, held in Athens in September of 1983. The aims of the study are as follows: to eliminate the causes of deterioration; to improve conservation and also the character of the building as a scientific and historical document and as a work of art. The study makes the following proposals: removing the iron and steel elements from previously restored parts of the building; removing all restorations in reinforced concrete carried out under Balanos and replacing them with Pentelic marble; resetting displaced architectural blocks in their original places; protecting the architectural sculpture now *in situ* and protecting the floors and steps of the building. The proposals for intervention on the Parthenon are arranged in twelve programs according to the parts of the building.

The first program, concerning the east side of the building, was presented in final form at the International Meeting in September and was unanimously approved by the specialists. As soon as the Parthenon work site has been installed this program will begin. Program 2 pertains to the north side; programs 3 and 4 to the south and west sides; program 5 to the pronaos; program 6 to the east cella wall, pronaos, inner dividing wall; programs 7 and 8 to north and south walls; programs 9, 10 and 11 to the west porch, the western chamber and the ceiling of the west wing; program 12 to the steps and floors of the temple.

Because the operation on the Parthenon is a matter of particular importance, other international meetings are planned where specialists will scrutinize and pass on final decisions concerning the restoration projects and special problems, e.g. the method of protecting the sculpture that is *in situ*, covering the west colonnade, protection against earthquakes; preliminary studies of these problems were presented at the meeting of September 1983.

1a. Erechtheion
1. Dismantling began in August 1979 with the removal of the architrave from the southwest corner
2. Taking down a section of the wall crown from the south wall
3. Taking down the architrave from the northern end of the west wall

b. Erechtheion
Inventory cards used to record architectural blocks during the dismantling process
Pencil and China ink on cardboard; 0.21x0.29 m.; scale 1:10
By A. Papanikolaou

2 a. Erechtheion
Final study for transporting the Caryatids to the Acropolis Museum
By A. Papanikolaou and K. Zambas (1979)

b. Erechtheion
Transporting the Caryatids on tracks to the Acropolis Museum (October, 1979)

c. Erechtheion
Two stages during the transferral of the Caryatids to the Acropolis Museum (October, 1979)

d. Erechtheion
Transferring the Caryatids to the Acropolis Museum (October, 1979)

3 a. Erechtheion
The iron beams which had been embedded in the architraves of the Caryatid Porch by N. Balanos
Pencil drawing; 0.75x0.51 m.; scale 1:10
By K. Zambas and A. Papanikolaou

b. Erechtheion
1. The iron reinforcement embedded in the architraves of the Caryatid Porch by N. Balanos, as they were found when the coffers were taken apart.
2. The new reinforcement made of titanium which replaced the iron one used in Balanos' restoration.

4 a. Erechtheion
1. Drawing of the podium for the Caryatids before dismantling.
2-3. Proposal for reassembling the podium
Pencil drawing; 0.73x0.49 m., 0.21x0.29, and 0.42x0.29 m.; scale 1:10 and 1:20
By A. Papanikolaou (1980)

b. Erechtheion
Repairing architectural blocks in the Caryatid Porch
1-2. Repairing the wall epistyle
3-4. Repairing the cymatium moulding on the podium.

5 a. Erechtheion
Restoration of the second ceiling coffer from the west in the Caryatid Porch
China ink; 0.52x0.77 m.; scale 1:10 and 1:2
By K. Zambas

b. Erechtheion
Repairing the cornice of the Caryatid Porch with new marble

6 a. Erechtheion. Caryatid Porch
Study for the new bearing system made of titanium
China ink; 1.16x0.52 m.; scale 1:10 and 1:15
By K. Zambas and A. Papanikolaou (1979)

b. Erechtheion. Restoration work on the coffered ceiling of the Caryatid Porch
1. Putting the first coffer from the west in place
2. Attaching the third coffer from the west

c. Erechtheion. Restoration of the coffered ceiling of the Caryatid Porch
1. Suspension and transport of the third ceiling coffer from the west
2. The porch after the ceiling coffers had been reset in place

7 a. Erechtheion
Successive phases of dismantling the south wall

b. Erechtheion south wall
Restoration in progress
1. View of the upper surface of the orthostates after the courses above had been taken down. The rusted clamps are from Pittakis' rebuilding operations.
2. View of the upper surface of the orthostates after cleaning off the mortar, removing the clamps and demolishing the masonry in back, all from earlier rebuilding operations.
3. View of the upper surface of the orthostates after setting newly made marble backers in place. The new titanium clamps have not yet been placed in the cuttings made for them.
4. Resetting the third course of the south wall above the orthostates.

8 a. Erechtheion
Determining the correct positions of the blocks in the south wall by means of a computer
China ink; 0.65x0.28 m. and 0.48x0.34 m.;
Study by K. Zambas, drawn by K. Moschouri (1982)

b. Erechtheion
View of the south wall as rebuilt by Balanos
Proposal done on the computer for assigning the blocks to their correct positions in the south wall (photomontage)

c. Erechtheion south wall
The dismantled wall blocks on the ground

9 a. Erechtheion. West wall
Conservation and reattachment of the first engaged column from the north (1982)

b. Erechtheion. Repairs with new marble
1. West wall. Repairing the base of an engaged column
2. South wall. Repairing a wall block.

c. Erechtheion. West wall
The dismantled wall blocks on the ground.

10 a. Erechtheion North Porch
1. Raising a section of a beam
2. Restoring a ceiling beam of the North Porch with a titanium reinforcement
3. Connecting the two sections of a beam

b. Erechtheion North Porch. Restoration in progress
1. Iron beams used in Balanos' rebuilding operations to suspend the marble ceiling beams. The corrosion of the iron beams and flanges is clearly to be seen.
2. Titanium beams that replaced the iron beams used by Balanos.

11 a. Propylaia East porch. Proposal for restoring the second architrave from the south.
Mending some of the fragments. The east and west faces of the architrave.
China ink; 0.45x0.30 m.; scale 1:10
By A. Tzakou (1982)

b. Propylaia East Porch. Proposal for restoring the second architrave from the south.
1. The architrave from above and from the side
2. The architrave as repaired, showing the inset titanium rods.

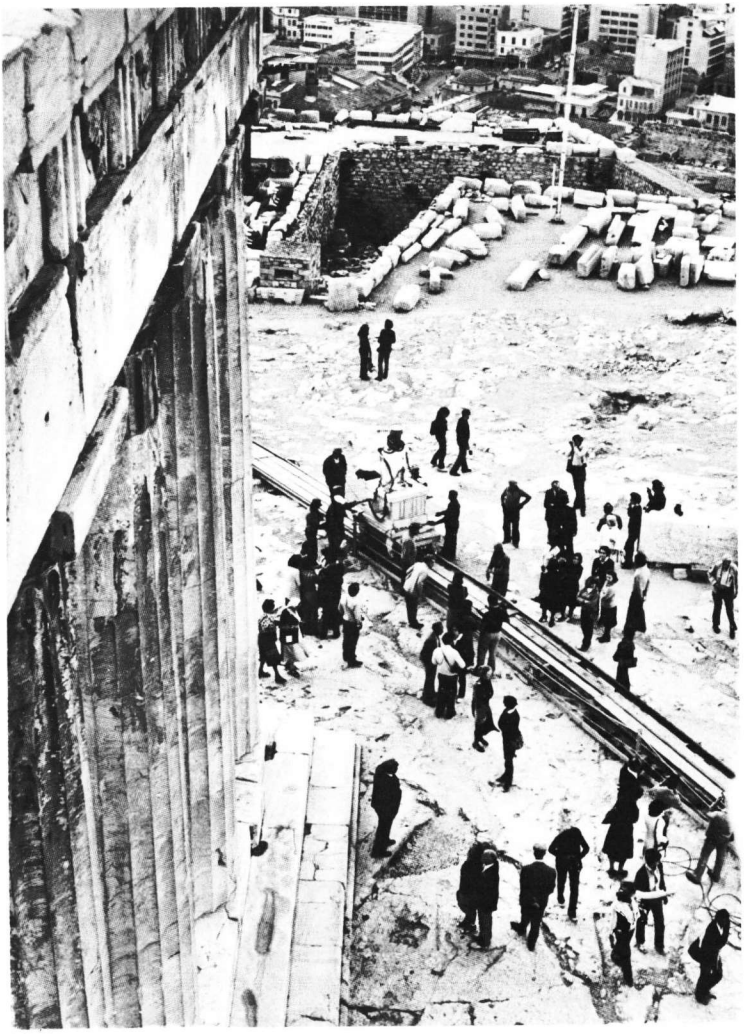
China ink; 0.45x0.30 m.; scale 1:10
By A. Tzakou (1982)

c. Propylaia East Porch
Conservation treatment for the architrave on the ground

12 a. Propylaia East Porch
1-3. Recording the area of the second architrave from the south during the dismantling operation
China ink; 0.43x0.31 m., 0.21x0.29 m. 0.29x0.21 m.; scale 1:10
By A. Tzakou (1982)

b. Propylaia East Porch
Restoration work on the architrave. Lowering the architrave to the ground

c. Propylaia East Porch
The architrave after restoration



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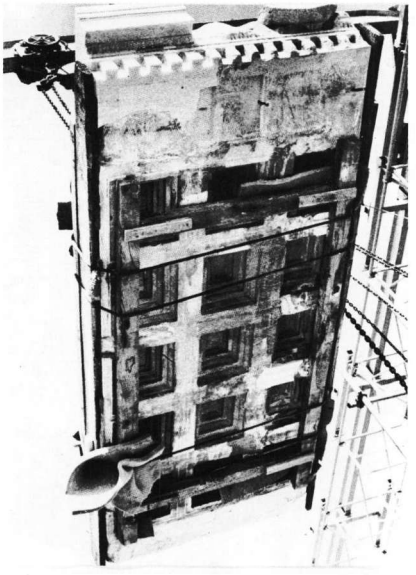

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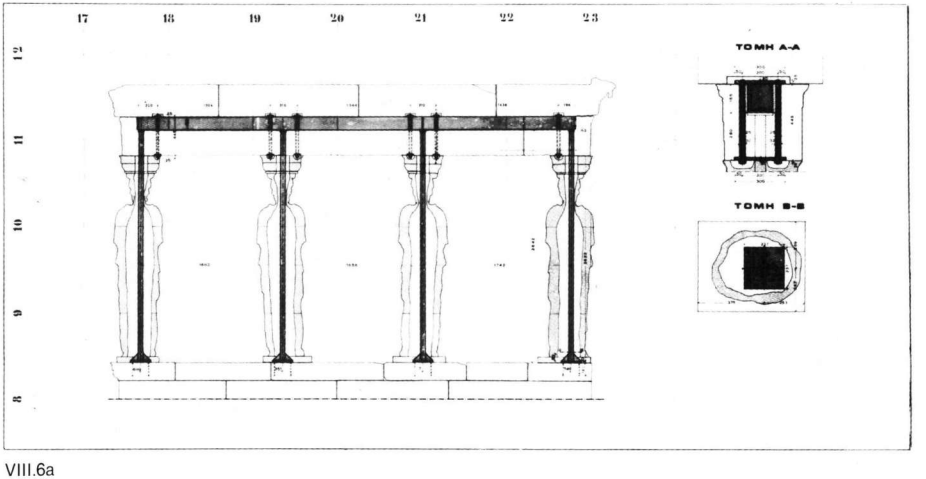

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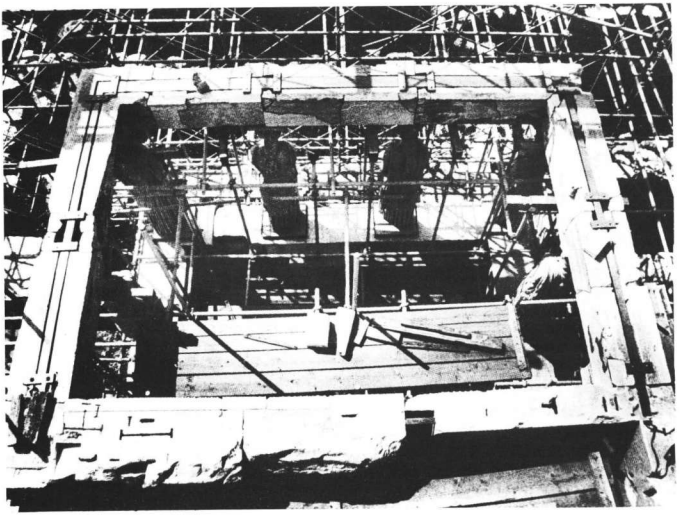

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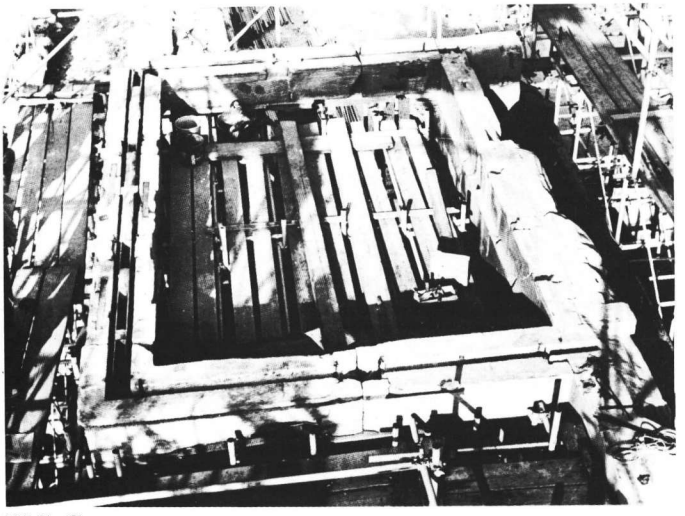

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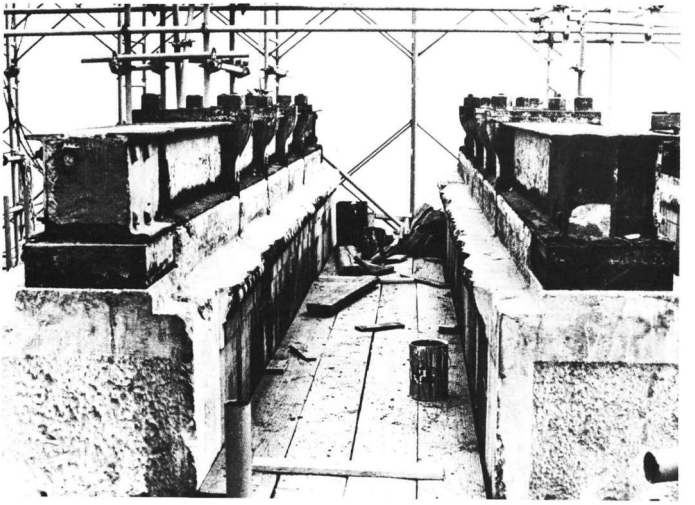

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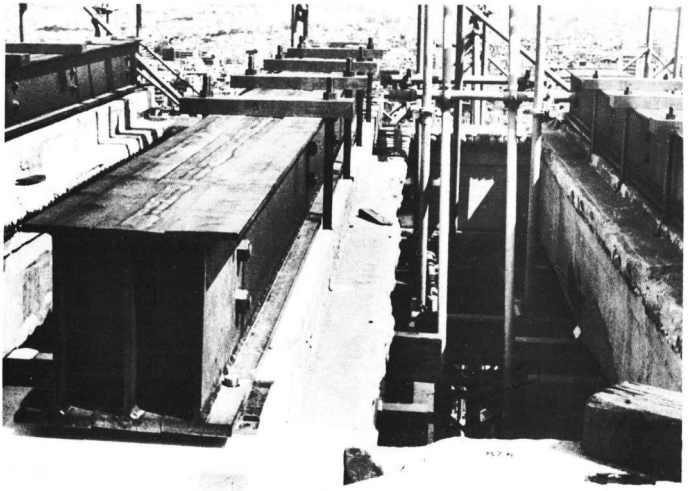

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IX.14a

IX. Research

IX. Research

New evidence has come to light as a result of recording the monuments, inventorying and identifying scattered architectural members, and dismantling the buildings; the new evidence has in turn led to fresh observations, clearing up uncertainties and has produced new interpretations as to the architecture and history of Acropolis monuments.

Thus, today, eight years after the Acropolis project began, our knowledge of the Acropolis monuments has been greatly enriched. Of course research on ancient monuments, particularly those on the Acropolis, is practically endless. The monuments themselves are always a source of information not only about architecture and sculpture but also in regard to the technology, economy, and the social and religious life of the time. Because the Acropolis Committee attaches great importance to the monuments as invaluable scientific documents, it adopted the principle of avoiding, insofar as possible, any work on parts of the building that have not been disturbed since ancient times, where the original jointing is still preserved. Intervention was to be limited to sections that had previously undergone restoration.
The restoration project has yielded new observations and information in regard to the three great Acropolis buildings: the Erechtheion, the Parthenon and the Propylaia on which the following work and research have been done up until now.

I. The Erechtheion
During the restoration project the architect in charge, A. Papanikolaou carried out a systematic study of the building throughout antiquity, with an evaluation of earlier studies and historical sources. The process of reassembling the ancient material led to interesting reconstructions; identification of architectural members produced new evidence used in reerecting the building as follows:

1. The east door-wall has been reconstructed with greater precision and the design of the south window in the east wall has been restored on the basis of ten large fragments. This window, shown here for the first time, will be permanently housed in the Acropolis museum.

2. While the south wall was being reerected a discovery was made about the five wedge-shaped apertures in the north and south walls. Up until now these apertures had been thought to belong to the church phase of the Erechtheion, but now it turns out, on the evidence of the way the stones were cut, that they are part of the original construction. The function of the apertures, which may be linked to the chthonic cult and rites performed inside the temple, will be the subject of a monograph.
3. The interior plan of the building has been investigated. A reconstruction of the west chamber as it was after the Roman repair (26 B.C.) has been drawn up. Various structural peculiarities have been interpreted, e.g. the niche inside the southwest corner held the lamp with the palm tree chimney, a work of the sculptor Callimachus, as reported by Pausanias, Book I.26.6
4. A restored drawing of the Erechtheion northeast court has been made and its function explained.
5. A little Ionic stoa has been discovered; it was built in the Pandroseion in the classical period, perhaps in Kimon's time. This stoa, which may have been a dedication, is the smallest ancient Ionic stoa known.
6. The many fresh observations about the temple which preceded the Erechtheion on the site led to a reconstructed drawing giving its plan and its dating at the time of Kimon.

II. The Parthenon
Investigation of virtually all of the ancient blocks that are on the ground and an intensive study carried out by the architect M. Korres from 1977 onwards have produced first-hand information and led to fresh observations on the construction and architecture of the temple. Thanks to this exhaustive research we now have adequate knowledge of the temple and vital new understanding of hitherto unknown or misunderstood features of the parts of the building that have not been preserved.

Investigation of the disiecta membra has led to the identification of a great number of architectural blocks, so that it is now possible to formulate proposals for restoration providing for rebuilding sections of the temple in which the ancient blocks will be reset where they belong. Should these proposals be put into effect the Parthenon will have, beyond what is standing now, much more of the cella walls, the colonnade and the cornice and the pronaos columns to the height of the architrave.
The following points have been the objects of special investigation:

1. The relation of the temple to the surrounding terrain, in ancient times and now. In ancient times the temple rose up in the middle of a large flat piazza. Because the earth fillings were removed during excavation and since that time the classical ground level never was restored, the relationship of the temple to the surrounding terrain is that of the Older Parthenon rather than that of the Parthenon.

2. It is now known that the cuttings for a base at the northeast corner of the Parthenon are for an important monument either contemporary with or later than the Older Parthenon which was either overhauled or replaced in the classical period.
3. The Parthenon cella had windows. Research demonstrated that the east wall had windows on either side of the great doorway; the windows are very high up and opened on the side aisles of the cella. These windows may be the oldest of their kind and appear to have had a strong influence on Athenian and Hellenistic architecture.
4. Technical and geological factors governing the architecture of the temple. Research showed that the properties and characteristics of the stone in the Penteli quarries and also the methods of quarrying determined the size of the blocks in the Parthenon. For the first time there has been an investigation into the entire process of planning and carrying out the quarry operations so as to produce the building units at the quarry, thus revealing the complicated theoretical calculations preceding the actual work.
5. Study of the phenomenon of creeping in Parthenon marble and fracturing of blocks. A detailed investigation of thermic fracture shows that the worst damage suffered by the Parthenon over the centuries was the ancient fire and not the explosion of 1687 as has been previously believed. In the explosion of 1687 fragments broke off en masse from blocks that had previously cracked due to thermic fracture.
6. The distribution of clamps and dowels in the Parthenon in relation to earthquake strain and an analytical investigation of the damage inflicted by the earthquake of 426 B.C. (Thucydides Γ89).
7. Investigation of peculiarities and irregularities in the Parthenon (excepting the refinements already known); new observations on the entablatures, doors, the ceiling design and the method of supporting the roof; correspondences between the structural design and formal composition.
8. The detailed study of blocks preserving distinctive features either unrelated to or incompatible with their final place in the building has greatly advanced the investigations of the following subjects: a) The Older Parthenon ; for the first time an exact plan and restoration of the cella façades to the height of the architraves has been drawn up; b) the stages of construction of the Parthenon; c) a well-documented reconstruction of the order in which the different parts of the building were erected; d) how the frieze was constructed; e) the cuttings and the unfinished or only partly finished surfaces.

Methodical recording and examination of the architectural material lying around on the ground led both to the identificication of a great number of architectural members mainly from the east wall and the east porch of the temple and to assigning many blocks to their right places, mainly in the north and south walls. These indentifications have led to proposals providing for the replacement of much of the newly-identified ancient material with limited additions of new material.

III. The Propylaia

In 1978 the architect A. Tanoulas began studying the Propylaia particularly the later phases. This intensive study has yielded the following results so far:

1. For the first time a complete survey of the building as it is now at a scale of 1:50 and reconstructed drawings of the classical building incorporating published information and quite a few original observations.
2. Finding out about a later repair, perhaps in the Roman period, to the superstructure of the Propylaia.
3. A study of the monument in the Middle Byzantine period (12th c.) and the Frankish period (1204-1458). The chapel east of the Propylaia north wing and certain arrangements in its ground floor are now assigned to the Byzantine bithop's dwelling. There is now a much more accurate understanding of the changes made in the Pinakotheke, the north wing and the area north of the central gate-building in the time of the Frankish dukes De la Roche (1204-1311) and also of the central building and the south wing (construction of the so-called Frankish Tower) in the time of the Florentine Acciajuoli family. A reconstructed drawing of the Propylaia as a mediaeval palace.
4. A study of the monument and the whole area of the western approach to the Acropolis during the Ottoman period and after, up until the beginning of the 20th century. The catastrophic effects of the big explosion of 1640 have now been traced.

IV. The Theatre of Dionysos

The project for recording and conserving the Theatre of Dionysos began in 1978. During this work a series of observations led to a new reconstructed drawing of the geometric pattern in the central lozenge of the orchestra. The bases that had originally been attached to the west parodos retaining wall were collected and identified; a reconstruction was drawn up after which five bases were reset in place.

1. Erechtheion
1. Reconstructed drawing of east door wall indicating the blocks that have been newly identified.
2. Bimetrical projection of the east door wall
3-4. Newly identified fragments of the cymatium moulding on the lintel over the east door
Pencil; 0.78x0.51 m., 0.30x0.20 m.; scale 1:20, 1:50, 1:2
By A. Papanikolaou (1980)

2. Erechtheion
Reconstructed drawing of the southern window in the eastern door wall
China ink; 0.47x0.87; scale 1:5
By A. Papanikolaou (1983)

3 a. Erechtheion
Proposal for restoring the northeast corner of the Erechtheion
China ink; 0.56x0.30 m., 0.48x0.30 m.; scale 1:50
By A. Papanikolaou (1977)

b. Erechtheion
Reconstructed perspective and plan of the Erechtheion north court at the end of the 5th century B.C.
China ink; 0.52x0.35 m., 0.48x0.35 m.; scale 1:50
By A. Papanikolaou (1980)

4 a. Erechtheion
1. The Pandroseion and the Erechtheion area in the mid-5th century B.C. Reconstruction
2. The Erechtheion and the Pandroseion in 406 B.C. Reconstruction
3. The Erectheion and the Pandroseion in 406 B.C. Plan
Water colour and China ink; China ink
Measurements: 0.25x0.20 m.; 0.25x0.15 m.; 0.60x0.40 m.
Scale 1:200
By A. Papanikolaou

b. Erechtheion
1. Reconstruction of the western chamber of the Erechtheion after the repair carried out in Roman times (25 B.C.)
2. The southwest niche which contained the lamp with the palm tree chimney made by Callimachus as Pausanias reports
3-4. Details of the southwest niche and the west cross wall. Reconstructed drawing
5. Reconstructed drawing of the east cross wall
China ink; 0.21x0.29 m.; scale 1:50
By A. Papanikolaou (1980)

5. Parthenon. East porch
Proposal for reconstruction 75% of which consists of recently identified original material which had been scattered around on the ground
China ink; 0.72x0.52 m.; scale 1:50
By M. Korres (1980)

6. Parthenon east and west façades
Actual state in 1983 and proposed reconstruction
China ink; 0.98x0.60 m.; scale 1:80
By M. Korres (1980)

7 a. Parthenon. South colonnade
Actual state in 1983 and a proposal for reconstruction
China ink; 0.95x0.60 m.; scale 1:80
By M. Korres (1980)

b. Parthenon. North colonnade
Actual state in 1983 and proposal for reconstruction
China ink; 0.95x0.60 m.; scale 1:80
By M. Korres (1982)

8 a. Parthenon. Southwest section of the building
A measured plan of the southwest part of the main building showing the older material behind the orthostates and the mediaeval spiral stairway (10th century)
China ink; 0.50x0.69 m.; scale 1:20
By M. Korres (1980)

b. Parthenon. East wall
Reconstructed drawing of southern window in the east door-wall
China ink; 0.25x0.53 m.
By M. Korres (1981)

9. Parthenon cella
Analytical bimetrical projection of the southeast part of the cella from the southwest (reconstruction 0^0, 1:20/45^0, 1:40/90^0, 1:20). The drawing sums up the most recent observations and discoveries
China ink; 0.84x1.19 m.
By M. Korres (1980)

10. Parthenon cella
Analytical bimetrical section of the southeast part of the building (reconstruction 0°, 1:20/60°, 1:40/60°, 1:20). The most recent observations on the architecture are summed up in the drawing.
China ink; 0.62x1.16 m.
By M. Korres (1980)

11. Parthenon
Analytical bimetrical projection, cross section of the southwest part of the building (reconstruction 0°, 1:20/60° 1:50/90° 1:20). The most recent observations on the architecture are summed up in the drawing.
China ink; 0.46x0.62 m.;
By M. Korres (1978-1983)

12 a. Parthenon
1. The Older Parthenon (first marble Parthenon) under construction (488-485 B.C.) Reconstructed drawing.
2. Reconstructed perspective of the western chamber at the time of its completion.

China ink; 0.29x0.42 m. 0.69x0.50 m.
By M. Korres (1980, 1979)

b. 1. Parthenon. Restoration program 1. East side. Reconstructed drawing of the lion head pseudo-spout at the northeast corner from the east.
2. North end of the east pediment. Reconstructed drawing of the corner and the rooftiles.

China ink; 0.47x0.53 m., 0.65x0.49 m.; scale 1:2, 1:10
By M. Korres (1981)

13 a. Parthenon
Special device for lowering a ceiling beam in place (bimetrical reconstructed drawing 1:20, 1:40)
China ink; 0.75x0.52 m.; scale 1:10
By M. Korres (1983)

b. Parthenon
Using levers to set a block in course 20 of the east wall. Reconstruction.
China ink; 0.44x0.37 m.; scale 1:10
By M. Korres (1983)

14 a. Parthenon
The Parthenon marble quarry. Reconstructed drawing of the original appearance of the quarry. Perspective view from the south.
China ink; 0.42x0.79 m.
By M. Korres (1983)

b. Parthenon
Reconstructed drawing on the type of crane to be used in the Parthenon project.
China ink; 0.42x0.64 m.; scale 1:50
By M. Korres (1980)

15 a. Propylaia
Reconstruction of the building in classical times. West elevation
Scale 1:50
By A. Tanoulas (1983)

b. Propylaia
Reconstruction of the building in classical times Section on the axis of the central building Looking north
Scale 1:50
By A. Tanoulas (1983)

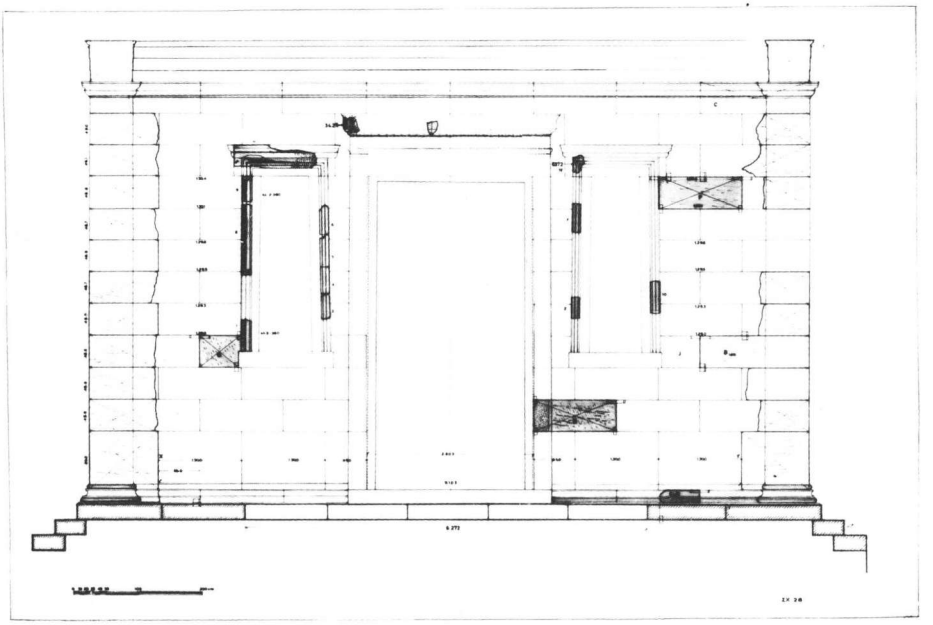
16 a. Propylaia
Reconstruction of the building in the 15th cent. Ground floor plan
Scale 1:75
By A. Tanoulas (1983)

b. Propylaia
Reconstruction of the building in the 15th cent. West elevation
Scale 1:75
By A. Tanoulas (1983)

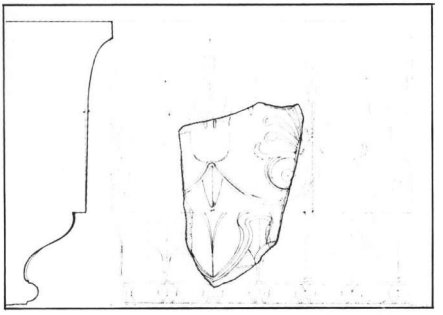
17. The Theatre of Dionysos. Orchestra
The central pattern in the marble floor. Drawing and reconstructed drawing
Reproductions; 0.75x0.50 m.; scale 1:20
Recorded by W. Wurster, drawn by M. Korres and L. Valakas (1980)

18. The Theatre of Dionysos. West parodos
1. Reconstructed drawing of the bases and a representation of the entire area
2. Drawing of the west parodos retaining wall

China ink; 1.16x0.52 m., 1.16x0.23 m.; scale 1:25
By M. Korres (1982)



IX.1(1)



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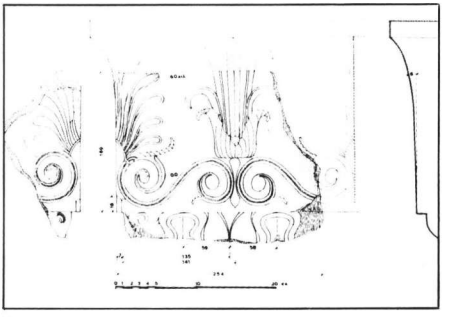

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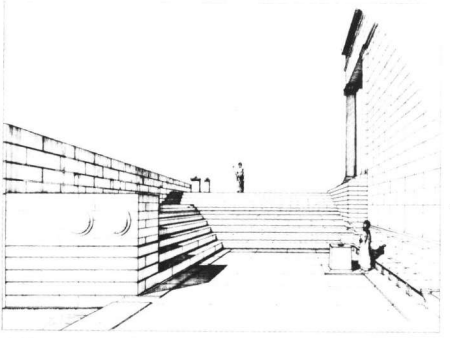
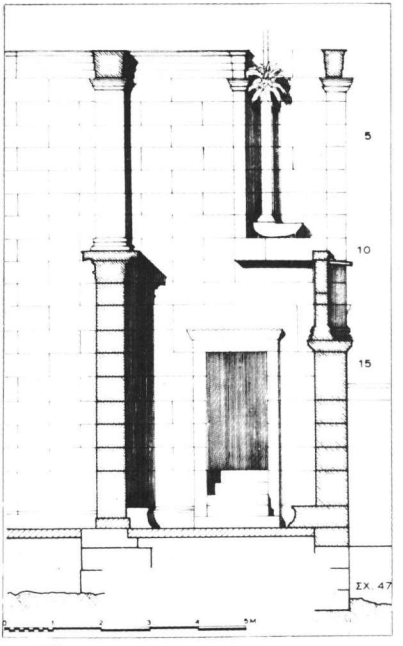
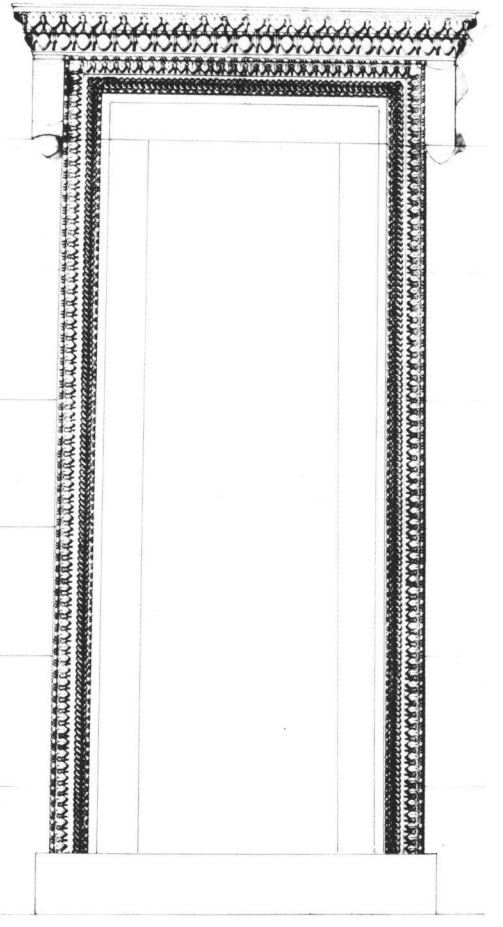


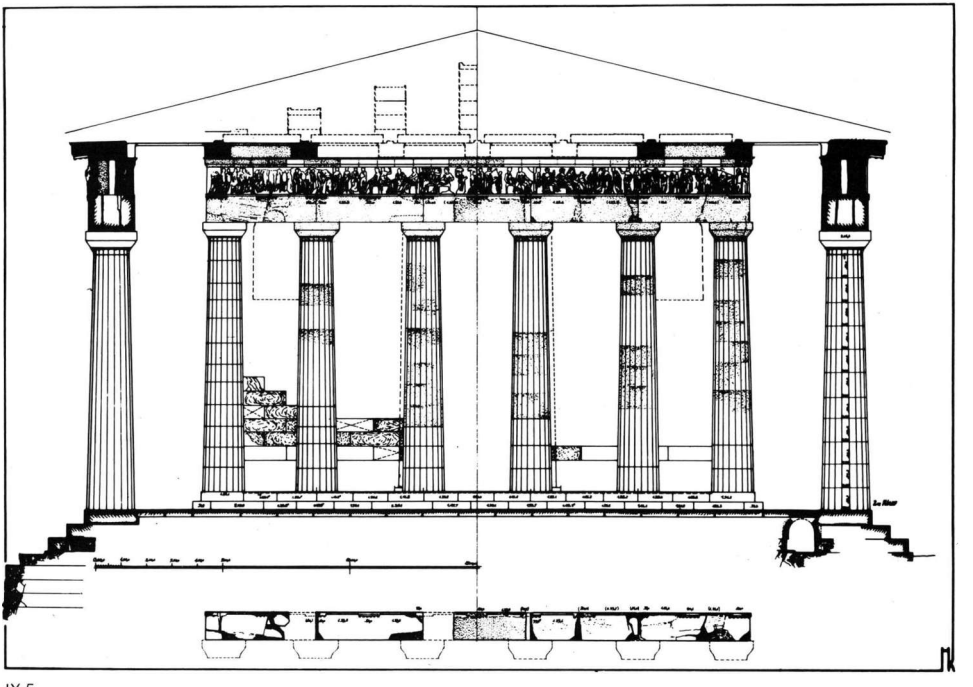
IX.3b



IX.4b(2)



IX 2



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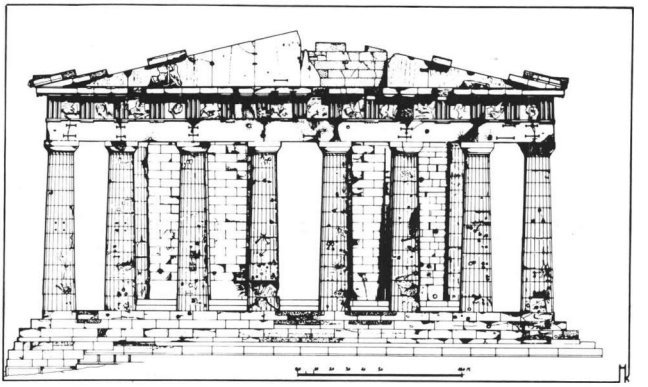

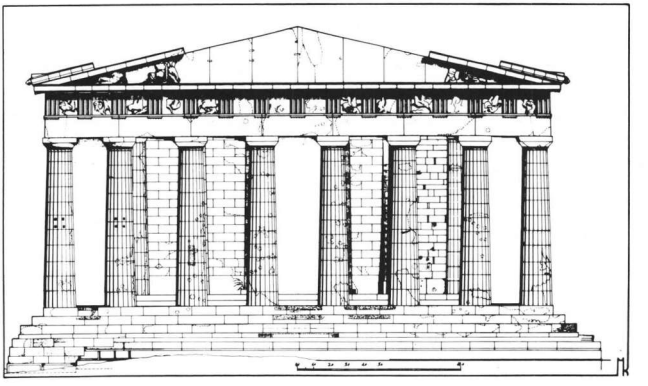

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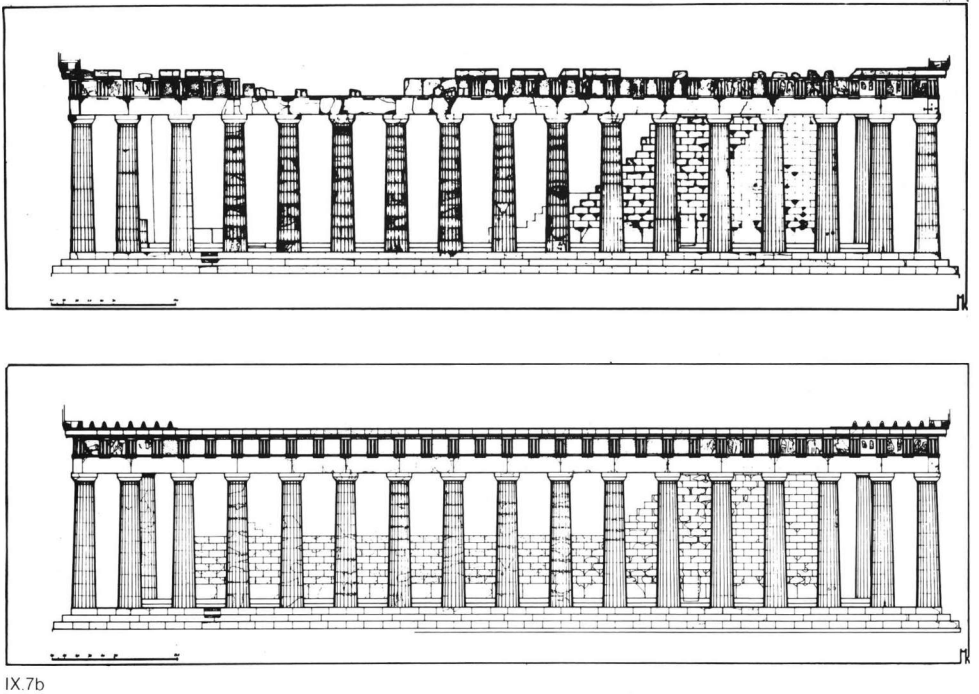

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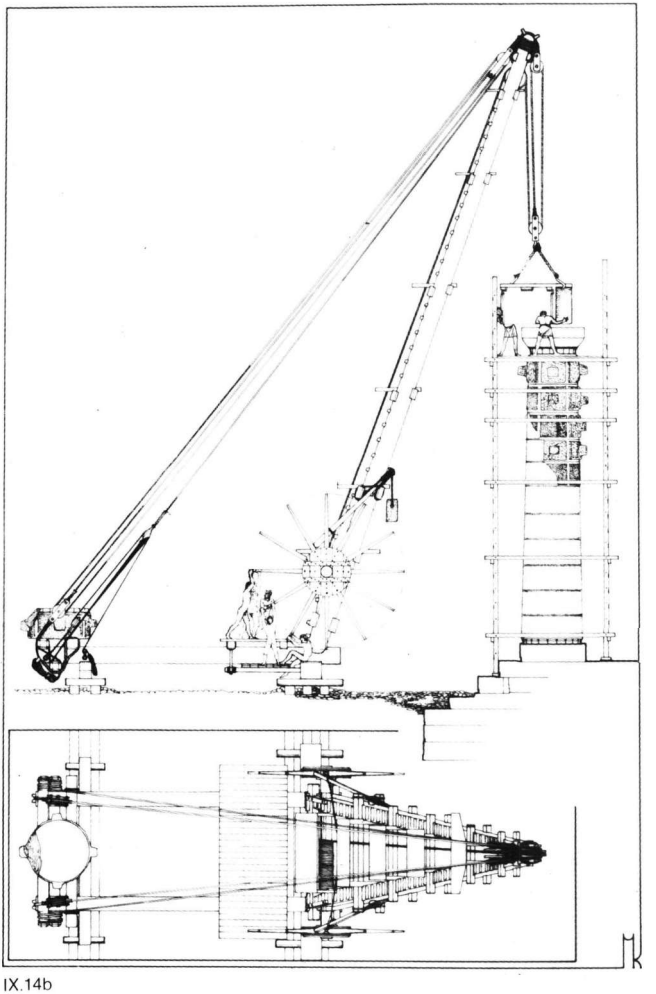

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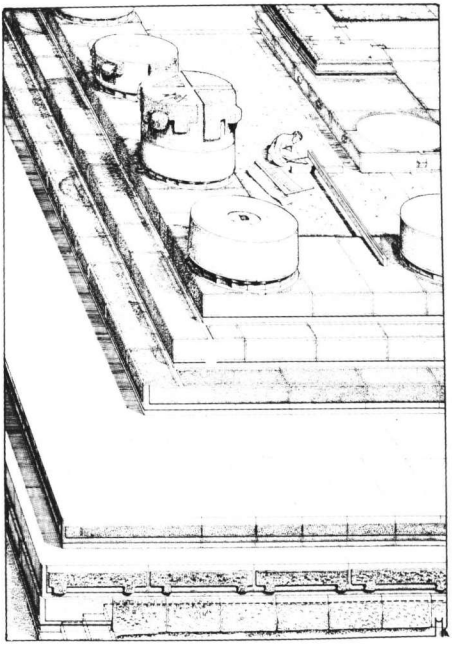

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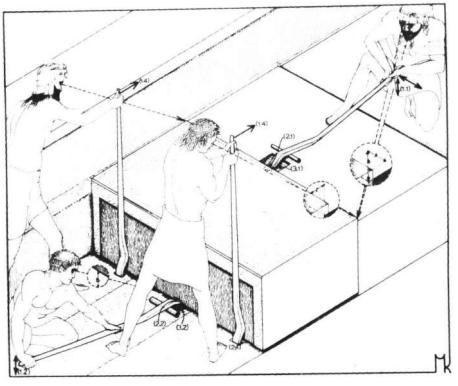

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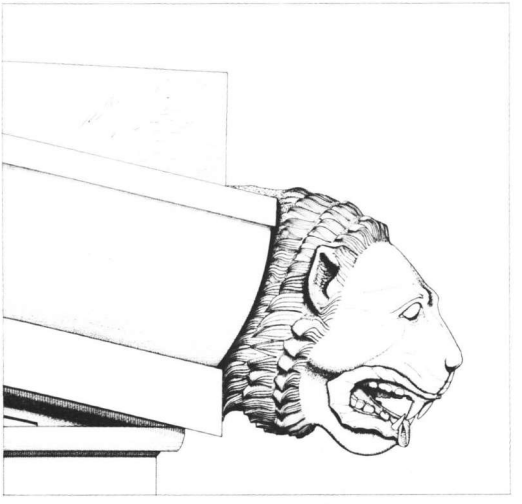

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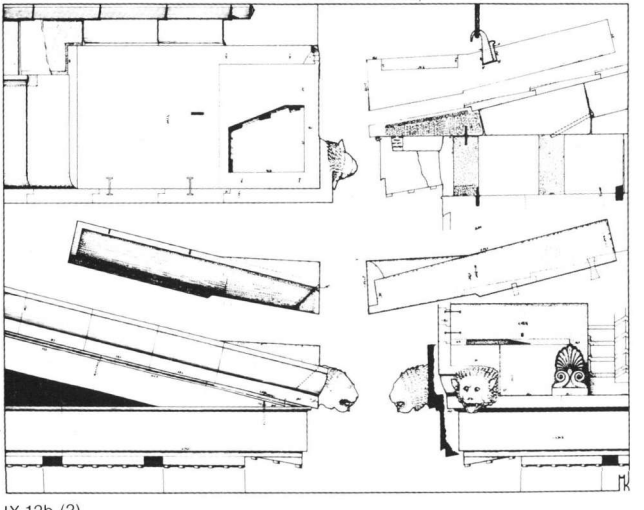

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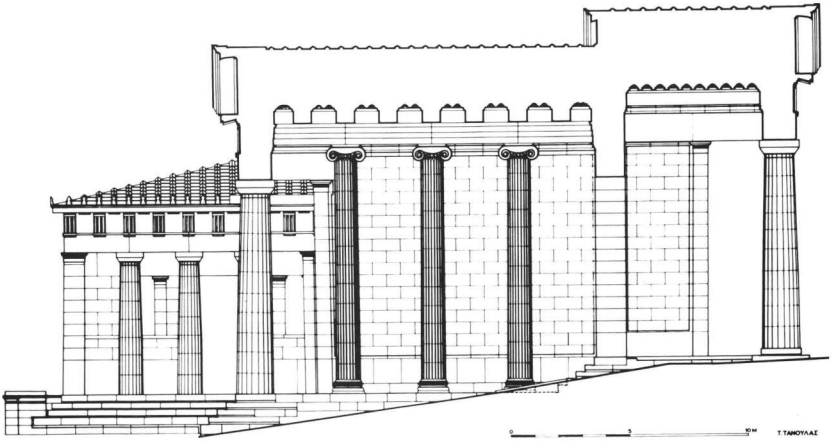

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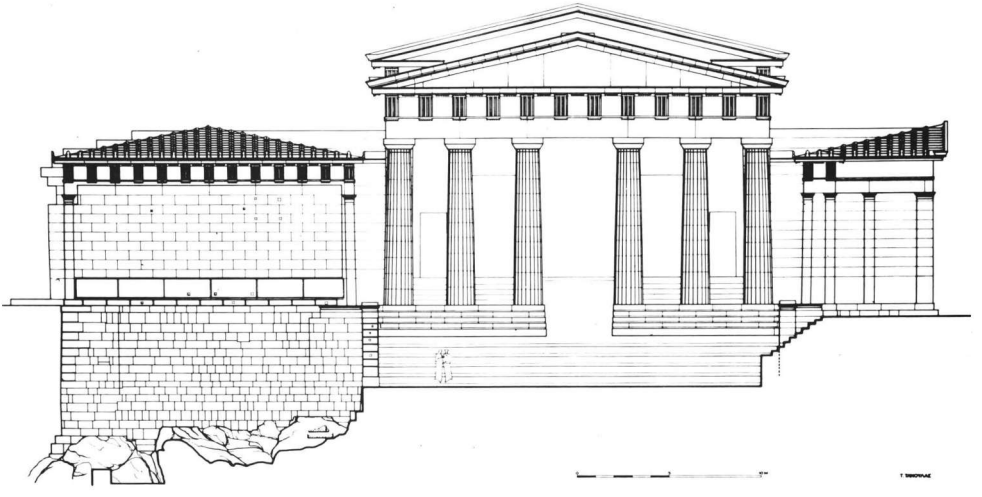

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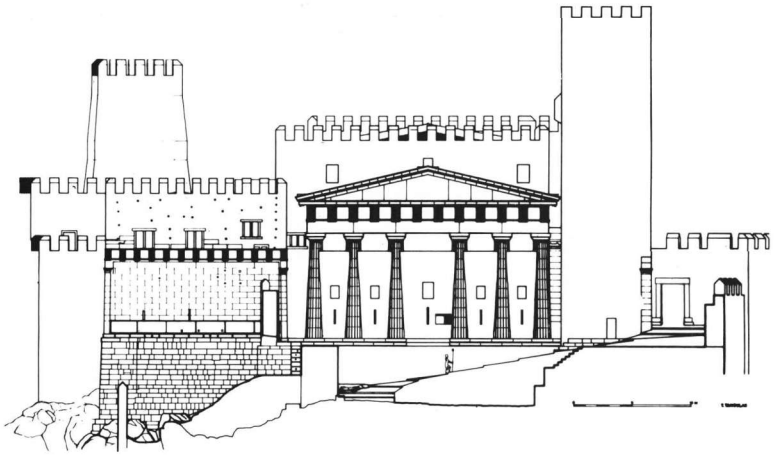
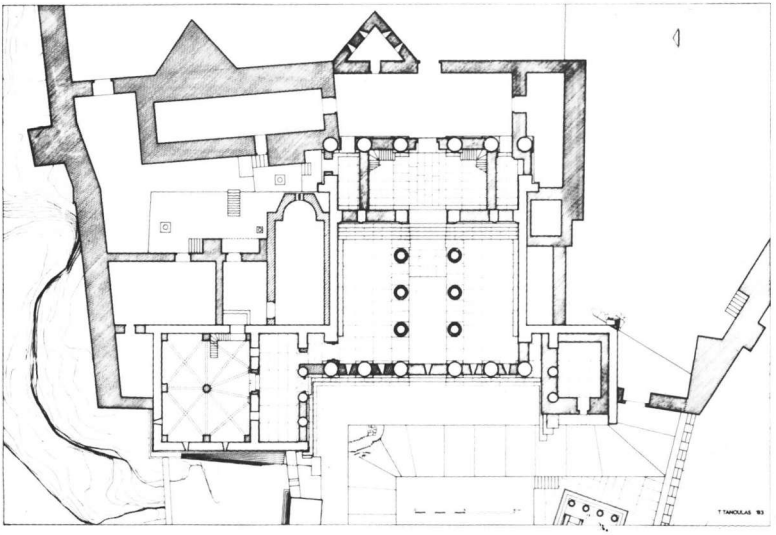


IX.16b



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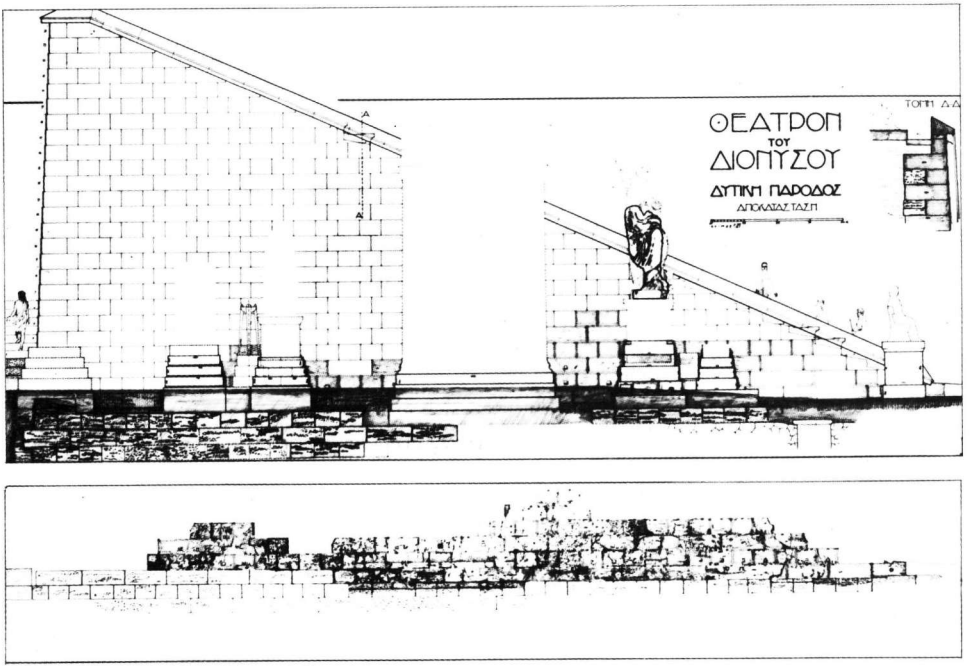


IX.18

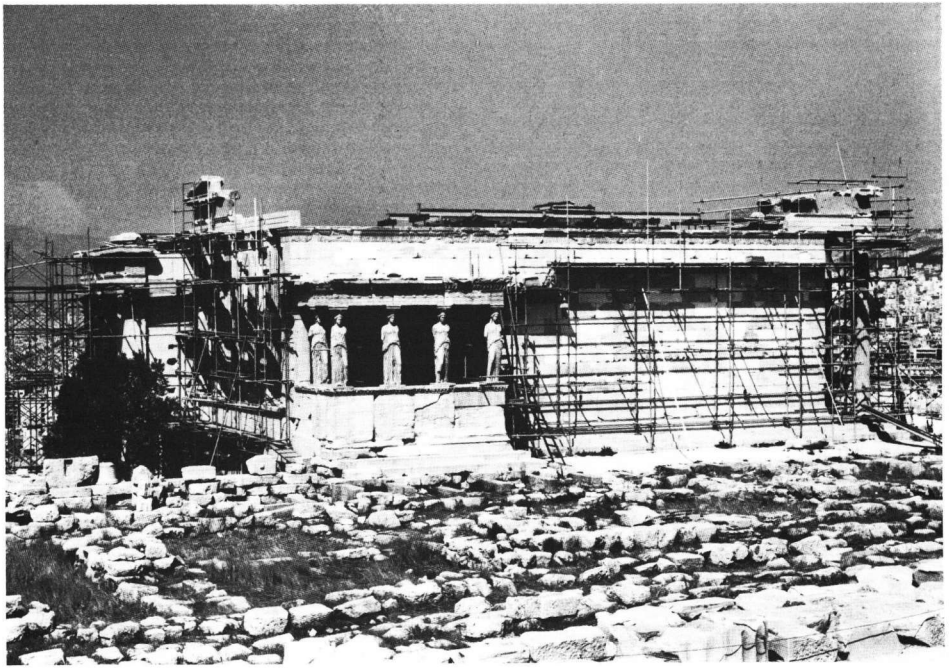
X. The monuments after restoration

The current intervention aims to save and preserve for future generations the Acropolis monuments, worldwide symbols of classical culture. When the work is completed the most important cause of deterioration, fracturing due to embedded iron attachments, will have been eliminated from the Parthenon, Erechtheion, Propylaia and the temple of Nike. A major part of the other dangers now constituting a threat will have been removed. Because of the increase in static sufficiency the buildings will, in great measure, be able to protect themselves against natural disasters.

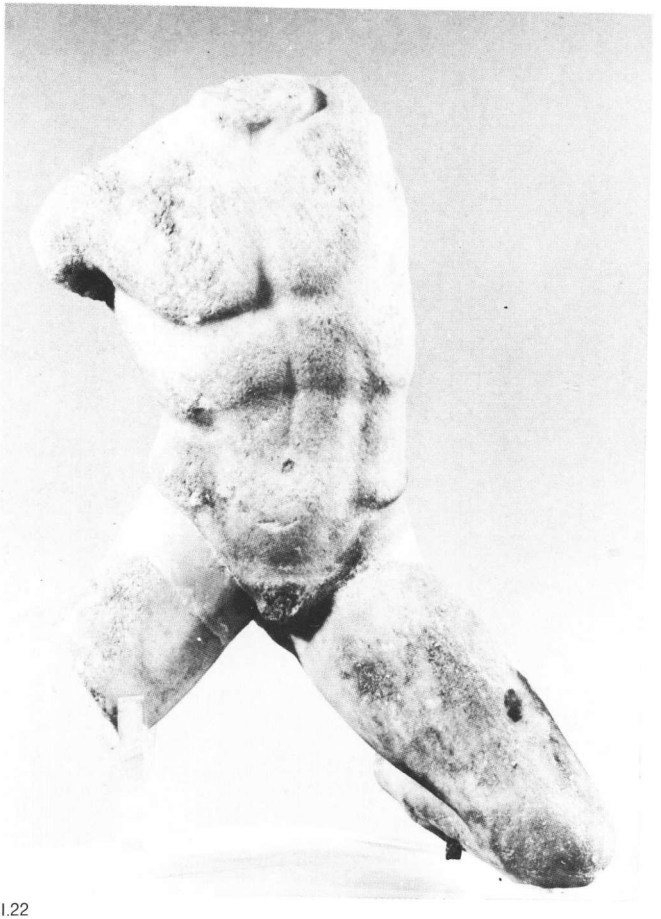
Restoration of certain parts of the buildings, while not substantially affecting their general appearance so well-known all over the world, will contribute to a deeper understanding on the part of a wider public and will display their unique artistry to better advantage. The monumental ensemble will be preserved as truly ancient buildings, their genuiness guaranteed by these precautions: rebuildings to be limited mainly to resetting ancient blocks, now scattered around; keeping new additions to a minimum; the reversibility of the operations; and scientific documentation. When the restoration is finished the Acropolis monuments will appear revivified, rid of errors of past interventions, harmonious, in equilibrium and in accord with their original construction.

Beginning with 1975 a new chapter is being added to the long centuries of Acropolis history. A chapter, bearing the hallmarks of 20th century which looks ahead to the 21th century when the final verdict will be returned.

X.1. Erechtheion
The south wall of the Erechtheion restored (1985)



X.1



XI.22

XI. Investigating and attributing fragments of architectural sculpture

XI. Investigating and attributing fragments of architectural sculpture.

Since the time of Kyriakos Pittakis one of the main concerns of scholars working on Acropolis monuments has been to search for, gather up, preserve and study fragments of architectural and other sculpture. The sculpture collections, which were considerably augmented by the large-scale excavations of the Acropolis in 1885-1890, were first temporarily kept in various places and structures on the Acropolis until the Acropolis Museum was built (1865-1874). The new finds necessitated enlarging the Museum and rearranging the exhibits. After World War II the Museum was again enlarged, all of the gallery displays were entirely redone and two storerooms were added for sculpture and architecture that could not be exhibited.
Systematic study of the fragments, attempts to make joins and to attribute them to known ensembles, particularly of architectural sculpture, had gone on without a break in the past; these activities were intensified in the years following World War II in connexion with the reorganization of the Museum. New material was then identified in the storerooms of the Acropolis or even in the National Museum or in the marble dumps of the Acropolis, and some new pieces came to light on the Acropolis slopes as well. Identifications were made mainly on the basis of style, scale, technical details and other external evidence. In some cases drawings made by early travellers (Carrey and oth.) provided evidence for the identifications. It often happened that fragments now in foreign museums (The British Museum, the Louvre) were identified as belonging to Acropolis sculpture. In these cases identifications were verified by exchanging casts. These researches have been constantly increasing our knowledge of the architectural sculpture and sometimes gave valuable help in reconstructing the scenes represented in the sculptural compositions. The new material was of course systematically recorded, the fragments were numbered and inventoried, they were photographed. Most of them were published.

The fragments on display come mainly from the Parthenon pediments, the frieze and the metopes, and from the temple of Athena Nike and the Erechtheion. Most of the fragments are in the Acropolis Museum; a smaller number from the storerooms of the National Museum also are known to come from the Acropolis, with the exception of a few pieces whose provenience is not recorded. These latter may be however securely attributed on the basis of internal and external evidence.
The work of searching for new unidentified material continues after the Acropolis Committee was formed, in connexion with the restoration projects. The marble dumps have been systematically dismantled and new valuable fragments, mainly architectural, have been discovered.

PARTHENON - PEDIMENTS

1.2.3.4.5. Five new fragments belonging to the Athena in the Parthenon west pediment.

Five hitherto unknown fragments found in the Acropolis storerooms have been added to the figure of Athena in the Parthenon west pediment: part of the aegis and part of her right shoulder (these fragments make joins with the body), the two feet and part of the forearm with shield strap (which certainly belong to Athena to judge by the scale, the workmanship and Carrey's drawing). A plaster cast of her body is shown, supplemented by casts of the joining fragments in the Acropolis Museum.

1. Aegis fragment. Acropolis Museum no. 6663. H. 17cm., W. 24 cm., Th. 28 cm.
2. Fragment of right shoulder. Acropolis Museum no. 7323. H. 27 cm., W. 26 cm.
3. Right foot. Acropolis Museum no. 7397. H. 15 cm., W. 35-39 cm., Th. 17 cm.
4. Left foot. Acropolis Museum no. 2271. H. 26 cm., W. 18 cm., Th. 20 cm.
5. Left forearm with shield strap. Acropolis Museum no. 9242. H. 18 cm., W. 16 cm., W. 16 cm.

Bibliography: M. Brouskari, "From the Parthenon west pediment" (in Greek), *Deltion* 24 (1969) A, 10-11, fig. 2, pls. 6 γ, 8 α-γ, 9 α-γ. Idem, "Parthenon-Fragmente", *AM* 75 (1960) 8, pl. 10:1. J. Marcadé, "Zu den 'Skulpturen der Parthenon-Giebel", *BCH* 88 (1964) 636, figs. 9-10.

M.B.

6. Fragment of right foot of colossal male figure
Heel, ankle and start of shin are preserved. The slope of the sandal shows that the foot slants sharply inward. The fragment is attributed to the west pediment Poseidon, as shown in the Carrey drawing, on the basis of the indubitably Parthenonian style and scale.

Acropolis Museum no. 7600
H. 25 cm.; L. 28 cm.; Th. 13 cm.

Bibliography: M. Brouskari, "From the west pediment" (in Greek), *Deltion* 24 (1969) A, 9, fig. 2, pl. 6 α-β. M.B.

7. Back of head and nape of neck from a male figure
The fragment is attributed to Figure H (Hermes) of the Parthenon west pediment on the basis of workmanship, scale and agreement with Carrey's drawing of Figure H.

Acropolis Museum no. 2286
H. 32 cm.; W. 27 cm.

Bibliography: M. Brouskari, "From the west pediment", (in Greek), *Deltion 24* (1969) A, 12, fig. 3, pl. 10 M.B.

8. Right thigh of over-lifesized male figure. Cast.
The thigh, preserved to below the knee, joins break on break with the start of the right thigh of Figure H (Hermes) from the Parthenon west pediment.

National Museum no. 5676
H. 56 cm.; maximum and minimum widths above: 29.7 and 26.8 cm.; maximum and minimum widths below: 16.2 and 15 cm.

Bibliography: G. Despinis, *Parthenoneia* (in Greek), Athens, 1982, 7-8, no. 1.8, pls. 7-11; cf. *Parthenon - Kongress Basel*, Mainz, 1984, 294, pl. 38:3-6. G.D.

9. Upper part of the body of a male figure
Mended up from three joining fragments. The modelling of the torso, the weathering and the pose of the head and arms, as they may be reconstructed, permit the attribution to Figure S of the west pediment which, according to the Carrey drawing, was seated on the knees of the female figure T. The fragment of right shoulder was already known from a cast in the British Museum.

National Museum no. 5678
H. 28.5 cm.; maximum W. 43.2 cm.

Bibliography: G. Despinis, *Parthenoneia* (in Greek), 10-14, no. 1.11, pls. 15-16; cf. *Parthenon - Kongress Basel*, Mainz, 1984, 294 f., pl. 41:3-4

G.D.

10. Fragment of a horses' left hindleg
The fragment comes from one of the horses of Athena's team on the Parthenon west pediment. The attribution was made on the basis of scale, modelling and chiefly because the outside of the leg has the same kind of chopped off surface that has been noticed on other Parthenon pediment sculpture.

National Museum no. 5677
H. 49 cm.

Bibliography: G. Despinis, *Parthenoneia* (in Greek), 8-10, no. 1.9, pl. 14; cf. *Parthenon - Kongress Basel*, Mainz, 1984, 294, pl. 40:4-5 G.D.

11. Left hand from a colossal statue
The hand belongs to a statue of Zeus holding the shaft of a winged thunderbolt. The bronze wings were separately inserted in the small holes in the middle of the thunderbolt. The rays of the thunderbolt, also of bronze, were affixed in the holes in the socket - like end of the shaft. Even though the provenience of this fragment is not known, the style and the weathering make it highly likely that the hand belongs to the statue of Zeus seated in the centre of the Parthenon east pediment.

National Museum no. 5679
H. 39.2 cm.

Bibliography: G. Despinis, *Parthenoneia* (in Greek), 15-21, pls. 17-21.1; cf. *Parthenon-Kongress Basel*, Mainz, 1984, 295 f., pl. 42:1-4 G.D.

METOPES

12. Fragment of a male head
The iconographic factors, the wide open eye, the disordered hair on the cranium, the rough thick locks over the forehead, the tufts of hair at the temples, taken together with the fact that this fragment, like all of the damaged east metopes, has been hacked with a sharp instrument clinches the identification with the head of a giant from the Parthenon east metopes.

National Museum no. 673
H. 13 cm.

Bibliography: G. Despinis, *Parthenoneia* (in Greek), 1-3, no. 11, pl. 1; cf. *Parthenon-Kongress Basel*, Mainz, 1984, 293, pl. 36:1-2. G.D.

13. Shoulder of naked male figure
This fragment is attributed to the torso Acropolis Museum no. 715 from the south metopes on the basis of anatomical rendering and style.

Acropolis Museum no. 7330
H. 25 cm.; W. 17 cm.; Th. 16 cm.

Bibliography: M. Bruskari, "Metopen Fragmente des Parthenon," *AM* 80 (1965) 134, fig. 2, Beilage 43:1-2 M.B.

14. Torso of a male figure
Identified as the body of the Lapith of south metope XXII on the basis of the style and agreement with the Carrey drawing.

Acropolis Museum no. 7251
H. 49 cm.; W. 21 cm.; Th. 21 cm.

Bibliography: M. Bruskari, "Metopenfragmente," *AM* 80 (1965) 132, Beilage 44:1-2
M.B.

FRIEZE

15. Fragment of Parthenon east frieze, slab VI
Fragment giving part of the hands of Artemis who is shown on slab V. A cast of slab VI together with a cast of the new fragment is on display.

Acropolis Museum no. 9447
H. 28.5 cm.

Bibliography: G. Despinis, *Parthenoneia* (in Greek), 6, no. 1.7, pl. 6 G.D.

16. Fragment of lower right hand corner of slab II, east frieze
Left leg of a female figure, clad in chiton and himation, facing right. Attributed on the basis of the quality of the style, the scale and the subject matter.

National Museum no. 5674
H. 26.7 cm.; W. 13.3 cm.; Th. 12 cm.

Bibliography: G. Despinis, *Parthenoneia* (in Greek), 3-4, no. 1.2, pl. 3.1; cf. *Parthenon-Kongress Basel*, Mainz, 1984, 293, pl. 36:4 G.D.

17. Fragment of relief. Lower part of draped figure walking left
Attributed to the Parthenon north frieze, probably slab VII with musicians, on the basis of material, style and subject matter.

Acropolis Museum no. 7411
H. 46 cm.; W. 34 cm.

Bibliography: M. Brouskari, *Deltion* 27 (1972) A, 138-139, 311, pls. 47-48 (in Greek). M.B.

18. Fragment of north frieze slab XVI
Hand of a charioteer; this fragment joined slab XVI of the north frieze.

Acropolis Museum no. 3743
H. 15.5 cm.; W. 19 cm.; Th. 19.5 cm.

Bibliography: M. Bruskari, "Parthenon-Fragmente," *AM* 75 (1960), 5, Beilage 4 M.B.

19. Two joining fragments of north frieze slab XX
Part of an apobates and horses' legs. Both of these fragments were previously known. They have now been found to join and they belong to slab XX in the north frieze.

Acropolis Museum nos. 1065 + 1039
H. 63 cm.; W. 61 cm.

Bibliography: M. Bruskari, "Parthenon-Fragmente," *AM* 75 (1960) 7, no. 16, Beil. 11 M.B.

20. Fragment of relief with horses' legs. Plaster cast.
This fragment from north frieze slab XVIII gives the forelegs of horses on slab XIX. Slab XVIII had already disappeared by the time Carrey drew the frieze. The fragment had been built into the wall of a house on the Acropolis north slope.

Acropolis Museum no. 13291
H. 47 cm.; W. 20 cm.

Bibliography: M. Bruskari, "Paralipomena aus dem Parthenonfries," *Festschrift für Frank Brommer,* Mainz/Rhein, 1977, 65, pl. 20. M.B.

21. Fragment of a relief representing the tip of a rider's foot and a bit of horse's leg.
The fragment joins figure 56 of south frieze slab XXII in the British Museum. It belongs to slab XXIII known only from Carrey's drawing.

Acropolis Museum no. 7417
H. 15.5 cm.; W. 11 cm.; Th. 8.5 cm.

Bibliography: M. Bruskari, "Parthenon-Fragmente," *AM* 75 (1960) 4, Beil. 2. M.B.

THE TEMPLE OF ATHENA NIKE

22. Statuette of a naked male figure in a posture of defence.
Thje statuette is assigned to a pediment of the Athena Nike temple on the basis of stylistic and technical evidence.

National Museum no. 5367
H. 26.2 m.

Bibliography: G. Despinis, "The pediment sculpture of the temple of Athena Nike," (in Greek), *Deltion* 29 (1974) A, 1-6, no. 1, 273-275, pls. 1-5. G.D.

23. Right foot
Assigned to a pediment of the Athena Nike temple on the basis of stylistic and technical evidence.

National Museum no. 5368
H. 4 cm.; L. 7.2 cm.

Bibliography: G. Despinis, "The pediment sculpture...", (in Greek), *Deltion* 29 (1974) A, 10-11, no. 2, 273-275, pl. 14:1-2. G.D.

24. Fragment of drapery on a plinth.
Probably part of a himation falling straight down and reaching the ground. Assigned to a pediment of the temple of Athena Nike.

National Museum no. 5369
H. 5.5 cm.; W. 8.5 cm.

Bibliography: G. Despinis, "The pediment sculpture...," (in Greek), *Deltion* 29 (1974) A, 11, no. 3, 273-275, pls. 14.3 and 15. G.D.

25. Naked male torso.
Preserved from base of throat to below the waist. The marble, the proportions, the way the body turns and moves, the weathering and a comparison with the figures on the east frieze of the temple of Nike, all of these factors make the attribution of this torso to a pediment of the Nike temple certain.

Acropolis Museum no. 2791
H. 15.8 cm.; W. 12.5 cm.

Bibliography: G. Despinis, "The pediment sculpture...," (in Greek), *Deltion* 29 (1974) A, 13, no. 5, 273-275, pls. 18-19. G.D.

26. Left foot.
Part of foot and ankle preserved with the sole of the sandal shown in relief. It probably belongs to a figure moving briskly to the right. Attributed to the pediment sculpture of the Nike temple.

Acropolis Museum no. 6865
H. 3.7 cm.; L. 7.7 cm.

Bibliography: G. Despinis, "The pediment sculpture...," (in Greek), *Deltion* 29 (1974) A, 14, no. 6, 273-275, pl. 20. G.D.

27. Right foot on a plinth
The foot is broken off at the ankle. It probably belongs to a figure in the centre of the Nike temple pediment.

Acropolis Museum no. 242
L. 9 cm.; H. 6 cm.

Bibliography: G. Despinis, "The pediment sculpture...," (in Greek), *Deltion* 29 (1974) A, 14, no. 7, 273-275, pl. 21. G.D.

28. Female head with helmet.
Technical and stylistic evidence make it likely that the head belongs to the Nike temple pediment sculpture.

Acropolis no. 4303
H. 8 cm.

Bibliography: G. Despinis, "The pediment sculpture...," (in Greek), *Deltion* 29 (1974) A, 12-13, no. 4, 273-275, pls. 16-17. G.D.

29. Lower part of relief of Nike from the parapet of the Athena Nike temple
The Nike faces right and is very similar to the Nike facing left on the south side of the parapet, first from the west, Acropolis Museum no. 974.

Acropolis Museum no. 7304
H. 54 cm.

Unpublished. To be published by M. Brouskari. M.B.

ERECHTHEION

30. Upper part of the head of the 6th Erechtheion Caryatid
Parts of the hair, kalathos and abacus are preserved. The sixth Caryatid is known to have been missing from at least as early as the early 18th century. Perhaps it was injured in the explosion of 1687 and the fragments dispersed (see also no. 31 below).

Acropolis no. 6715
H. 26.5 cm.; W. 30 cm.; Th. 12.5 cm.

Bibliography: M. Bruskari, "Kopffragment einer Erechtheion-Kore," *AM* 78 (1963) 173-175, Beilagen 83-86. M.B.

31. Lower part of the 6th Erechtheion Caryatid
Mended up from five fragments consisting of part of the peplos below the waist. The fragments were lost in the last century when the Italian sculptor Andreoli repaired the 6th Caryatid with new marble and set it in place; in 1966 the fragments were found in a marble pile southeast of the museum.

Acropolis Museum no. 7163
H. 1.05 cm.; W. 49 cm.

Bibliography: M. Brouscaris, "La sixième Caryatide," *AAA* 1 (1968) 61-64, figs. 1-4. M.B.

32. Kourotrophos figure from the Erechtheion frieze
The upper part of the body of a female figure and the body of the child she holds in her arms.

Acropolis Museum no. 10265
H. 22 cm.

Unpublished. To be published by M. Brouskari. M.B.

33. Kourotrophos group from the Erechtheion frieze.
The fragment preserves some of the lower part of the body and legs of both figures.

Acropolis Museum no. 8589
H. 32 cm.; W. 28 cm.; Th. 18.5 cm.

Bibliography: Ch. Coucouli, "A New Group of the Sculptured Frieze of Erechtheum," *Deltion* 22 (1967) A, 133-148, 219, pls. 89-98.

34. Two fragments of Lesbian kymation moulding
Architectural data and numbering done with letters of the alphabet in ancient times provide evidence for assigning these fragments to the west corner epistyle at the north side of the Erechtheum North Porch. The fragments have been restored with new marble.

Acropolis Museum nos. 6271, 6263 (3414)
H. 15 cm.; W. 15 cm.
H. 15 cm.; W. 18.5 cm.

Unpublished. To be published by A. Papanikolaou.

35. Window-frame fragments from the southern window in the Erechtheum east wall and reconstruction of the window.
Preserved: a section of the lintel, five fragments of the southern jamb and four of the northern. The reconstructuion based on these fragments is by A. Papanikolaou

Acropolis Museum no. 6259

36. Fragment of a seated figure
Attributed to the classical prototype of the so-called Aphrodite-Olympias type. Preserved: the upper right part of the body with upper right arm and part of the back of the chair.

Acropolis Museum no. 6692
H. 30 cm.

Bibliography: A. Delivorrias, "Das Original der sitzenden Aphrodite Olympias," *AM* 93 (1978) 1-23, pls. 1-14.

37. Base with the feet of two figures
Probably a miniature version of the central figures of the Parthenon west pediment, Athena and Poseidon, made in late Roman times.
Plaster reconstruction made by S. Triantis.

Acropolis Museum no. 3081
L. 35 cm.; W. 14 cm.; Th. 5.5 cm.

Unpublished. To be published by M. Brouskari. M.B.

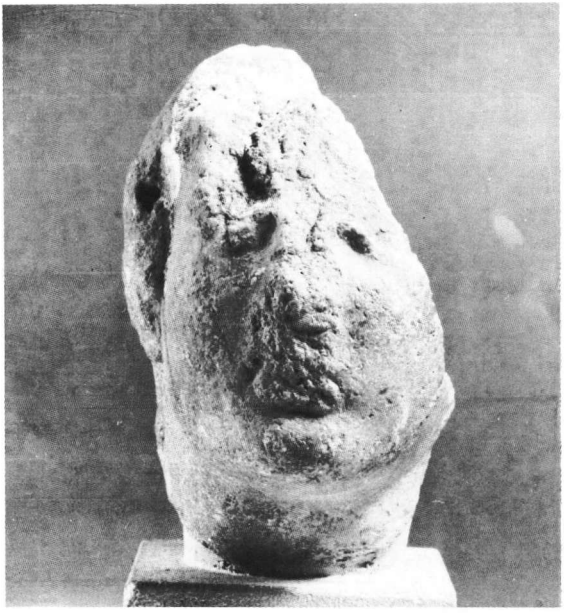
XI.18

XI.15

XI.16

XI.17

XI.19



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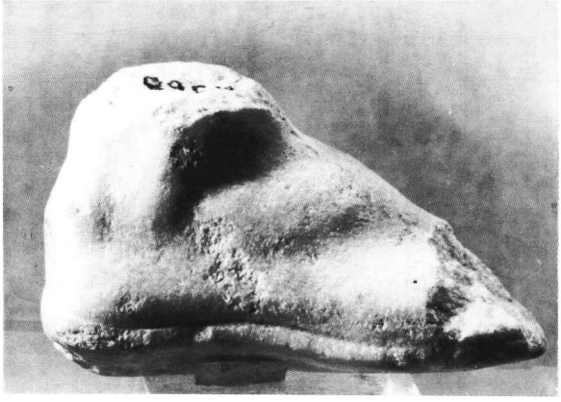

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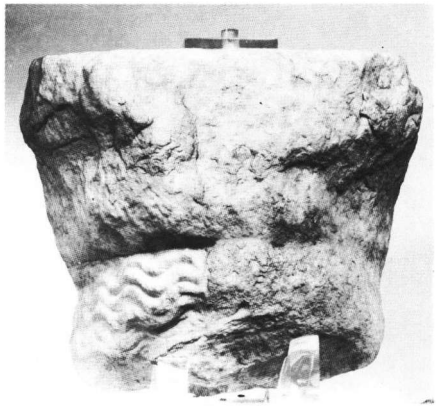

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XI.32

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