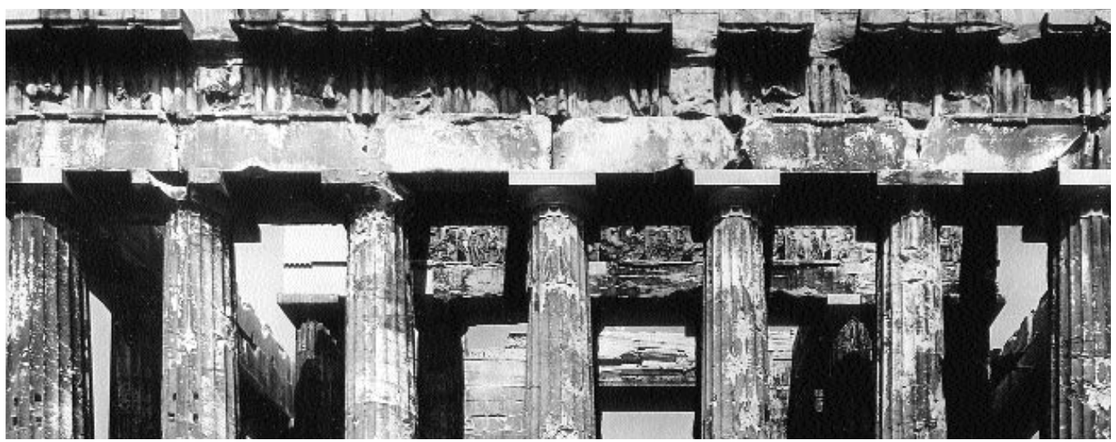
ΥΣΜΑ ΥΠΠΟ

The Acropolis Restoration News

5 • July 2005



Parthenon. From the west, with the west frieze in situ (above) and the cast copy that has replaced it (below)
Photos, respectively, W. Hege (1929) and S.Mavrommatis (2004)

In memoriam: Theodore Skoulikidis (1925-2005)

On the 7th of April we lost Theodore Skoulikidis, Chemical Engineer, Professor Emeritus of the National Technical University of Athens (NTUA), member of the Committee for Conservation of the Acropolis Monuments (ESMA) from its very founding in 1975 and researcher whose splendid work has been internationally recognised.

It is not easy to include everything we should like to say in a short retracing and tribute to his work. Gratitude to the University Teacher, who dedicated himself to the NationaL Technical University and taught generations of chemical engineers for some 40 years, respect for the visionary researcher who with his original ideas opened the way to new fields of scholarly knowledge that were directly connected with the needs of contemporary Greece, admiration for the man who lived his life with principles, with humility and dignity and who stood with daring and valour during the dark times when freedom and democracy were tested in the country and in the universities.

Theodore Skoulilidis was born in Athens, in 1925. In 1948 he was awarded the diploma of Chemical Engineer by the National Technical University (NTUA) and in 1950 he received the doctorate, likewise from the NTUA. During the decade of the 1950's he continued his postgraduate studies in the Institute of Physical Chemistry of the University of Munich, with scholarships from the Thomaïdeion Trust, the Alexander von Humboldt Foundation and the Deutsche Forschungsgemeinschaft. His course after that followed all the academic stages. In 1954 he was elected Associate Professor and in 1968 Full Professor in the Chair of Physical Chemistry and Applied Electrochemistry in the Department of Chemical Engineering of the NTUA. He then assumed the position of Director of the Division of Research and Technology of Materials. Together with his teaching he wrote 16 books (now considered classics) in the field of Physical Chemistry, Applied Electrochemistry, the Deterioration and Protection of the Marble and Building Stone of the Monuments, the Corrosion and Protection of Materials and others. As Professor, he supervised two Associate Professorships, forty Doctor of Engineering Degree Theses and six hundred Diploma Theses.

He served the NTUA with all his strength and from all the administrative positions he held, he fought for its progress and growth. As Dean (1975-1978) and President of the Department of Chemical Engineering (1986-1990) he helped to raise the standards in the School of Chemical Engineering. He divided the then unified Faculty of Chemical and Mineral Engineering into two separate Departments and furthered the development of the Department of Chemical Engineering as it is organised today. He oriented the undergraduate course programme toward gaining experience (establishing the five pre-diploma directions and the practical training of the students). For many years he was a Senate Member of the University Council (1968-1990) and Associate Dean of the NTUA (1982-1986). In 1994 he became Professor Emeritus.

Theodore Skoulikidis devoted all his life to research, both basic and applied. As early as 1950 he spoke of the need of combining research with industry, for control of pollution and for the protection of materials. With his avant garde studies over many years, he was the first in Greece to introduce research on corrosion and protection of metals and on the deterioration and protection of monuments. In the field of metals, he promoted the theory of revealing, interpretation and prediction of the mechanism of corrosion, while developing methods for their cathodic protection using atmospheric electricity, protection of aluminium alloys with electrolytic oxides, new pigments (n semi-conductors) for anti-corrosive paints, new method of electroplating aluminum surfaces and others. At the same time he worked on a corrosion map of Greece. He also carried out a whole series of research programmes associated with chemical kinetics, catalysis, absorption and liquid crystals.

From the decade of the 1970's until the final day of his life, he devoted himself to research on the damage suffered by the monuments and their protection, especially those of the Acropolis. This work coincided with the establishing in 1975 of the Committee for Conservation of the Acropolis Monuments (ESMA), of which he was a founding member, and the beginning of the great programme of anastelosis and conservation of the monuments of the Rock that is continuing today. His contribution was enormous, in formulating the principles that guided the works and in research on the mechanicism of deterioration in the building material of the monuments and the materials, as well as on methods and materials for protecting them.

With the other founding members of the ESMA, Theodore Skoulikidis introduced interdisciplinary collaboration in the conservation of monuments. Until then, conservation had been carried out on the basis of experience, mainly with the methods and materials used abroad in monuments constructed of quite different building materials and in quite other environmental conditions. During the 1970's, throughout Europe the "plastic fashion" prevailed, while a variety of commercial polymers were used without control for the protection and stabilizing of the stone surface. Despite constant pressure from various companies, Theodore Skoulikidis suggested that the use of such materials on the Acropolis be avoided, demonstrating that these chemicals not only did not fulfill the requirements but in the long run were catastrophic for the stone. A few years later, in 1980, he was proven right, when the negative results that had started to be evident on various monuments were presented in international congresses. Theodore Skoulikidis, moreover, had rejected the proposals of some foreign specialists that water be used to clean the monuments and sculptures of the Acropolis from atmospheric encrustation, a method that would have removed valuable information from the surface of the marble, as was subsequently proven.

Theodore Skoulikidis taught that evidence should first be obtained for the causes and mechanisms of damage to the monuments, and that intervention should follow. Methodically he began to try to find the mechanisms of marble deterioration, to determine the causes of the damage (mechanical, chemical, biological, electrochemical). He then turned to the development of methods and new materials for conservation, cleaning and protection that were suitable for the aged and sensitive Pentelic marble of the Acropolis. Among others:

• He proposed for the first time the use of titanium istead of iron alloys in restoring the monuments. From then on titanium has been used in the anasteloses of the Acropolis monuments and other monuments in Greece and abroad.

• Through research carried out with his colleagues at the Laboratory of the NTUA, using the model of galvanic cell, he discovered the mechanism whereby marble is sulphated through the action of sulphur dioxide in the atmosphere. He found that the sulphated layer (gypsum) preserves details of the statues and carved decorations that have been obliterated from the marble surface, and that this gypsum layer must therefore be preserved rather than removed as had previously been done. He then developed a method for consolidating the details by the inversion of gypsum back into calcite, which is the main component of marble.

• He proposed increasing the mechanical resistance of lime, which was used in the conservation of monuments, by adding crystallization seeds. The method is now used on the monuments of the Acropolis and abroad.

• He tested 42 methods used internationally for cleaning the stone of monuments and he proposed the use of laser, which was finally chosen for cleaning the sculptured surface of the Parthenon west frieze.

• He proposed making an artificial patina on the new marble that was used in the restoration of the Acropolis monuments.

• He developed the non-destructive method of distinguishing, in situ, marble from sulphated marble and from calcite, that comes from the inversion of gypsum.

• He developed new material for protecting the surface of marble from atmospheric pollution, which is based on n-semiconductors. This has been applied successfully from 1995 on in a pilot programme on the Acropolis. His complaint was that no decision was made to apply it generally.

Always with a spirit of collaboration and friendliness, through all this he led his colleagues at the NTUA, he worked with the conservation group of the Acropolis Monuments –conservators and marble technicians– and he increased collaboration with scholars in other fields –geologists, biologists, physicists and others– who contributed greatly to solving the problems of the monuments.

His research is to be found in more than 150 publications and papers (together with his colleagues) in academic periodicals and in congress proceedings. In addition, he has stated his opinion on 220 serious technical problems and he has written many articles of a more general nature. He has given also many lectures world-wide on subjects on which he was working. For his great scholarly achievement he was honoured and awarded by the Greek State and by international organisations. He was a member of many Greek, European and international professional and academic organisations.

From his days as a student he took part energetically in common causes. For his resistance during the German Occupation of WW II, he was held in the Averoff prison in 1942, when he was not yet 18. After the "Polytechneion Uprising" in 1973 he was imprisoned in the EAT-ESA (the military police). During the Dictatorship, when most were silent, he stood with the struggling students and he supported their demands.

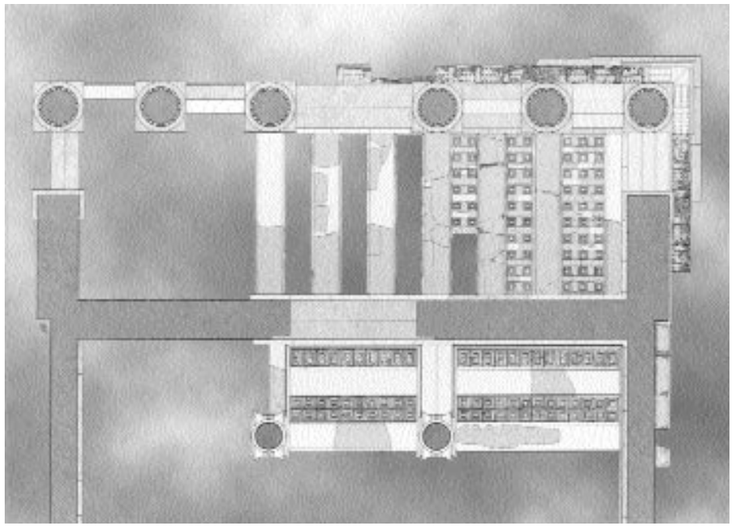
For all these reasons and for all that is remembered by whoever worked together with him, the loss of Theodore Skoulikidis is tremendous. His work, however, has rooted well and many shoots have been grafted. His work has influenced many and it will continue to inspire many more.

The new titanium clamps that replaced the iron ones of the Balanos' restoration. Photo S. Mavrommatis

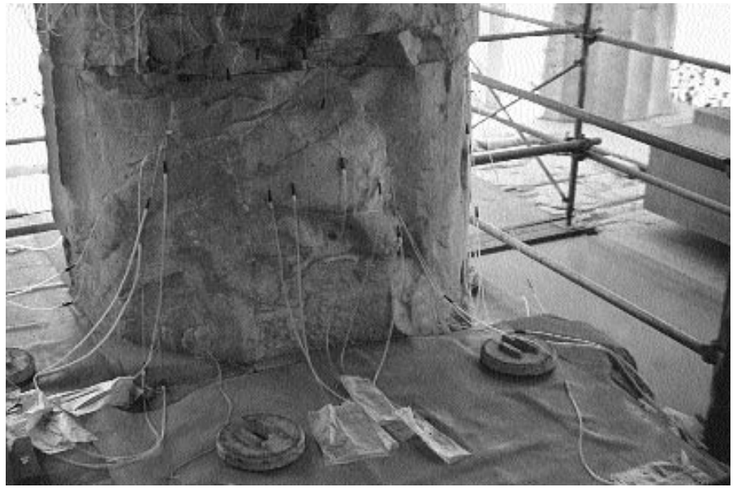
To his beloved family, his wife Aliki and their children, the Acropolis staff give their word that they will remember him always with love and gratefulness.

Evi Papakonstantinou-Zioti
Chemical Engineer
Head of the Department of Surface Conservation of the Acropolis Monuments

The restoration works on the Acropolis have in 2005 completed thirty years. Indeed it was in February 1975 that the Working Group for the Conservation of the Acropolis Monuments (later ESMA) was formed. For the Greek scene, it was a model, an interdisciplinary committee of specialists –archaeologists, architects, civil and chemical engineers– that established special procedures for interventions on the monuments. Special emphasis was placed on ensuring, from the standpoint of accuracy and completeness, the best proposals possible for intervention as well as the greatest possible objectivity in making the relevant decisions. Thus the methodology was enacted for composing the general, interdisciplinary studies for restoration of the monuments prior to beginning the works, or the composing of special studies, as applicable, while the work was being carried out. Enacted too were procedures for multiple and successive inspections and approvals of the proposals for restoration of the monuments. This came under the pertinent offices of the Ministry of Culture. Included also was an international forum by means of a meeting of specialists on a regular basis. Emphasis was placed as well on insuring advanced technology both in carrying out the relevant research and in the work itself, especially where it concerned the organisation and function of the work-sites, the choice of materials and inspection of the work as it proceeded. All these activities of ESMA irrevocably bound the restoration work of the Acropolis to research and technology, with results that have to now been extraordinarily fruitful.



Propylaia. Proposal for the restoration of the coffered ceilings. View from below. Photorealistic drawing Th. Moutopoulos



Parthenon. Sructural restoration of the drums of the opisthonaos columns with hydraulic grouting. Photo A. Panou, 1998

To begin with, much new information has come to light about the archaeology, history and architecture of the Acropolis monuments, while in these fields the monuments are –and will continue to be– the focus of study by leading scholars. The new information has not simply increased our knowledge and added to the relevant bibliography; it has contributed to the compiling of studies that are basic to the interventions being carried out today. Yet, theoretical, scholarly and technical problems have been encountered during the application of these studies. To resolve these problems, many research programmes have been carried out by the scholarly personnel of the works, either alone or in collaboration with educational institutions or other research centres of the country (such as the National Technical University of Athens, the Aristotle University of Thessalonike, the Capodistrian University of Athens, the Institute of Technology and Research, The Institute of Geological and Metallurgical Research, the Research Centre "Demokritos" etc.). These research programmes have produced a great many innovative technical methods and technological practices. Among the works carried out in the course of the interventions, the most important are:

• Resetting of parts of the monuments that had been restored in the past on the basis of new evidence that emerged after dismantling. Good examples are seen in the N and S walls of the Erechtheion that were restored in 1987, the north colonnade of the Parthenon and the cella walls of the temple of Athena Nike, two programmes in process today.

• Search for joining ancient fragments and the re-formation of architectural members from fragments that belong together. This work, together with finding the original position of the members on the monuments, opens the way for restoring a greater expanse of the monuments, the direct result being to promote their potential, their aesthetic and scientific values and to make the monuments more comprehensible to the general public. A representative example is provided by the restoration of the ceilings of the Propylaia – a programme being carried out at present. The original positions of the coffered slabs and beams were identified after research on the fragments of beams and coffers that were dismantled from the ceilings, together with fragments that had been scattered on the rock and not used in the previous restoration. Another example is the identification and recognition of the original positions of the column drums and members of the entablature of the Parthenon pronaos colonnade. This has made possible its partial restoration.

Parthenon. Machine for cutting the flutes of the column drums in new marble. Photo Sp. Oikonomopoulos, 2002

Propylaia. Structural restoration of a ceiling beam using a steel wagon on rails. Photo K. Karanasos, 2004

• Inquiry into the stability, against static or dynamic charges, of the *in situ* or restored areas of the monuments, employing modern scientific methods.

• Research on the structural restoration of architectural members (joining of fragments with titanium rods, filling in with new marble) and establishment of relevant calculation methods, in accordance with the strain applied to the members (bent beams and architraves, column capitals etc.).

• In collaboration with other scientific bodies, study of natural and mechanical properties of the building materials of the monuments and the materials used in restoration (ancient and new marble, ancient iron, titanium, special mortar used in the interventions). Included in these investigations is the artificial stone used for copying the original sculptures that are removed from the monuments (for example the west frieze of the Parthenon or the frieze of the temple of Athena Nike).

• Development of original and new applications in the course of the works. Representative examples are: 1. repair *in situ* of the cracks in columns of the Parthenon Opisthonaos caused by thermal fracture in antiquity. In order to avoid dismantling them and to retain their authentic structure, after research, the cracks in the drums were injected with an hydraulic grout especially prepared for this purpose. 2. Cleaning of the surfaces of the dismantled blocks of the Parthenon west frieze with an original Laser system working on two wave lengths (infrared and ultraviolet) with different levels of power. By means of this original system, developed by the Institute of Electronical Structure and Laser of the Technological and Research

Foundation of Crete, the historical layers of the surfaces of the frieze were preserved, with an excellent aesthetical result.

• Improvement and protection of the environment through research programmes connected with biological attack on the architectural members of the monuments.

• Notable improvement in technological know-how with the hoisting systems used for dismantling and reassembling the monuments. To a great extent this technological knowledge is based on ideas and hoisting systems already known and employed in antiquity for building the monuments. The developments and achievements of modern technology, however, are utilised in the motive power of the systems and in the choice of material. Thus, we have metal systems for the cranes and bridge cranes on scaffolding, which are moved by electricity with low speeds and can move with great precision. Special care is taken with the form and extent of the hoisting systems used, so that they are adaptable to the particular aesthetic and environmental requirements of the sensitive area of each monument, which is surrounded by ancient remains and at the same time is deluged daily by hordes of visitors.

• The building of original fixtures using the ultimate in modern technology for carrying out the works of restoration. Many innovative devices were designed by the engineers of the YSMA and built for the purpose of accelerating the works, while retaining their well-known high quality. Representative examples are: the suspension cramps for the architectural members, the steel wagons on rail for joining large marble members, the special pantographs. Notable among these is the new cutting machine for carving the flutes of the column drums in new marble. It can cut to millimetre precision and its use is greatly accelerating the restoration of the north colonnade of the Parthenon. An inviolable principle of the interventions, however, remains the final carving of the flutes by the experienced marble technicians of the YSMA.

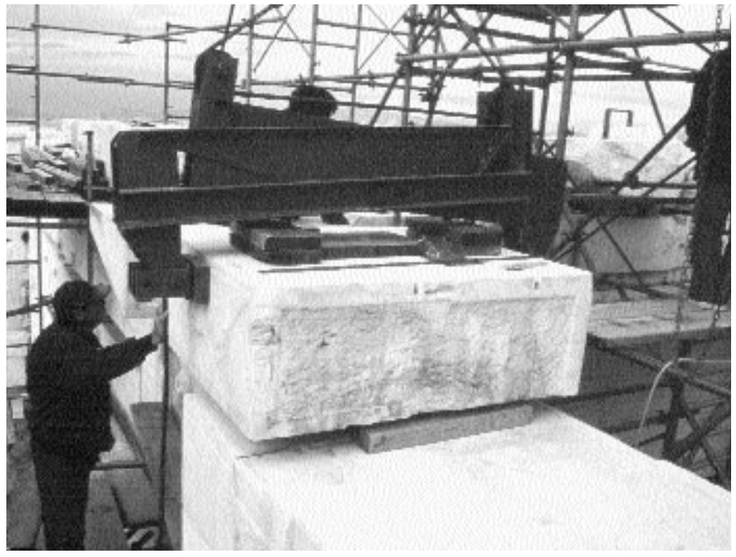
• The use of completely up-to-date technology, with the development of a specially designed electronical programme of a Data Base for working and providing immediate access to the exhaustive body of documentation – graphic, photographic, cinematographic etc., which accompanies the work in all phases.

• Making use of the world of information technology in order to create an infrastructural network and to generate digital material comprising virtual reality, photorealistic rendering of the monuments etc.

Among the first principles that ESMA established for its work –still followed unswervingly today– is to publicize and spread the new scientific, scholarly and technical knowledge that is emerging and expanding continuously. Informing the scholarly world and the wider public is achieved through international academic meetings, scholarly and informative publications, films and the YSMA website. Particularly significant is the providing of information to the students of the elementary and secondary school levels through the educational programmes of the Service.

Finally, we must count among the positive results of the works the creation of a personnel that is highly specialised in the subject of restoring ancient classical monuments. They are already staffing the Universities of this country.

The Acropolis, universal symbol of ancient Greece, presents today the appearance of a work-site. A work-site, however, that is an international model – from every point of view, research and study, theory and principles of intervention, technological applications and also transparency in performing the work of restoration. It honours and, especially, it demonstrates potential of contemporary Greece.



Propylaia. Dismantling of blocks using a special suspension cramp. Photo K, Karanasos, 2001

The crane on the SE corner of the Acropolis circuit Wall. Photo F. Mallouchou-Tufano, 2005

Parthenon. Dismantling of the cornice of the north colonnade using a special suspension cramp. Photo L. Lambrinou, 2001

The Work of the Acropolis Restoration Service in 2004*

The work of the Acropolis Restoration Service (YSMA) in 2004 was characterized by intensification of its activities and their even greater acceleration. On the positive side of this progress may be counted the experience of the personnel, both scholarly and technical, the assistance of mechanical means down to the penultimate stage of cutting the marble, the advantages of administrative and financial autonomy, assured by the founding Presidential Decree of YSMA in 1999, and the enthusiasm of the personnel, who draw confidence from the progress of the work.

Among the unexpected negative components, as in 2003, the unforeseen revelation of the actual condition of the ancient material was a determining factor. This may happen when architectural members are removed and surfaces hitherto unseen become visible. It means an expansion of the actual area undergoing restoration on all the monuments and, toward the end of the year, an adjustment of the technical report on the work, all this prolonging the time required by two years and increasing the funding requirements by 5,5 million euros.

The twelve-member interdisciplinary Committee for Conservation of the Acropolis Monuments (ESMA) held 21 meetings in 2004. The members of the Committee remained the same except for the replacement of Mrs. Nikoletta Valachou by Mrs Aikaterini Kyparissi, when she succeeded her in the position of Director of Prehistoric and Classical Antiquities of the Ministry of Culture. The year 2004 was, sadly, the last year of our collaboration with Theodore Skoulikidis, who died in the present year, 2005. He was one of the founding members of the Committee and for thirty years our colleague in charge of matters involving Physical Chemistry and the conservation of surfaces. From the end of March, the duties of Secretary of the ESMA were performed by the archaeologists Evi Petropoulou and Theodora Moullou. Thanks to their ability and conscientiousness we have full and analytical proceedings of the meetings of the Committee that fully reflect the scholarly speculations about all the subjects. The participation of Alkestis Choremis, Director of the First Ephorate of Antiquities, and our continuous excellent collaboration with her, resolved immediately many of the daily problems in the Acropolis area.

As last year, so also in 2004 I note that the pressure to accelerate the works did not lessen the quality of the work being done.

Parthenon. Restored pronaos colonnade from the east. Photo S. Mavrommatis, 2004

Maria Ioannidou
Civil Engineer
Director of the YSMA

The daily process of detailed recording of each architectural member separately, of the drawings, of photographing, of describing and recording in the journals, the writing of studies for the partial-projects and their approval by the Committee continued unabated. All this goes into the Archive and the Data Bases, so that no substantive information is lost, whether it concerns the condition of the monuments or our interventions. This approach to each stone as an historic piece of evidence indeed makes the work progress more slowly. Yet it is this very approach that has distinguished the work, on an international level, as a model of how an intervention on the architectural monuments of Antiquity should be performed.

The publication a month ago in the newspapers about the completion of the restoration works on the Acropolis in 2020 refers to future programmes that are considered from the scientific standpoint to be totally necessary. They have not yet begun, however, and they are not the immediate responsibility of the YSMA. The duration of the programmes that have been carried out from 1979 on is, indeed, justified by the fact that from classical antiquity until our times, there was no systematic and scholarly conservation of the monuments of the Rock. Quite otherwise, they were continuously degraded and damaged.

To the Director of the Service, the civil engineer Mrs. Maria Ioannidou, we owe the coordination of all the works being carried out on the Acropolis. Her obligations, which she has fulfilled with great ability and responsibility, include, apart from introducing all matters to the Committee, the coordination of the various works in collaboration with their directors, the revision of the Technical Report and the time schedules, writing up the budgets and accounts of the work, her contribution to matters concerning civil engineering, especially the Propylaia where she retains full supervision of the tasks of the Civil Engineer and the solving of many problems that arise daily and demand immediate action. Her position also includes the presentation of the progress of the Acropolis works at congresses, seminars and through lectures in Greece and abroad.

We now come to the work carried out in 2004.

Parthenon. Restored opisthonaos colonnade from north. Photo F. Mallouchou-Tufano, 2004

Parthenon. The north colonnade during restoration. Photo L. Lambrinou, 2004

In the **Parthenon**, as is well known, three programmes of structural restoration are underway, in the pronaos, the opisthonaos and the north colonnade. The architect Nikos Toganidis, colleague of twenty years, is in charge of the entire project. The scholarly group that supplements the general studies with studies for their actual implementation, comprises the architects Lena Lambrinou, Rosalia Christodoulopoulou, Aikaterini Paraschi, Angelos Papandropoulos, the civil engineers Marilena Mentzini, Eleni Toumbakari and the archaeologist Eleni Karakitsou. They supervise also the intervention. Anastasia Panou is in charge of the conservation of marble surfaces.

The pronaos programme has virtually been completed, with the architrave set in place, in accordance with the approved study by Manolis Korres. Left undone is the fluting in the parts of the columns filled in with new marble. This is a subject that the Central Archaeological Council of the Ministry of Culture decided should be re-examined. In September the ESMA decided unanimously that the flutes should be cut, but that matter was not placed before the Council as the corresponding work beneath was cancelled after the budget was cut. Likewise the architrave between the colonnade and the southeast anta has not been set in place as its joining with the south wall of the cella has yet to be decided. The removal of the scaffolding at the end of June, which signalled the completion of this restoration programme, revealing the new form of the pronaos, showed how great an improvement had been made in the appearance of the east end of the temple. It has justified the study by M. Korres.

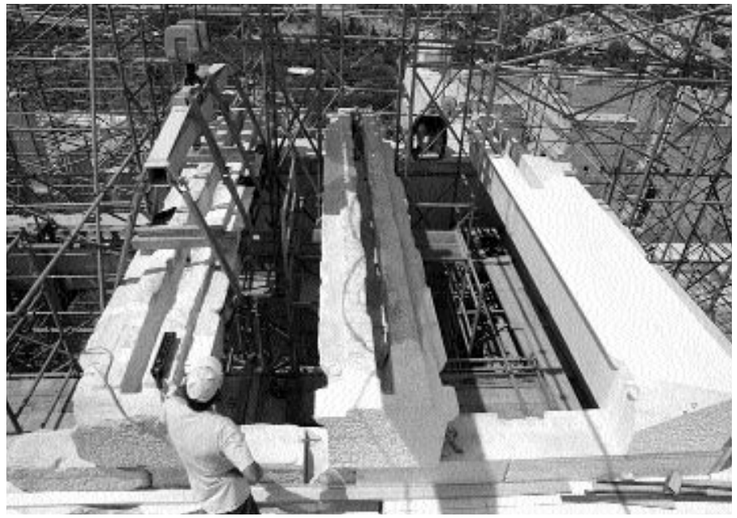
The opisthonaos programme was likewise completed in time, last June. Important in this were the efforts of Petros Kouphopoulos, now Assistant Professor at the University of Patras. He wrote the study for the work and he worked as Technical Advisor together with the engineers R. Christodoulopoulou and E. Toumbakari, who made the implementation studies and supervised the work on a daily basis. Damages not foreseen obliged the opisthonaos team temporarily to remove two column capitals, which were set again in position in February. Matters connected with the cast copies of the west Ionic frieze and the frieze-backers were included, in somewhat inverted order, in the report of 2003. Now the building form has been completed with the resetting of the crown blocks over the frieze and the water-proofing of the mediaeval stairway, in accordance with P. Kouphopoulos' study. Here the intensive efforts of the staff of the YSMA to complete the work before the Olympic Games should be noted.

Given the poor condition of the crown blocks above the west colonnade, the beams of the west pteron are to be part of the future programme for the entablature and west pediment. The study for this has been undertaken by Mrs. R. Christodoulopoulou, following the decision of the ESMA that only a few days were needed for setting both the beams and the inter-beam blocks above the frieze. They would, however, have to be lowered again to the ground once the future programme of the entablature and pediment of the west façade of the temple is under way.

The great effort of 2004 was focussed on the north colonnade of the Parthenon (the restoration of which is in the hands of Mr. N. Toganidis and the engineers L. Lambrinou and M. Mentzini). As you know, eight columns, from the 4th to the 11th counting from the east, were restored by Balanos with all of the drawbacks of the method he followed. These had already been dismantled in 2003, and efforts were devoted to finishing the studies (mainly on the column capitals and the entablature) and on clearing the rusted iron and cement from the members, replacing the cemented drums with new marble and filling in a number of members. And while, after interminable discussions in the ESMA, all or nearly all the drums had been reset or were ready to be reset, a serious problem with at least two column capitals emerged and was studied by Mrs. L. Lambrinou. Balanos had incorporated in these capitals fragments belonging to other capitals, in an affort to make his additions look ancient. Now that these fragments, by necessity, had been removed, other problems arose that were difficult to resolve. To what extent should the new additions prepared by Balanos be used? Can additions be made to these additions or should they be removed and replaced entirely with new marble, in accordance with the method used on the Acropolis for the past twenty years? It should also be noted that the fillings in the drums, necessary for structural reasons (because of the heavy load supported), tend in some cases to negate the character of the ruin in the north colonnade, quite unintentionally.

The study of the entablature of the north colonnade likewise presents problems, not so much for the architrave blocks as for the

Propylaia. The east portico from the east, with the ceiling beams of the north section restored and in place. Photo T. Tanoulas, August 2004



Propylaia. The three north ceiling beams of the east portico restored. Photo V. Papavasileiou, 2004

overlying Doric frieze. It is clear that some of the backing blocks of the frieze belong to the south colonnade and had been transferred to the north by Balanos. N. Toganidis has already suggested their replacement by others in new marble. Equally difficult is the problem of the cornice blocks that preserve only the projecting section, while the rear parts that provided the bed-joint on the frieze have disappeared and been replaced by concrete during Balanos' anastelosis. On the rear part, however, is the evidence that demonstrates the original position of the cornice block, with clamp and dowel holes, dowels, auxiliary dowels and pry-holes. There are, moreover, indications that in an effort to present a better picture of the more fully preserved west part of the north colonnade, Balanos set many cornice members there, regardless of their original position. Be that as it may, the recording is being finished, the problems have been identified and it is hoped that perfect solutions or at least satisfactory compromises will soon be found.

It should be noted also that for cutting the flutes of the columns of the north side, the machine designed by the mechanical and electrical engineer, Mr. Spyros Oikonomopoulos, has been used with great success. Moreover, in order to accelerate the work a second pantograph was acquired, the bridge-crane was redesigned so that it could come closer to the building and yet another shed was made to house it.

The group working on the **Propylaia** is headed, as always, by the architect Tasos Tanoulas, with structural restoration the responsibility of Mrs. M. Ioannidou. Collaborating with them are the architect Konstantinos Karanasos, the civil engineer Vasilis Papavasileiou, the archaeologist E. Petropoulou, who is responsible for keeping the journal and for providing the information for the archive, Aikaterini Babanika, responsible for marble conservation and the exceedingly experienced draftswoman, Yiota Moutopoulou.

Propylaia. Resetting the central architrave block of the east portico. Photo. K. Karanassos, 2004

Propylaia. Resetting a wall beam of the east portico. Photo. K. Karanassos, 2004

By February 2004, the "inserted" programme for the north wall of the central building had greatly progressed, and was one of the four programmes that were completed before the Olympic Games. I have characterised it as "inserted" because in 2003 it was discovered that Balanos had moved and secured with his usual method 91 more architectural members than had been known. The matter has been resolved with the recent placing of the ten last wall blocks. The weight now shifts to the east portico with its six interior columns. These were conserved and their restoration had already been completed to the height of the column capitals in April. Unfortunately, Balanos incorporated into the frieze members and cornice blocks many fragments that do not belong. These are being removed and their original positions sought or else they are being replaced in new marble. Similar work is being done on the huge blocks of the coffered ceilings and the Ionic architrave blocks, with joins and fillings, unfortunately on a large scale. In carrying out the specific programme of the ceiling in the central building, the drums of the Ionic columns (to which joining fragments have been added) and two Ionic capitals, entirely of new marble, were made ready beforehand to replace the patch-work introduced by Balanos. It should be noted that the experienced marble technicians who made the new Ionic capitals, used as guides the fragments of the original ancient columns themselves. Three beams and a number of inter-beam blocks have been placed in the east porch and the lintel of the great door is being reinforced.

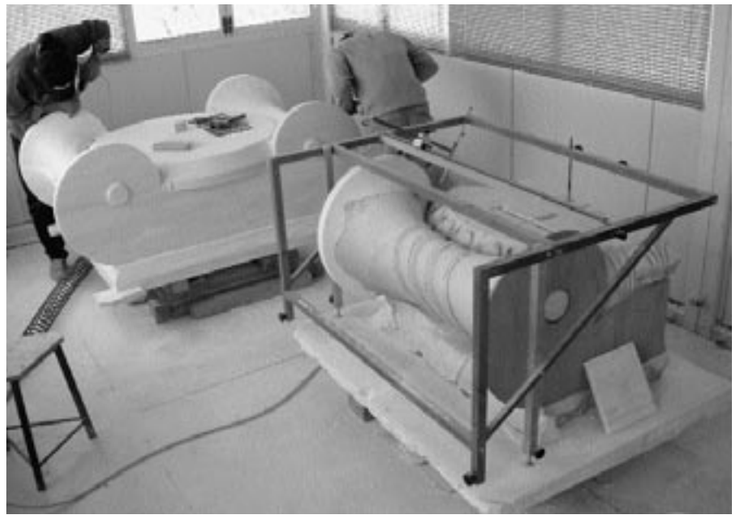
In the spring of 2004, the floor of the central passageway through the Propylaia was redone with a safety measure taken for the protection of visitors on the basis of T. Tanoulas' study. Surface conservation of the architectural members, that are being reset in the building, continued throught the year by a specialised team.

The year 2004 saw great progress in the **temple of Athena Nike** as work continued at accelerated speed. The civil engineer Dionysia Michalopoulou is in charge of the work with the architect Kostas Mamaloungas, the archaeologist Evi Lebidaki and the conservator Anthe Tsimereki as collaborators. Modern material was removed from the basement space beneath the temple and the preceding classical poros shrine (*naïskos*) was conserved. Following this a small wall of reinforced concrete was built, fully reversible, and the decision was made to make a totally inflexible metal grid to support the eight massive marble slabs of the floor and to some extent the walls of the temple.

Throughout the year the main occupation of the team was the removal of rusted metal pieces and cement fillings and the creation of new marble fillings on hundreds of architectural members. The final result was due to the transfer of marble and cast technicians from other work teams to the Nike temple, the ordering of some of the fillings from outside and the overtime work by members of the staff. In place again by the end of 2004 were the blocks of the euthynteria and part of the krepis of the temple (one stylobate block and five toichobate blocks), after repeated checking of the general alignment.

The **circuit Wall** is the responsibility of the architect Vasso Manidaki, who has submitted a series of reports with observations about the cracks that have appeared at various places and on the measurements that are necessary. The ESMA had, in 2003, entrusted the topographer-engineer Mr. M. Kapokaki with making a systematic survey of the south circuit Wall, which was completed. In 2004, systematic documentation continued, with inventories. It was decided to monitor the Wall on a regular basis to clarify its actual condition and to investigate its structural efficiency in the places that had cracked. A subcommittee was appointed to deal with the structural problems of the south fortification Wall. Ten crack meters and topographical markers were put in place in order to obtain more accurate measurements. It was decided to acquire a moveable platform from which close observation would be possible.

In connection with the circuit Walls, an access of the Acropolis to people with special needs was made during the past year. There had been discussions and meetings in 2003, but final decisions were made in May and June of 2004. The Central Archaeological Council approved the installation of a lift for two years and carried out an inspection of the place on 23 June. This urgent programme was carried out expressly, on the decision of the Deputy Minister of Culture Mr. P. Tatoulis, by the personnel of the YSMA and outside collaborators, coordinated by the mechanical engineer Sp. Oikonomopoulos, with studies and the supervision of V. Manidaki and the general coordination of Mrs. M. Ioannidou. Various alternative proposals had been made by Sp. Oikonomopoulos prior to this. The programme comprised 14 separate projects. It was finished shortly before the Olympic Games, with superhuman efforts, repeated inspections and care on the part of the ESMA members, the Ephor Mrs. A. Choremi and the General Secretary of the Ministry of Culture, Mr. C. Zachopoulos. It should be noted that the intervention is entirely reversible and that the tracks for the lift have been anchored not in the natural rock or any antiquity, but in a massive buttress built by Balanos in the 1930's. The work was costly, time-consuming, and hardly accords with the form of the Acropolis. It meets specific needs, however, which we hope in time can be satisfied in a better way.



Propylaia. Cutting the Ionic capitals of the western hall of the central building in new marble. Photo T. Tanoulas, 2004

Likewise connected with the circuit Walls is the problem of the **Arrephoreion**, a monument of great importance archaeologically. The superstructure is not preserved and the foundations, of soft poros stone, have remained exposed to the forays of dampness, freezing and wind. The ESMA had endless discussions as to whether it was better to bury the foundations or to roof them and leave them visible and open to visitors. The architect V. Manidaki presented alternative studies that led to an acceptable solution to the problem in 2005.

Surface conservation of the monuments was carried out by a team of conservators and technicians under the direct supervision of the chemical engineer Mrs. Evi Papakonstantinou and the direction of the late Professor Theodore Skoulikidis. Throughout 2004, despite his problems of health, he never ceased to offer his services, both in carrying out the works and as a member of the Committee.

As each year, the usual task of stabilizing and conserving the surfaces of architectural members that were moved was continued throughout. The work was extended to include the Erechtheion with the columns of the east

porch, the interior of the cella side walls and one of the copies of the Caryatids.
In research, study continued on the biological cause of marble corrosion by Mrs. Karagouni, professor in the Biology Department of the University of Athens. The work is in process.
The most significant achievement of the conservation team during 2004, however, is the completion of the cleaning and structural restoration of the west frieze of the Parthenon. For the Laser method used, the relevant instruments and the collaboration with the Technological and Research Foundation of Crete, there was extensive discussion a year ago and you can read the report in the Acropolis Restoration News, No. 4, 2004.
In addition to cleaning, the old dowels and the remains of Meyer stone-glue were removed and then the very special problems of restoring the continuity of the figures and the aesthetics of the sculpture, in preparation for exhibiting them where concerned. The work was done under the direction of a committee of archaeologists, with the Director of the Acropolis Mrs. A. Choremis as president, and with the direct supervision of the archaeologist Mrs. Christina Vlassopoulou. The Technological and Research Foundation of Crete was represented by Mrs Pouli and Mrs. Ditsa and the YSMA by the conservator Mrs. Panou. As a result of the work of the First Ephorate of Prehistoric and Classical Antiquities the west frieze is now on display in the Acropolis Museum, accompanied by Sokrates Mavrommatis' photographs showing the process of cleaning the reliefs. We hope soon to see them in the New Acropolis Museum.

The team working on **recording the scattered members** on the Acropolis, headed by the achaeologist Mr. Konstantinos Kissa, continued this project in 2004, making a limited contribution to the actual restoration of the monuments, since very few of the fragments of architectural members found are used in the anastelosis. For a considerable time, moreover, many technicians of this team had been transferred to the Nike Temple team. The crucial question of where to house the inscriptions that are on the Acropolis unfortunately is still unresolved.

Using contemporary technology work continued on the Archive of the Service, the **Documentation Office** and on the Data Base, head of which is the archaeologist Fani Mallouchou-Tufano. The archive receives information on a daily basis directly from the groups working on the monuments.

Athena Nike Temple. Steel grid for supporting the classical building. Photo K. Mamaloungas, 2004

In March the cinematographic documentation was allotted to an outside collaborator. S. Mavrommatis produced an excellent documentation of the process of cleaning the frieze with Laser, both with photographs and video.
As for purely theoretical matters: work began on the final report on the restoration project of the Parthenon opisthonaos with the collaboration of all the engineers, conservators and archaeologists who had taken part in it, and with P. Kouphopoulos as coordinator. The writing up of the work on the east façade of the temple remained unfinished. The editing of the text on the Erechtheion restoration (1979-1987), left unfinished by the late Alekos Papanikolaou, was undertaken by Mrs. F. Mallouchou-Tufano, while the drawings have been reduced in size so that we can proceed with the final lay-out of the book and in 2006 its publishing.

The **Office of Information and Education** covers the management and interventions on the monuments determined by contemporary criteria, from the standpoint of information and the diffusion of new knowledge that comes from research and from everyday experience. As in previous years, the Office comprises Mrs. Cornelia Hatziaslani, architect-archaeologist, Irini Kaïmara and Assimina Leonti, both archaeologists. In collaboration with the First Ephorate of Classical Antiquities and with other departments of the Service, its activities were most successful both in Greece and abroad.
On the occasion of the Olympic Games, a special programme was organised on the subject of the corresponding games in ancient Athens, the Panathenaia. This began with a seminar for educators, the distribution of museum kits and booklets and ended with the 8th symposium "Educators and Programmes about the Acropolis". Eleven thousand five hundred children took part, some 1800 students participated in the regular educational programmes and twice this number used the museum kits. It is worth noting that up to now 720 museum kits have been distributed in Greece and another 210 to Greek and other schools abroad, in 25 countries. In addition, the Office issued four new publications and arranged to have the folding booklet and the CD-Rom on the

Parthenon. Exhibition of the west frieze, cleaned and structurally restored, in the Acropolis Museum. Photo S. Mavrommatis, 2004

Parthenon Frieze (which was published with the cooperation of the National Documentation Centre) sent to libraries and universities abroad.

In the framework of information, the photographic exhibition of Mr. S. Mavrommatis was presented in January in Rome, at the so-called Mercati Traieanei, at Fairfield University in the United States and at the Museum of Folk Art in Kyme, Euboia. A smaller exhibition by S. Mavrommatis was held at the Benaki Museum on Piraeus Street on the occasion of the publication of Mr. A. Delivorias' book on the Parthenon frieze.

The work of the YSMA was likewise presented abroad in 2004 with great success. Mrs. C. Hatziaslani was invited to present the educational programmes of the Acropolis at the Yearly Meeting of the Archaeological Institute of America, held in San Francisco, at the Paul Getty Museum in Los Angeles, and at a seminar organized in London by the Society for the Promotion of Hellenic Studies. Mrs. F. Mallouchou-Tufano gave lectures on the works of the Acropolis at the Universities of Florence, Naples, Perugia and at the Academy of St. Luke in Rome. The works of the Acropolis were presented at a symposium at Paestum (Poseidonia) by Mrs. F. Mallouchou-Tufano together with Mrs. M. Ioannidou, Mr. T. Tanoulas, Mrs. E. Papakonstantinou and Mr. K. Karanasos. The Director M. Ioannidou and Mrs. P. Pouli presented the restoration of the west frieze of the Parthenon at the Institute of Historical Heritage in Madrid, and the conservators K. Frantzikinaki and K. Vasileiadis at the 10th Symposium on the Conservation of Stone in Stockholm. Finally, Mr. S. Mavrommatis gave a talk at Fairfield University on the photographing of the works.
Other notable activities relevant to Information are the guided tours of the Acropolis on the 27th of July 2004, when the President of the Democracy, Mr. K. Stephanopoulos, visited the Acropolis work-site on the occasion of the completion of four of the YSMA programmes, the announcements to the foreign reporters at the Zappeion during the Olympic Games, the up-dating of the YSMA website by Mrs. Th. Moullou, the incorporation of the CD-Rom on the frieze in the introductory page of the website of the French Ministry of Education and the publishing of the 4th issue of "The Acropolis Restoration News" under the supervision of Mrs. F. Mallouchou-Tufano in two languages. It was sent to a great number of recipients.

It remains only to thank all who are taking part in this great cultural and technical work. The members of the Committee and the scholarly personnel, engineers and archaeologists of the Technical Office, whose names I have already mentioned. The First Ephorate of Prehistoric and Classical Antiquities and Mrs. A. Choremis. The supporting staff of the Secretariat, the Accounting Office and the Archive. The marble technicians and all who assist them in their continuing work and the great effort of 2004, which had, as we have seen, excellent results. Finally, Mrs. Maria Ioannidou, Director of the Acropolis Restoration Service, for all that she managed, with great effort, to accomplish during the past year.

* From a talk given at the Centre for the Acropolis Studies on 16 May, 2005.

Professor Emeritus ***Charalambos Bouras***
President of the ESMA

The access of the Acropolis to people with special needs

The access of the Acropolis to disabled people had been considered repeatedly in the past, but a definite solution was never given, due to the inherent difficulties and the numerous parameters that had to be dealt with.

By the end of 2002 and given the general interest of the Ministry of Culture in providing access to archaeological sites for disabled people, YSMA was asked (as a technical service) to investigate the problem and suggest a solution, in cooperation with the First Ephorate of Prehistoric and Classical Antiquities. Action was taken in 2003, which was declared "accessibility year to cultural sites", and the problem was finally solved in 2004, year of the Olympic Games in Athens.

The problem as a whole had many aspects and many problems. The main problem was how to transport the disabled visitors from a place with road access to a certain point on the Acropolis Rock, from which wheelchairs could move to as many destinations as possible. Another aspect, easier to resolve, but equally important, was access to the Acropolis Museum, the floor of which lies about 3m below ground. Moreover, passageways suitable for wheelchairs had to be designed on the rock itself as well as W.C.'s appropriate for people with special needs.

Various solutions were considered for solving the main problem, chiefly a lift, a funicular railway or teleferique. The funicular railway was quickly abandoned because it entailed heavy infrastructure on the rock, which would be visible from many parts of Athens. Although aesthetically better, the idea of a teleferique was also abandoned because of high cost, long completion time and the massive station required on the Rock.

From the beginning the installation of a lift seemed to be the most flexible solution, with certain restrictions: an almost vertical part of the Rock had to be chosen for the installation, the length of the required cantilever embarkation platform over the Wall had to be minimised, the engine room had to be minimal or non-existent (lack of space), and the "well" for guiding the cabin should be omitted (aesthetic reasons).

A construction-site lift travelling along a trussed mast of small cross-section without "well" or engine room was considered suitable. Additional advantages of this type of lift are: the suspension of the motor mechanism from the cabin frame, allowing easy safety-parking of the cabin at the ground, stop by the operator in case of power failure, and the availability of a type with a slightly off-vertical inclined mast, adapting itself to the slope of the Rock and minimizing the required length of the top cantilevered platform.

The best position for the installation of the mast proved to be the north side of the Rock, where it is almost vertical in certain places. Another advantage of this place is the road access to the foot of the Rock, with some improvements to the paving of the ancient "Peripatos" (the circular road at the foot of the Acropolis Hill). The small square NW of the Erechtheion seemed to be the first and best place for landing on the Rock. In this area the mast could be fixed close and parallel to the Rock, only 12° off vertical. Almost all the mast supporting struts (except for the top ones) could be anchored to the strong buttress wall built in the 1930's to support the overhanging Rock, thus leaving the Rock itself and the fortification Wall intact.

General view of the Acropolis from the northwest. Visible is the lift recently installed for the people with special needs. Photo F. Mallouchou-Tufano, 2004

Although this solution was technically ready by June 2003, its implementation had been delayed because of official reservations about the aesthetic consequences of the mast and top platform. Instructions were given to continue considering other possible solutions.

One of the solutions considered was to construct an access to the Acropolis for disabled people by means of equipment that would run parallel to the pathway followed by the general public. Further investigation showed immediately that this solution would impede the flow of visitors, restricting even further passages that are narrow and restricted at peak hours. At the same time the capacity of the system for disabled people would be very reduced, approx. 10 per day, due to the long route and the very low approved speed of the suitable platforms (approx. 7 m/min). So this solution was rejected, in favour of the mast–and–lift, but with consideration of some other possible sites around the Rock.

In the Spring of 2004 another project was investigated with two lifts in the area of the Belvedere: one from the "Peripatos" guided on an inclined mast to the foot of the "Belvedere" tower and one on a vertical mast in the hollow tower. In this case the inclined mast, hidden in a natural recess in the Rock, would be less visible. On the other hand access from the "Peripatos" to the lift and from the top of lift to the Rock would be more difficult in comparison to the site near the Erechtheion. A bigger difference in height would have to be spanned and the mast would have to be directly anchored into the Rock rather than into a modern stone wall. Furthermore, to change from one lift to the other, a steel platform would have to be installed, a door would have to be opened through the Northern wall of the "Belvedere" tower, and a trap door on the floor of the terrace. All these interventions to a medieval building would be irreversible. Another disadvantage of this solution is the poor access for transportation and assembly of the various parts, which would increase the building time and cost, considering also the additional infrastructure required in the "Belvedere" area.

After all the above, in May 2004, with the Olympic and Parolympic games very close, it was decided, with the consent of the Central Archaeological Council of the Ministry of Culture, to make a temporary installation of lift and mast in the Erechtheion area, as originally suggested. At the same time the other minor interventions required to gain access to the lift were approved, that is the levelling of the slopes and the paving of the north Peripatos (so as to be strong enough to support road traffic) from the entrance of the Acropolis to the lift ground station, the construction of a new staircase suitable for the installation of a stair platform to bridge the 5m height difference between the Peripatos and the lift ground station, the building and installation of a steel cantilever platform to connect the lift top station with the small square NW of the Erechtheion, the paving of walkways on the Acropolis rock, suitable for wheelchairs, the installation of a vertical lift platform to gain access to the Museum, as well as W.C.'s for the disabled. YSMA proceeded to the necessary design and construction, so that the system would be ready to operate by the opening of the Games. Thus, within record time, the first wheelchair reached the Acropolis on the 12th of August 2004. As a demostration of the system capacity, within the 10-day period of the Parolympic Games, up to 130 wheelchairs were transported daily, with 3400 disabled visitors and escorts.

The lift for the disabled on the north slope of the Acropolis. Photo P. Konstantopoulos, 2004

Concerning the technical details of the system, the following may be noted: the lift, installed by the "B-Lift VALSAMIDIS" company, spans a 25m height from the north Peripatos to the top of the Acropolis Wall in the Erechtheion area. The lift cabin rolls along a truss mast with equilateral triangular cross-section of approx. 300mm base by 400mm height. A rack is fixed at one end of the base along the mast, engaging a pinion powered by an electric motor and speed reducer, supported on the cabin. The mast is inclined, 12° off-vertical, following the slope of the Rock and it is anchored at 5m spans.

The whole power unit and control gear are fixed to the cabin frame and follow it as it travels. There is no engine room, only a roofless ground station booth. Electric power is supplied through an electric cable, following the upward movement of the cabin through special guides, while on its way down it is coiled into a barrel in the ground station. The 4kW electric motor is inverter controlled, securing progressive starting and braking. The motor is equipped with a spring loaded safety brake, that applies automatically in case of power failure, and can be released by a hand operated lever to park the cabin at the ground station by gravity, and release the passengers.

The lift is equipped with an additional safety device made by "ALIMAK", that continuously monitors the cabin speed through its own pinion engaged to the mast rack. As soon as the speed exceeds by a certain small percentage the nominal speed of the cabin, (loss of control) the safety device cuts off the power to the motor and applies a safety brake (in addition to the motor brake).

The lift, type P600, is made by the Italian company "CIMAR Ponteggi S.p.A.", licensed by the Swedish company "ALIMAK AB". It has a 5-person or 600kg load capacity. The cabin floor dimensions of 1m x 31,5m allow the simultaneous transport of a wheelchair and three standing passengers (including the operator). Two upwards sliding transverse doors 0,93m broad are used to enter and leave the cabin (west at the ground and east on top). The doors have a steel frame and a dense strong grid, allowing visibility and low wind resistance. The cabin speed is 0,43m/s, covering the vertical distance of 25m in approx. 1min.

The top station of the lift is a platform in the form of a girder made of a strong hot-galvanized steel section HEA 200, measuring 9,4m long by 1,6m wide. The longer part of it, behind the Wall, spans like a bridge the gap between the Wall and the square NW of the Erechtheion, supported on two concrete blocks, the outer lying on the Wall. The shorter, cantilever part, projects 2,4m beyond the Wall face. The inner part, together with the concrete blocks provide the necessary counterweight for the stability of the construction. The platform axis differs by approx. 10° to the west from the vertical line of the Wall.

Acropolis. Landing point of the lift for the people with special needs northwest of the Erechtheion.
Photo. P. Konstanntopoulos, 2004

Inauguration of the lift for the people with special needs on the Acropolis.
12 August 2005

The ground station of the lift stands approx. 5m higher than the Peripatos. To span this, a new, 1,8m broad, concrete staircase was built, that was also used to support the guiding rail of a staircase platform, made especially for disabled people by the "HIROLIFT Company", type "HIRO 320". It is suitable for open-air, public operation, with a 225kg lifting capacity and a 7 m/min travelling speed. It is self powered by batteries, and is not subject to power failures. The batteries are automatically charged, each time the platform parks at either end of its travel. The 15m travel takes a little more than 2 minutes to be covered. A full return trip, with the necessary time for ramp and bracket folding and unfolding requires approx. 5 minutes. A fully charged battery, without intermediate charging, can power approx. 35 return trips. Obviously, in periods of intense, continuous use (as during the Parolympic Games), this platform is the weak link in the transport chain, both because of the speed (5 min return trip, compared to 2 min return trip for the "ALIMAK" lift) and availability. To solve the second problem during the Parolympic Games, a fully charged spare battery was kept at the worksite, so that the empty battery could be replaced.

The Acropolis Museum floor lies 3m underground. The staircases leading down to the Museum are overcrowded with visitors during peak hours, so that the operation of a staircase platform would be a problem. The installation of a vertical platform lift, leading to the Museum yard in a transparent well, was considered a better solution. It was made by the Austrian manufacturer "STAKO" has a capacity of 250kg, and its floor area allows for a wheelchair and an escort. In case of power failure, a hand operated crank can safely land the platform.

Finally, the north Peripatos was paved to allow access for both wheelchairs and cars or vans from the main Acropolis entrance to the lift ground station. Many walkways on the Acropolis Rock were paved to allow access to wheelchairs and two new W.C.'s for the disabled were built: one next to the Museum and the other at the entrance of the Acropolis.

The design of artificial stone for the production of cast copies of the Parthenon frieze

M.Ioannidou, the director of YSMA, was responsible for coordinating the entire project. The undersigned designed the alternative solutions and the electrical and mechanical aspect of the work. The architect V. Manidaki made the architectural study of the debarcation platform and supervised the implementation of the study and the precise location of the mast.

Most valuable for the completion of the work was the contribution of the electrical and mechanical team of YSMA, who worked long hours with great enthusiasm both for the construction and for its proper functioning. Finally, there was close collaboration throuthout the project with the Acropolis Ephorate and particularly with D. Bithas, engineer of the Acropolis Ephorate, who supervised the construction of the pathways on the Acropolis Rock, the bathrooms and the adjustment of the Peripatos. Also, the topographer K. Kazamiakis, who surveyed the area where the lift was installed. Valuable also was the assistance of the Directorate for the Studies of the Museums of the Ministry of Culture.

The Firm "VALSAMIDIS ATEA" supplied and installed the "HIROLIFT" lift platform, the "ALIMAK" lift mast and the "STAKO" lift of the Museum.

The work was completed in record time and functioned regularly, mainly through the high technical knowledge and skill, the personnel and the technical equipment of the Acropolis Restoration Service.

Spyros Oikonomopoulos
Mechanical and Electrical Engineer
In charge of the electromechanical support of the Acropolis Restoration Works

The design of artificial stone and the supervision of producing the copies of the west and south friezes of the Parthenon were among the activities of the structural engineer that were carried out during the period 2001-2004. The study for the restoration of the opisthonaos by P. Kouphopoulos planned the replacing of the original blocks that were removed from the monument, with new blocks, each one of which is a marble member to which the artificial stone copy is attached. An archaeological study of the same subject by A.Mantis, likewise preceded the work. The present note discusses elements of the study of the material design and the reinforcement of the structural member, the experimental part of which was carried out in collaboration with other research institutions. Emphasis is placed on design logic rather than on analysis of the technical results of the programme.

Parthenon. View from the west with the cast copies of the frieze in place.
Photo F. Mallouchou-Tufano, 2004

Approach to the design of new materials for use in archaeological sites

The use of artificial stone at archaeological sites, either to complete ancient members or to make new ones, is an old practice in anastelosis. Its use must be preceded by appropriate research, the extent of which depends both on the specific problem and on the available data about the assessment of previous such interventions. The question of the design is complex because the materials and compositions to be used for the production of artificial stone must meet certain specifications that depend on factors such as the physicochemical and mechanical properties of the ancient materials, the position of the structural member –which is to be completed or replaced by artificial stone– in the building and thus the expected mechanical actions as well as the conditions of exposure to the environment, which introduce physicochemical and biological actions (Table 1).

The above factors lead to an equal number of requirements in terms of materials (Table 2), which frequently conflict with each other. The materials chosen, moreover, must perform very well over time, they must have durability, both to protect the ancient material and for reasons of economy.

The question of life span in reversible interventions is frequently not given the proper attention. Yet reversibility is relative in meaning –at least in the field of materials, which is the subject at hand– for every removal of material from a previous intervention is *inevitably* accompanied by loss of

authentic material. Furthermore, a limited life span, even of materials or compositions that have been proved compatible with their substratum, implies a higher cost of repair/conservation compared to a longer-lived solution and, obviously, the *tying up of funds* that could productively be used for other works.

Finally, the complexity of the requirements that the material shout meet, and the contradictions that frequently accompany those requirements, *transform the problem of material design to one of optimization*. Research thus becomes inevitable. Unfortunately, materials are often applied simply on an empirical basis, without the necessary research, despite the fact that the cost of such research is small compared to that of production and application.

Consequently, in the design of materials it is not only the factors pertaining to each member and its environment that must be considered. It must also be *demonstrated* that each new proposal is not only a pertinent answer to the problem posed by the archaeologist but, in addition, that its durability is *at least greater* than the solution applied earlier.

Table 1. Factors affecting the design of the repair materials

In situ materials	Mechanical strengths, porosity, grain-size distribution, chemical and mineralogical composition …
Position of the member on the bearer	Foundations, bearing element of the colonnade or entablature, element of retaining wall, presence or not of connectors …
Environment	Sulphate/carbonic etc. pollution, sea aerosol, sulphur from the ground, rising damp, freezing, biological erosion, salts …
Economy	Conditions of production (equipment, personnel, place of production, period of production), cost, accessibility (for production, application, future conservation), available budget, importance of the monument and the work …

Table 2. Factors affecting the durability of cast materials

The mass of the material	Workability, water capacity/cement/pozzolans/lime content, type and compression strength of the aggregate, grain-size distribution of the aggregate, maximum grain-size, quality of interfacial transition zone, microstructural characteristics of the binder …
The surface of the material	Speed of carbonation of the surface, compression strength of the material, grain-size of the aggregate, cement/pozzolan content, curing conditions …

The copies of the west and south frieze of the Parthenon

Purpose of the study
The first aim was to eliminate the network of microcracks that sometimes develop on the surface of cast copies. The second aim of the study was to demonstrate the general improvement in durability of the artificial stone through the modifications proposed.

Design logic - methodology
The first step was to evaluate the factors that could affect the behaviour of the materials *in their specific location and for their specific function*. Thus, in addition to searching in the bibliography, the Acropolis site was extensively investigated for the detection of mortar and/or concrete remaining from earlier applications in order to evaluate their performance. The results of the above research, together with the study of the properties of the materials that we *should* use, enabled us to make an initial interpretion of the cause of the microcracking and to define the desired performance requirements that the final material should meet (both in terms of mechanical properties and in terms of durability).

For the given materials and reference composition, the mechanism of surface cracking and the general performance in environmental actions were related to the grain-size distribution of the aggregate and the porosity of the surface of the hardened material. As a result, the perfect material (compared to the reference material) should have the following characteristics:

• reduced porosity
• increased strength, but less than that of Pentelic marble
• improved durability under certain characteristic environmental actions

Achievement of the above, for the given material, was through

• the study and adaptation of the grain-size distribution of the aggregate
• study of the influence of the maximum aggregate grain
• reduction of water content
• use of natural pozzolans to improve the interfacial transitional zone and to bind the portlandite originating in the cement hydration
• reduction of the cement content by substituting pozzolan for part of the cement
• proper curing of the cast members in order to cope with expected high hydration temperature resulting from the great fineness of the cement used
• curing of the structural member in water for at least three weeks after casting.

Materials that were used
The materials used are: white Portland cement of categories I and II 52.5, pure quartz sand of various grain-sizes and natural pozzolan with a maximum grain-size of 75 μm. All the material underwent quality control. A total of six different mix designs have been studied, three of which were without pozzolan and the rest with natural pozzolan in replacement of a 20% weight cement content as well as a reference mix design.

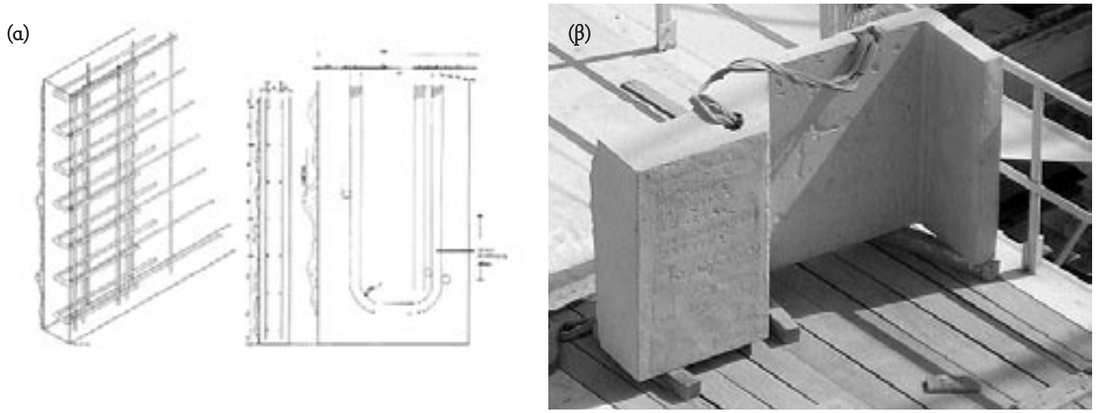
The structure of the frieze of the opisthonaos during its anastelosis: (a) view toward the north and (b) view toward the NE, showing clearly the structure of the artificial members that replaced the frieze blocks.
Photos E.-E. Toumbakari, 2004

Summary of the results of the research
By increasing the maximum grain-size and with the proper grain-size distribution, the required water content was reduced to the extent desired and as a result porosity was reduced. The capillary absorption factor was noticeably reduced and strengths increased. While the volume of water permeable pores of the compositions containing pozzolan was higher than that of the compositions without pozzolan, the total pore volume (measured with mercury intrusion porosimetry) is lower. This result is important because the durability of the materials is affected particularly by fine porosity.

From the durability tests, the reduction of water permeability in relation to the reference material was demonstrated. The durability tests carried out in cycles of wetting and drying showed that the loss of weight of the specimen containing pozzulan was always less than that of the specimen without pozzolan. Durability tests in sea water demonstrated again the superior performance of the pozzolanic specimen with a larger aggregate grain-size. While the presence of relatively large aggregate could mean a greater sensitivity to reactions of the type of the alkali-silica, in the end all the trials showed a notable volume stability and durability. Finally, durability tests in acid solution showed that damage initiation is retarded in the pozzulan specimen in relation to those without pozzulan as well as in the specimen with a larger aggregate grain-size.

Comments on the reinforcement design logic
The excessive thinness of the cast slabs (10 cm plus the relief thickness) aggravated a number of problems of reinforcement that are known in thin pieces of this sort: (a) the rectangular form of the steel anchor slabs creates a danger of localised cracking, and (b) the reinforcement that is introduced into the body of the material to attach the anchor slabs works as a dowel and is subject to strong shear, resulting in the development of strong splitting forces. To resolve the above problems, a sort of cage reinforcement was studied and applied. On the basis of this design, even if there is extreme displacement on the level of the entablature, the structural member will not split, but there will be localised crushing of the material below the dowel. Finally, with the curvature of the reinforcement the corners of the copy are strengthened and better protected.

Conclusions and perspectives
Analysis of the test results and observation



(a) Reinforcement of a typical slab (study by: E.-E. Toumbakari), (b) the special case of the copy of the frieze block SW: the joining of the thin slab and a fully cast section. Photo E.-E. Toumbakari, 2003

Concreting the artificial stone for the production of the copy of block W II. Photo A. Baibas, 2003

of the behaviour of the cast copies –some of which are now more than two years old– showed that our design logic was justified. Surface cracks were successfuly eliminated, and the durability of the material against expected environmental actions was significantly improved in relation to the reference material. For the future, we believe that a number of conclusions from the field of chemistry and technology of cement materials should be taken into account and that the use of fibres, calcareous aggregates and organic additives as well as the application of surface protection measures to the copies themselves should be allowed. With the investigation of even more complex mix designs, we believe that not only will more accurate copies be possible but that we will be able to eliminate the miniscule holes that appear on the final surface due to air entrapment.

Acknowledgements
The necessity to investigate the subject of the design of artificial stone was supported by the Technical Advisor of the restoration work in the opisthonaos, Assistant Professor P. Kouphopoulos, architect engineer. For the formulation of the requirements from the archaeological point of view and for information about the previous actions undertaken in the past, discussions were held with the Ephor Dr. A. Mantis, archaeologist, and with the civil engineer Dr. C. Zambas respectively.

The application of the test programme was carried out in collaboration with the following laboratories: the first phase of the testing was done at the Laboratory of Reinforced Concrete of the NTUA by permission of Associate Professor E. Vintzilaiou. Most of the tests for the second phase were done at the Greek Cement Research Centre (EKET) under the supervision of Mrs. Ch. Malami, Dr., chemical engineer. The petrographic analysis was carried out at the EKET by Mr. P. Tsakiridis, Dr., chemical engineer. The durability tests in cycles of wetting and drying and in emersion in acid solution were carried out at the Centre for Stone Conservation by Mrs. Ch. Lazari, conservator of Antiquities, with the supervision of the Director of the Laboratory, Mrs. K. Kouzeli, Dr. of Chemistry.

I warmly thank them all for our splendid collaboration.

The copies were produced by the YSMA Cast Workshop (messrs. G. Argyris, T. Kayiorgis, D. Katsaros, G. Liakopoulos, H. Mangaphas and A. Baibas). Once again I thank them for our splendid collaboration, which was based on constant communication, our regular meetings prior to decision-making and to the personal commitments made for the date of completion of the work. This practice resulted in the timely delivery of the work and the minimisation of delay.

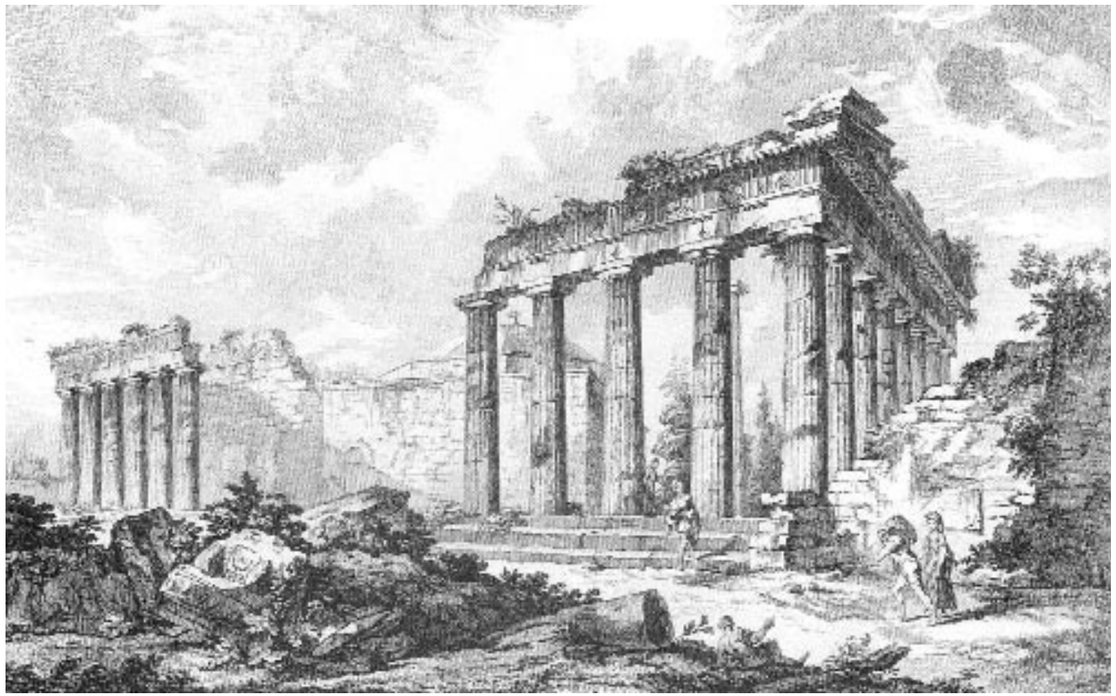
Approval of the funding for the research programme was given by the ESMA, to which, for my part, I express my thanks and gratitude.

Eleni-Eva Toumbakari
Dr. Structural Engineer
of the Parthenon Restoration Project,
in charge of the opisthonaos programme

The ruining of the monument - the monumentalising of the ruin
The most significant day for the Parthenon, after its initial dedication, may well be that of its destruction in 1687. For this day became a landmark, not just for the catastrophe itself, but because this event, unlike others in the past, perhaps less serious, was never refuted from that time on. The destruction, annihilating the role of the Parthenon as a building, denuded it of every utilitarian value and definitively altered the meaning of its essential nature. The Parthenon passed the next one and a half centuries in a state of utilitarian non-existence, which turned it into an excellent source of building material and sculptural decoration for the villas of the worshippers of antiquity.

The building's conversion into a symbol was promoted by the philhellenic spirit of the Europeans of the 19th century and the neoclassicism of the Bavarians of the newly created Greek state. Its ruined condition provided the perfect scenario for its heroic idealisation in the spirit of European romanticism. The historic revival of the Greek consciousness was supported by the raising of the monumental remains of the glorious past of ancient Greece to the status *symbols*. Thus, this particular ruin, which happened not to have been repaired, was transformed into a *romantic hero*. Here was the ideal materialization of the heroic character of the nation itself. Its new manifestation had nothing to do with its historical function, but rather with its *display as a symbolic ruin* at a time when its value as a witness of *memory* and archetypal architecture and culture was far more significant than any utilitarian value, which, indeed, would have reduced it as a *symbol*. Briefly, when the Parthenon again became the centre of interest at a time when antiquity was being romanticised, it was automatically accepted as a ruin without any practical use, which would itself have obscured the *pure truth* of the building as a direct messenger from Perikles himself.

New interventions
It was this spirit of preserving the picturesque and emphasizing the *symbolic character of the ruin* that inspired all interventions from the moment in 1834, when the Acropolis was proclaimed an archaeological site on the proposal of the architect-archaeologist Leo von Klenze, who laid the foundations for the approach to the restorations that ensued. Klenze himself carried out the first restorations of the Parthenon. They were followed by those of K. Pittakis and A.R. Rangabé and, in the 20th century, by the restorations of the civil engineer N. Balanos. All these works gave the monuments of the rock a new appearance. The interventions of Balanos, radical both in method and in the new visual result when they were completed, gave us as an *alibi* the appearance that had already been imposed on the monuments and their serious structural problems as well. These were arguments both necessary and sufficient for their re-restoration by the YSMA.



The Parthenon as a symbolic ruin. Illustrated by J. D. Le Roy, 1755

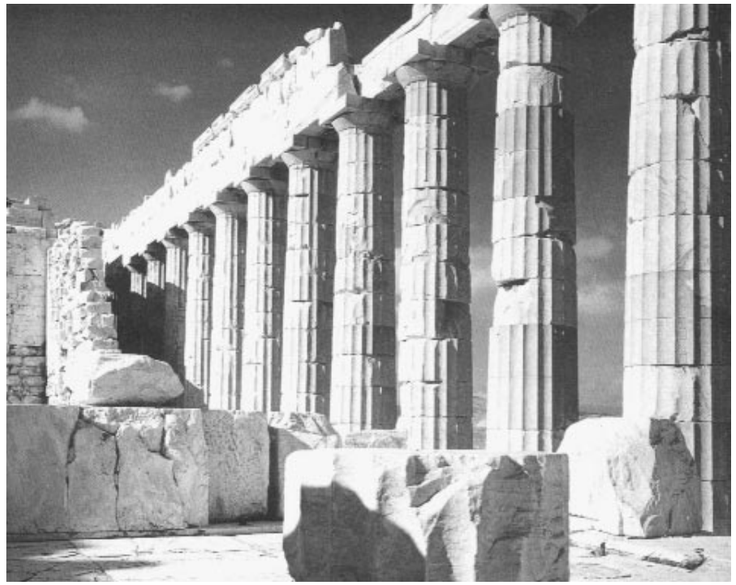
The new programmes of intervention on the Parthenon did not deviate from the principles of preserving the form of the ruin. Accepting the *"Balanos form"* of the monument as an existing condition, the aim of the interventions was a comparable *visual* result. Scattered members whose original place in the monument is certain, are incorporated in the new intervention wherever that does not alter the general image.

The intervention being carried out during recent years includes in the study of the monument a) r*esearch on its architectural characteristics*, b) the *archaeological facts*, and c) the *recording of previous interventions*. The documentation for these interventions is frequently insufficient or missing altogether. By increasing this documentation, we have a better understanding of the older methods used and our interpretation of the phenomena caused by those methods is more accurate.

The purpose of the previous interventions was to improve the aesthetic and morphological appearance of the monument. Today, the goal of anastelosis is to *come closer a structure compatible with the ancient form* of the building. The aesthetic of modern intervention has freed itself of puristic approaches and it is now a requirement that traces of the historical vicissitudes of the monument be retained. The archaeological importance of a building such as the Parthenon is so great that in every intervention, the consequences for its historical evidence must seriously be considered. The characterization of a monument as the *historical evidence* of the place to which it belongs, is far removed from the idea that it represents one and only one period of its existence.

North colonnade

One of the 12 Parthenon restoration programmes (according to the YSMA's classification) is that of the north colonnade. The destruction of the Parthenon in 1687 by Morosini's bombardment, among other things, felled eight of the columns and the entablature of the north colonnade. Apart from a limited attempt at restoration by Pittakis in 1844, the architectural members knocked out at the time of the bombardment remained on the ground until the beginning of the third decade of the 20th century, when Balanos began his intervention on the north colonnade. He began his restoration in 1923 and finished it in 1930, using methods acceptable at that time, employing reinforced concrete for filling in the members and joining and strengthening them with iron clamps and iron double-T beams. The rusting out and swelling of the iron reinforcements caused new cracks in the ancient marble of the members, accompanied by the well-known serious structural problems. The fact that the architectural members were not reset in their original positions, meant that the north colonnade was altered morphologically.



Parthenon. North colonnade after restoration by Balanos, view from southeast. Photo S. Meletzis, 1958

The contemporary reassessment of Balanos' intervention on the north colonnade is founded in the framework of a form that has been entrusted and accepted, since *memory* has been re-established in a new reality and the new anastelosis is aimed at correcting the technical and scientific "errors" of the Balanos intervention. The "justification" for the new intervention is based primarily on arguments concerning the actual rescue of the monument and then on correcting the positions of the members, on the aesthetic differentiation of the interventions and on objections in terms of methodology and practice. The *rescue aspect* of the new interventions provides an argument for escaping a re-examination of theoretical questions about the historical character or genuiness of the form. The *refutation of the natural historical continuity*, moreover, is no longer pertinent, for the "Balanos form" –which contains just such a refutation– with its existence over a period of some 70 years, has acquired a weighty position in the history of the monument and has therefore been considered to be a decision already made.

In 1998, the civil engineer C. Zambas completed the study for the restoration of the north colonnade, which was approved by the ESMA and by the Central Archaeological Council of the Ministry of Culture (KAS). Despite that, the proposal to begin work received no response from the KAS until February 2001, after a new time-schedule had been proposed. The restoration was to be based on the approved study by Zambas. In October 2001 dismantling of the members of the north colonnade began. In February 2003, during the first effort to reset the drums of the 10th column, a discrepancy was observed in the diameters and heights, which made necessary a revision of the study. Soon, new information about the morphology and construction of the columns made it clear that a new study was needed for the rearrangement of the members of the north colonnade.

The new finds

The observation by the undersigned, in August 2003, that the *drums were consistently not precisely circular in section, that there was a systematic discrepancy in their interior diameters* (i.e. of the diameters from the middle of each flute to the middle of the opposite flute), provided a new, very important *criterion for comparing the drums* in order to find their authentic vicinity. The interior diameters of each drum were found to have a range that increased/decreased with a variation as much as ~3 millimeters! Discrepancies in the interior diameters of the drums had been observed by both Dinsmoor and Zambas, but had been interpreted as chance differences of no importance. The recent observation, however, that the phenomenon was consistent and systematic has permitted its use as a criterion for placing the drums.

Yet, what did we actually observe? *Flutes, some deeper, some shallower*. Exploring the meaning of such a discovery takes us back to the process of making the monument. We already know from Vitruvius that the final dressing of the flutes was done *in situ* after the drums had been set and the column finished, using as a guide indications on the lower level of the column and on the upper part at the level of the capital. We may well imagine that this finishing followed specific procedures for bringing each column into line with the system of *entasis/meiosis*, and with other refinements of the monument as well. The dressing of the columns may be an obvious procedure, but the aim of so much accuracy and similarity, and the actual controlling of the process, can only remain in the realm of theoretical, even if convincing, hypotheses, without further evidence apart from the result in itself.

To explain the quite unexpected disimilarity in the section of the circumferential flutes raises the dilemma of whether this was by choice or by chance. Have we perhaps evidence for an attempt at controlled chiaroscuro of the fluting of the columns? Is this a new refinement? Or is it simply an astonishing proof of the "artistry" to be expected in work that is done by hand, even on such a "perfect" monument as the Parthenon, with such deviations naturally in balance with its perfection? The certainty that strict mathematical rules were followed in a *monument with plasticity*, perhaps surpasses the degree of adherence to such rules, in a work that seems to proclaim a *dialectical relationship* between canons that are rather empirical and an artistic desire for an original *sculptural creation*. The Parthenon, moreover, is perhaps the highest achievement of a fresh, lively, original and, why not, experimental *art* (art meaning also architecture). Just so was the *art* of Perikles' generation.

Parthenon. Restoration of the north colonnade in process, view from northwest. Photo L. Lambrinou, 2004

Filling in an architrave block from the north colonnade with new marble. Photo L. Lambrinou, 2004

Among the probable reasons for the phenomenon, the historical factor of *erosion* must not be underestimated, especially on the north part of the monument, which is exposed to the strongest wind and greatest dampness, suffering the severe results of its northern orientation. The most accurate observations, as far as the orientation of the smaller diameter, that is the *deeper flutes*, were made on the drums that were undisturbed until the first restoration of the 19th century. These are the lower drums of the 6th and 9th columns (with a total of 9 drums), most of which preserve all their diameters, thus providing full information

Trimming a filling of new marble in a column drum of the north colonnade. Photo L. Lambrinou, 2004

about *orientation and measurements*. While smaller diameters (*deeper flutes*) may be observed on the northern flutes, the other flutes too show such differences in their cross-section, as to suggest that the form was purposely made *"picturesque"* through the hand finishing of the fluting by the ancient marble cutters. Discrepancy in the cross-section, to be sure, does not mean a similar discrepancy in the exterior diameters of the arrises of the flutes. These cannot in any case be measured accurately because of their destruction. Research on this matter is continuing.

Apart from the question of meaning, the phenomenon of *discrepancy in the section of the flutes* makes the setting of adjacent drums unique. Since the section of the columns, on the vertical level, forms a *continuous even curve*, these increase/decreasings of the interior diameters of each drum can only be alike, with corresponding increase/decreasing of the initially adjacent drums, the identification of which we have explored in the study for the rearrangement. The matching of the drums does not depend so much on the diameter of one, but of all ten, if indeed corresponding fluting is preserved. Thus, the correspondence of as

Survey and measurements of the diameters of the upper resting surface of a drum from the north colonnade. Survey by C. Paraschis, A. Papandropoulos, C. Matala, measurements by L. Lambrinou, September 2003

many as possible diameters for each probable pair of adjacent drums minimizes the possible matches left.

The original positions of the column drums were found by means of these new observations, but using also other criteria, which C. Zambas had employed as well in the previous study of the columns. The traces of their exterior adjacent surfaces, such as the *pitting corrosion*, showing the northern orientation of the flutes, the *cuttings* and the *sockets* from additions and mediaeval constructions that were supported against the colonnade prior to the explosion, the *fractures* and damage from shock or from the shells of the Venetians during Morosini's bombardment, and also *micro-cracks* that may continue on into adjacent drums, etc., were the main indicative features for the approach and for verifying the solutions that the comparison of the diameters indicated. The new observations provided a criterion, which was used as the basic *way of locating the position of the drums*. The final inspection of the correspondences was based on the curves of *entasis of the columns*, a method used in all previous studies of the north colonnade (N. Balanos, W.B. Dinsmoor, C. Zambas) for verifying the curve of the vertical section of the columns (with the awaited technological development introduced by C. Zambas, that is, the electronical pages of Microsoft Excel).

The new study for the rearrangement of the eight north columns of the Parthenon was submitted by the undersigned in June 2004 and was approved by the ESMA after completion and with supplementary studies of the column capitals, which were finished at the beginning of July 2004. Resetting of the drums began in July 2004. To date (March 2005), 57 drums, out of a total of the 83 drums of the eight columns, have been set in their original positions, in accordance with the new study for their rearrangement. Resetting of the column capitals is to follow. These are now in the process of structural restoration as are also the architraves and the upper entablature. In accordance with the proposed schedule, completion of the programme of the north colonnade may be expected at the end of 2006.

Lena Lambrinou
Architect-Archaeologist of the Parthenon Restoration Project, in charge of the north colonnade programmme

Temple of Athena Nike study for the resetting of the blocks of the cella walls

During the process of dismantling the temple of Athena Nike, problems were observed in the position of the cella wall blocks. In particular there were inconsistencies in the position of the sockets for the ancient dowels. Moreover the positions of the sockets of the ancient dowels and of the locking blocks (the last blocks set in each course, *kataphragai*) were found in some instances to differ from those which A. Orlandos himself, the previous restorer of the monument, had correctly published. For this reason, it was decided to inspect the wall blocks for accuracy of position and in order to find possible errors in setting.

Used for this study were the survey drawings of the architectural members that had been made by the architects G. Antoniou, V. Manidakis, and the draughtsmen Th. Moutopoulos, V. Savvatianou and others. In addition a great many additional measurements were made by the undersigned. The entire study was followed by and discussed extensively with the architect, D. Giraud, who had written the initial study for the work. The 108 blocks of courses II - IX of the monument were the focus of our study.

Method

To begin with, the wall blocks were separated according to their basic geometrical features (length, common wall block or anta block) into 13 groups, which comprise 4 to 32 blocks in each one.

Then the architectural members of the two eastern antae of the temple were rechecked for accuracy of their vertical positioning, in order to determine the heights of the courses. The eastern antae were chosen because they preserve sockets from the balustrade and the later constructions in the area of the pronaos. These sockets have parallels in the east columns and the pilasters.

The blocks of each category were then separated into smaller groups on the basis of the following secondary features:
i. The height of the block
ii. The existence or not of dowel sockets on the lower bedding surface of the block
iii. The position of the dowel socket of the lower bedding surface in relation to the outer side of the block, in connection with the ordinary wall blocks of the N and S walls. The outer side was distinguished on the basis of the slope of the surfaces of the block – positive on the outer side, negative on the inner.
iv. The distances of the dowel sockets in the upper surface of the blocks from the sides of thrust.

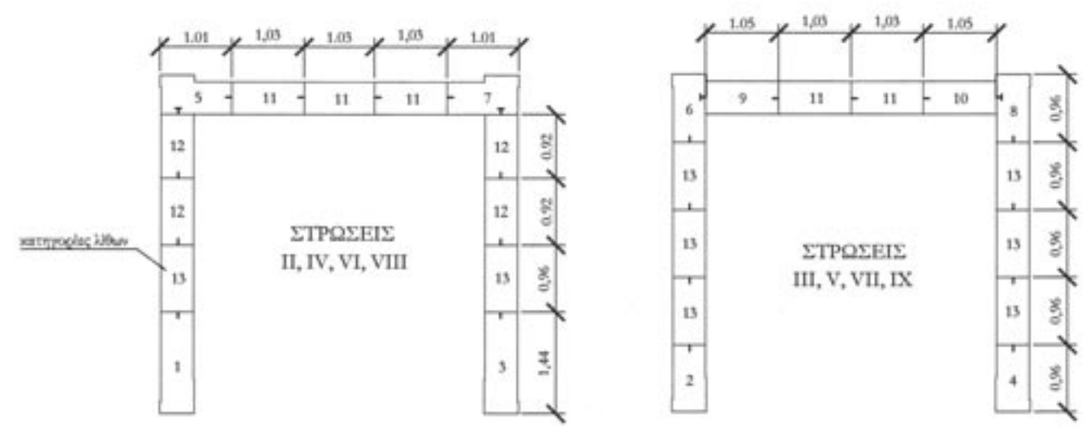
The choice of the above features for putting this into effect was made for the following reasons:
i. They are features that are probably still preserved on broken blocks as well.
ii By using them distinct groups, discernible one from the other, can be established.
iii Given the small number of members examined, the above criteria can in most cases determine the position of the blocks.

In fact, as emerged from the analysis, the combination of the above features is unique for most of the blocks; the most numerous groups of blocks with the same combination of characteristics, have only 4 members. In these cases and only these, it is necessary to make use of specific rather than general characteristics (exact position of morticed clamps and dowels etc) for determining their original location.

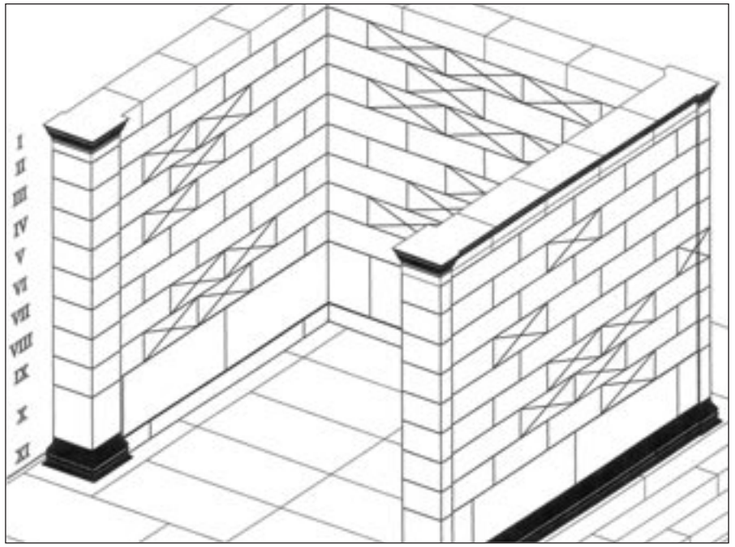
Particular emphasis was placed on locating the position of the locking blocks, since they are directly connected with the position of the sockets in the wall blocks. Different placings of the locking blocks mean also the existence of different groups of wall blocks – with the socket positions as criterion for their adjustment.

Conclusions

We have the following results from resetting the wall blocks:
i. Twenty-two blocks were moved from the positions they had in the previous intervention.
ii. A new wall block, found during the course of the work east of the work-site, has been put in place on the monument.
iii. Two large fragments of wall blocks, recognized as belonging to the temple in D.



Athena Nike Temple. Setting the wall courses on the basis of the categories of the blocks. Study and drawing by K. Mamaloungas, 2003



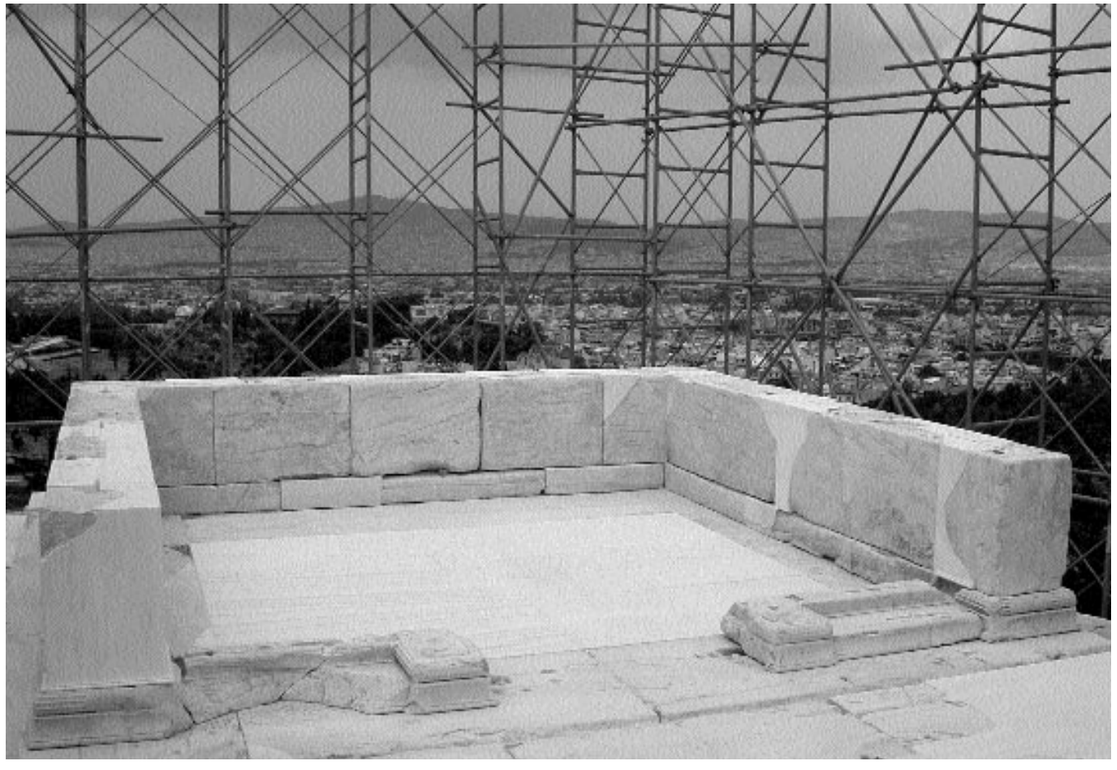
Athena Nike Temple. Proposal for restoration of the walls, showing the blocks moved to new positions and the fragments that have been reset. Study and drawing by K. Mamaloungas, 2003

Giraud's study, have been added to the monument.
iv. A fragment of an ancient wall block has been filled in with new marble and placed in its correct position, which had been occupied wrongly by a block from the SW anta.

With the identification and inclusion of the above blocks and fragments in the monument, the number of purely new wall blocks has been reduced from 14 to 10.

Finally, the study of the positions of the wall blocks has revealed the original position of the locking blocks (*kataphragai*) on all three walls of the monument.

K. Mamaloungas
Architect of the temple of Athena Nike Restoration Project



Athena Nike Temple with the orthostate course restored. Photo K. Mamaloungas, June 2005

The year 2004 was a year full of activity in connection with informing the general public and specialists alike about the restoration of the Acropolis monuments as well as the education of the young on the art, architecture, history and restoration of the monuments.

Educational Activities

The activities of the Department of Information and Education of the YSMA included educational programmes, such as "The Parthenon Frieze", the special programme - dedicated to the Olympic Year 2004 "The Panathenaia as seen through the Parthenon Frieze", and the distribution of Museum kits (33 kits given to educational organisations in Greece and abroad and kits lent to 155 schools), the supplying of educational material to 1980 people and 792 organisations, and the organising of lectures for 965 educators and students. Of special interest were the lectures given in various educational districts of Greece (Educational District of East Attica - Pallene Gymnasium, Educational District of West Attica - Cultural Centre of the Municipality of Aigaleon, 3rd Educational District of the Region of Evros-Souphli), at the Tellogleion Art Foundation in Thessalonike, at the European Centre of Delphi, and to French Professors of Greek in Middle Schools.

The Head of the Department, the architect-archeologist Cornelia Hatziaslani, gave a report on the subject of "Teaching the Athenian Acropolis" at the 105th Yearly Meeting of the Archaeological Institute of America at San Francisco in the United States. She also presented the educational programmes of the Acropolis at the J. Paul Getty Museum in Los Angeles. In December 2004 she spoke on the subject "Ancient Culture in Modern Education. The Athenian Acropolis Case" at the Institute of Classical Studies of London, at a meeting organised in collaboration with the Society for the Promotion of Hellenic Studies and the Joint Association of Classical Teachers. All these lectures were accompanied by an exhibition of the educational Museum Kits. Finally, the Museum Kit "Ancient Greek Musical Instruments" was included in the exhibition entitled «Coming of Age in Ancient Greece, Images of Childhood from the Classical Past», which was held at J. Paul Getty Museum in Los Angeles from September to December 2004.

The pamphlet "Acropolis and Education"

The photographic exhibition of the Acropolis Restoration Works by S. Mavrommatis held in the Museum of Folk Art at Kyme in Euboia

The pamphlet "Educational Museum Kits from the Acropolis"

In May 2004, the 8th Meeting on "Educators and Programmes about the Acropolis" was held with "The Panathenaia through the Parthenon Frieze" as special theme. Finally, new pamphlets have appeared during the past year: the educational game of recomposing "The Parthenon Frieze" and the pamphlets "Acropolis and Education"

and "Educational Museum Kits from the Acropolis".

Photographic exhibitions

The photographic exhibition by the Head of the Photographic Laboratory of the YSMA, Sokrates Mavrommatis, of the anastelosis of the Acropolis Monuments continued to travel during 2004 to various parts of Greece and abroad. To begin with, the exhibition at the so-called Mercati Traianei in Rome was continued until the beginning of March. It was then shown at the Museum of Folk Art in Kyme, Euboia (from 31 July to 29 August 2004). From September 2004 to the end of 2005 it is being exhibited at the University of Fairfield in the United States. On the occasion of the opening of this exhibition at Fairfield in September, Mr. Mavrommatis gave a lecture on the photographic documentation of the works on the Acropolis. Likewise in 2004, two special photographic exhibitions by S. Mavrommatis were held: last July the exhibition "The cleaning of the west frieze of the Parthenon" was shown in Gallery VIII of the Acropolis Museum (the exhibition is continuing at present), and in December the exhibition "The Parthenon Frieze" was shown at the Benaki Museum with the photographs that illustrate the book with the same title by Angelos Delivorrias, Melissa editions.

New Films

Two new films were made by S. Mavrommatis in 2004: one film, 7 minutes long on the subject of "The Parthenon West Frieze, Conservation and Cleaning, 2003-2004", and another, 14 minutes long on "The Works of Anastelosis of the Acropolis Monuments, 2003-2004".

The photographic exhibition of the Acropolis Restoration Works by S. Mavrommatis held at Fairfield University, USA

Presentation of the Acropolis Restoration Projects at the Paestum (Poseidonia) Symposium

A symposium was held at Paestum in Italy from the 26th to the 27th of June 2004 on the subject of the conservation works on the temples there, which have recently been completed. The symposium was organised by the Ephorate of Antiquities of Paestum and Salerno, and a group of scholars from the YSMA were invited to present the Acropolis projects. The Director of YSMA, the civil engineer Maria Ioannidou, presented the overall programme of restoration of the Acropolis and the architect Tasos Tanoulas, Head of the work on the Propylaia, gave a talk on the course of the restoration of the monument. The architect of the Propylaia project, Konstantinos Karanasos, spoke about the methods of filling in the ancient architectural members of the Acropolis monuments with new marble. The work of conservation and cleaning of the Parthenon west frieze was reported on by Evi Papakonstantinou, chemical engineer and Head of the Conservation Department. At the final round-table conference of the symposium, the Head of the Documentation Office of the YSMA, Fani Mallouchou-Tufano, archaeologist, gave a talk on the management of archaeological sites and monuments in Greece during the last thirty years following the political hand over of 1975.

Lectures on the Acropolis Works

Many members of the scholarly staff of the YSMA gave lectures in Greece and abroad about general or specific topics of the Acropolis restoration works. At a special event held at the Zappeion, M. Ioannidou spoke on the Acropolis works to the foreign correspondents during the Olympic Games in Athens. Last December she also gave a talk on the Acropolis restoration at the Instituto del Patrimonio Historico Espanol of the Ministry of Culture of Spain. The special project of cleaning and conserving the Parthenon west frieze was the subject of her lecture in Spain at the Instituto de Fisica-Quimica Rocasolano of the Conseijo Superior de Investigationes Cientificas. In October she took part in the Yearly Meeting of the International Scientific Committee on the Analysis and Structural Restoration of Architectural Heritage –ISCARSAH– of ICOMOS, that was held in Athens. She commented on the text of the relevant "Recommendations", in the light of her long experience with the restoration of the Acropolis monuments.

At a brilliant event organised last November by the Hellenic Society at King's College, London, T. Tanoulas presented the history and anastelosis of the Propylaia. E. Papakonstantinou together with the YSMA conservators K. Frantzikinaki, A. Panou, K. Vasileiadis and the specialists from the Institute of Research and Technology, P. Pouli, Th. Ditsa, V. Zafiropulos and K. Photakis, gave a lecture on "The Cleaning of the Parthenon West Frieze: An Innovative Laser Methodology" at the 6th International Symposium on the Erosion and Protection of Stone in the Monuments, that was held from the 28th of June to the 3rd of July, 2004 in Stockholm.

A report on "Dowel Action of Titanium Bars connecting Marble Fragments at Different Angles" was presented at the 13th International Brick and Block Masonry Conference by Dr. Eleni-Eva Toumbakari, structural engineer of the Parthenon project, together with Eleni Vintzelaiou, Associate Professor at the National Technical University, held from the 4th to the 7th of July 2004 in Amsterdam. Spyros Oikonomopoulos, mechanical-electrical engineer in charge of the electro-mechanical support of the Acropolis works, gave a lecture at the University of Patras last May on the electro-mechanical equipment of the Acropolis work-sites. Finally, last May, F. Mallouchou-Tufano gave courses on the Acropolis works at the Universities of Florence and Perugia and last October at the University III of Rome. She also took part, with a report on the Acropolis restoration, in a day-long conference on the management of archaeological sites and monuments organised in June 2004 by the Archaeology Department of the Faculty of Letters of the University of Naples.

Events

A special event on the occasion of the Olympic Games was held on the 11th of August at the Zappeion Megaron. The works of the YSMA, of the Acropolis Ephorate, of the Organisation for the Construction of the New Acropolis Museum and the efforts being made for the Restitution of the Parthenon Sculpture (Elgin

The first visitors with special needs of the Acropolis. Behind them are the Deputy Minister of Culture, Mr. P. Tatoulis and the Secretary General of the Ministry, Mr. C. Zachopoulos, 12 August 2004

A. Choremis, Director of the Acropolis Ephorate, guiding the first visitors with special needs to the Museum in the presence of the Deputy Minister of Culture, Mr. P. Tatoulis, the Secretary General, Mr. C. Zachopoulos and the Director of YSMA, Mrs. M. Ioannidou, 12 August 2004

Marbles) were presented. On the following day, 12 August, the lift on the north slope of the Acropolis for people with special needs was inaugurated by the Deputy Minister of Culture, Mr. P. Tatoulis. Present also was the General Secretary of the Ministry of Culture, C. Zachopoulos.
The most splendid event of last year, however, was held on the 27th of July at the Acropolis on the occasion of the completion (ahead of schedule) of four of the partial programmes of the YSMA: the structural reconstruction of the Parthenon Pronaos and opisthonaos, the conservation and cleaning of the Parthenon west frieze and the reconstruction of the north wall of the Propylaia. The event was held in the presence of the President of the Democracy, Konstantinos Stephanopoulos and the Alternate Minister of Culture, Fani Palli-Petralia, who were guided around the monuments and the Acropolis Museum by the Directors of the YSMA and the First Ephorate of Prehistoric and Classical Antiquities, Mrs. M. Ioannidou and Mrs. A. Choremis, respectively, the President of the ESMA Mr. Ch. Bouras and by the Heads of the various departments and offices of the YSMA.
Finally, on the evening of the 12th of August, 2004, the ceremony of lighting the Olympic Flame was held in front of the west façade of the Parthenon in the presence of many dignitaries and people. Without the scaffolding, removed with the recent completion of the restoration of the opisthonaos, the west end of the Parthenon literally shone in serene splendour, heralding the future appearance of the Acropolis monuments when their –necessary– anastelosis will have been finished.

The President of ESMA explains to the President of the Democracy the technique of adding fillings to the architectural members, 27 July 2004

The President of the Democracy, Mr K. Stephanopoulos and the Alternate Minister of Culture, Mrs. F. Palli-Petralia, being guided at the Athena Nike Temple restoration site by the structural engineer in charge, D. Michalopoulou, 27 July 2004

Presentation of the Restoration work of the Propylaia by the engineers in charge, Mr. Tasos Tanoulas and Mrs. Maria Ioannidou, 27 July 2004

The President of the Democracy, Mr K. Stephanopoulos and the Alternate Minister of Culture, Mrs. F. Palli-Petralia, being guided at the Parthenon restoration site by the architect in charge, N. Toganidis, 27 July 2004

Fani Mallouchou-Tufano
Archaeologist PhD., Head of the YSMA Documentation Office

On the marble technicians of the Acropolis

"...never have I been disappointed by the Greek marble workers who have taught me so much. Some were true archaeologists or real artists. All were devoted to their work and we became friends..." These are the words of the Academician Jean Marcadé in his talk on the 28th of May, this year, to the Association of the Friends of the Acropolis.

I shall not refer to the experiences of other archaeologists in their work with conservators and marble technicians in museums, excavations and anasteloses. I shall recall only two who, for me, were unforgetable teachers, Christos Chatziliou at the National Museum and Yiannis Tsephlikos in Epeiros at the various monuments. I shall also talk about the marble technicians who worked at the Acropolis from 1975 on, when the works for restoring the monuments began.

Filling in the ceiling beams of the Propylaia with new marble. Photo K. Karanasos, 2004

Carving the new Ionic columns of the west hall of the central building of the Propylaia. Photo T. Tanoulas, 2005

In the beginning the Committee for Conservation of the Acropolis Monuments invited those with experience from working on various monuments, such as the Odeion of Herodes Attikos, the temples of Aphaia and at Sounion, the Stoa of Attalos: Nikos and Markos Skaris, Yiorgos Vidos, Stavros Voudouris, Alexandros Nikolouzos... These experienced marble technicians initiated the works on the Erechtheion under the direction of responsible engineers and on the basis of approved studies. In the shed that served for years as the work-site of the Erechtheion, the collaboration of the engineers with the technicians was direct and we archaeologists too learned something about the mysteries of their work, when we escaped our office...

Some of the older marble technicians before retiring managed to work on the Parthenon as well, when the works began there in 1986. The younger ones, when the work of the Erechtheion was finished, went to various work-sites of the Acropolis and most continue still, as master technicians now, to offer their invaluable services.

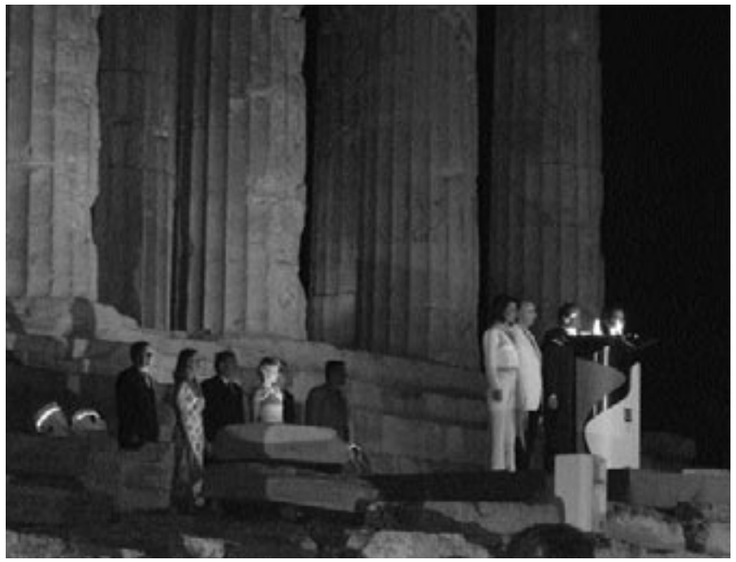
After 2000, when the YSMA was established and the works on the Acropolis expanded, there was the possibility of hiring young marble technicians. Most were graduates of the Tenos Technical School. Initially we were afraid they might not meet the standards of the older technicians. Fortunately we were proved wrong. Among the qualifications obtainable at the School –knowledge of marble and how to work it, but also general knowledge of the art and architecture of the monuments– there is always skill, artistic sensitivity, and especially a feeling for the monuments.

A decade after the departure of the first, a second group of marble technicians was to retire. In 1999, the Association of the Friends of the Acropolis organized a celebration in their honour. Present were Kosmas Theotikos, Head of the Propylaia team, Tzortzis Skalkotos, Demetris Mesolongis, Tzortzis Koukoulas, Alekos Sikalos and Yiannis Arbilias, Head of the Parthenon team, and later honoured also with the great prize of Europa Nostra.

In the meantime, two more marble technicians had retired: in 2001 Tzortzis Paparidis and in 2003 Iosiph Armaos. We shall honour them together with those who will retire at the end of 2005: Stelios Kaphouros, Head of the Parthenon work-site, and Francesco Alexopoulos, Head of the restoration team of the opisthonaos project of the great temple.

In 2004 the Association of the Friends of the Acropolis honoured Vasilis Anastasias, who has not yet reached retirement age. We always see him working on the monuments of the south slope of the Acropolis, somehow pleased that his work has been recognized.

Evi Touloupa
Ephor Emerita of the Acropolis
Member of the ESMA



Ceremony of the lighting of the Olympic Flame in front of the west façade of the Parthenon
12 August 2004

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