



View of the south wing of the Propylaea and the temple of Athena Nike from the N. Photo T. Souvlakis, 2013

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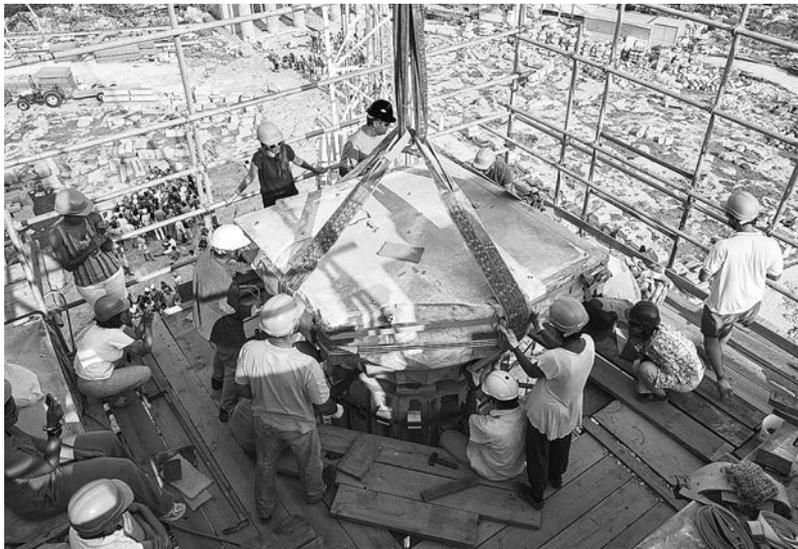
The most significant event of the past year for the Acropolis Restoration Service (YSMA) was certainly the organising of the 6th International Meeting for the restoration of the Acropolis monuments.

Eleven years after the 5th International Meeting, at which the anastelosis programmes for the Acropolis monuments were presented analytically both from the point of view of the development of theoretical questions and from that of reporting the works accomplished, the new Meeting was organised on a completely different basis. A determining factor, for one thing, was its duration, which was limited to two days, for reasons deriving from the general financial situation of the country. As a result, the number of speakers was limited and the themes were presented by those in charge of different Sections of the works, while the programmes planned for the future were presented by the President of the Committee for the Conservation of the Acropolis Monuments (ESMA). The problem of a limited amount of time in relation to the great number of subjects and works that had been carried out since the previous Meeting, was met by two supplementary actions: a poster exhibition to present the studies, research programmes and special subjects of concern, and a digital publication to report on the ten years' work of the Service. This digital report is a large volume of 900 pages, richly illustrated, and tirelessly prepared since the beginning of 2013 by eighteen architects and civil engineers, thirteen archaeologists, seven conservators, six draughtsmen, one photographer, the rest of the personnel of the Documentation Office and the administrative staff of the Service.

The YSMA was of course affected by the

mobility scheme stemming from law 4172/2013. Thus the Service lost two good colleagues, draughtsmen, G. Trichakis and A. Anagnostou. At the same time, two of the older colleagues, T. Skari, draughtswoman and P. Psaltis, draughtsman, retired at the end of 2013.

Voluntary work was offered to the Service during the past year by the architect Dr T. Tanoulas, the archaeologist C. Hatziaslani and the draughtswoman K. Matala. Research programmes and matters pertaining to the circuit wall and the rock itself were



Dismantling the NW column capital of the Parthenon. Photo T. Souvlakis, 2012

monitored by the Director Emerita and Special Expert, M. Ioannidou.

On the Parthenon the works proceeded in accordance with the approved programme. The Head of the work is the architect R. Christodouloupoulou. The scholarly staff of the work comprises the architects V. Manidaki, A. Papandropoulos and K. Skaris, the civil engineers A. Vrouva, Z. Konteas, E. Tavouktsi, E. Sourtzi and L. Palaiologos, and the archaeologists E. Karakitsou and Dr E. Mimidou. The architect L. Lambrinou was on leave this year with a study permit. Heading the team of marble technicians were G. Angelopoulos and S. Kardamis.

An extensive report on the problems and study for restoration of the west side of the

Parthenon was included in the preceding issue of "The Acropolis Restoration News". Carried out during the past year were works of structural restoration of the architectural members showing problems. The re-setting of architectural members at the two corners of the west side is scheduled to start at the beginning of next year, when the works of structural restoration of the 2nd from north and southwest column capitals will have been completed. Considerable time was needed for research on the structural restoration of the 2nd from north column capital of the west side. The

solution ultimately approved by the Committee for the Conservation of the Acropolis Monuments was to strengthen the column capital in situ with titanium reinforcement. Filling the missing west part of the southwest column capital—amounting to 1/4 of the whole—with marble proved likewise to be time-consuming. The tasks of working and joining the marble filling, applying grout in the cracks, working the outer surface for configuration of the

echinus and the formal rendering of the annulets of the member required both specialist personnel and considerable time.

Copies of seven metopes and two pedimental sculptures were cast in April 2013 to replace the originals, which were dismantled from the west side of the monument and are now exhibited in the Museum. Three weeks after being cast, the copies were placed in cisterns where they remained for two months so as to complete the maturation process. The making of the copies was undertaken by the experienced YSMA cast-makers, A. Baibas, Th. Kagiorgis, G. Liakopoulos, and G. Argyris, supervised by D. Michalopoulou and the member of ESMA, Prof V. Rigopoulou.

The spring of 2013 saw the revising of M.

Korres' study for the restoration of the Parthenon's west wall by the architect L. Lambrinou and the civil engineer V. Papavasileiou, and its approval by the ESMA. The restoration of the lintel above the doorway of the Opisthonaos, which N. Balanos had made of reinforced concrete, remains for the Service in a future programme. The study analyses the means of removing Balanos' construction, the structural restoration of the four plinths of the lintel, the restoration of the two overlying courses of the wall with fillings and the addition of new members as well as the organising of the worksite. The present programme includes the structural restoration of the two middle plinths of the lintel, ancient fragments of which were removed from their positions by N. Balanos and remain in the Parthenon cella. The marble blocks required have already been found and the forming of the fillings of these plinths is to be entrusted to an external partner.

The restoration of the orthostates and the first course of the cella north wall continued during the past year, in accordance with the approved study by N. Toganidis and K. Matala. The intervention includes the restoration of the bedding of the toichobate, structural restoration of 15 of the total of 17 blocks of the exterior layer, the making of new orthostates blocks for the interior course, only one ancient block of



Carving the flutes in the NE corner of the Pronaos. Photo V. Eleftheriou, 2013

which has survived, and their resetting. Structural restoration of the first course involves 20 ancient and 9 new blocks. Among the programmed works completed, the toichobate bedding restored and 9 missing corners of the slabs were filled in with marble or mortar. Twelve ancient blocks of the outer orthostate layer were restored and 4 of these were set in place. At the same time work was started on the restoration of 5 blocks of the first row of the north wall, for which 3 fillings of new marble had to be formed.

With the completion of the cutting of the

flutes on the 9th column of the Parthenon north side, the north colonnade, which was restored during the period 2002-2009, has now been fully rendered. The carving of the final surface of the flutes in the filled-in areas of the drums of six restored columns had still to be done after the work of that period was finished. The carving of the flutes, a work requiring the utmost accuracy, was undertaken by the most specialised marble technicians of the Parthenon team.

The carving of the flutes of the fillings and drums of new marble in the north column of the the pronaos porch was initiated in July 2013. Anastelosis of the colonnade was completed in 2004. The initial decision –to render the fillings and drums of new marble in a truncated form without fluting– proved from the aesthetic standpoint inferior to the architectural magnificence of the monument. After resubmitting the matter to the Central Archaeological Council (KAS), the proposal of L. Lambrinou and the writer for carving the flutes by hand was approved.

In the Propylaea, work continued in the south wing of the monument. The Head of the project is the civil engineer, D. Michalopoulou. The scholarly team includes the architect Dr K. Karanasos, the civil engineer V. Papavasileiou and the archaeologists E. Petropoulou and Dr C. Koutsadelis. Head of the marble technicians is G. Desypris.

The south wing had been restored in the past, during the years 1946-1954 and 1957-1960 by A. Orlandos, an intervention that remained half-finished. The approved study by T. Tanoulas calls for the resetting of 53 identified architectural members, of which 42 are on the ground and 9 had been wrongly set from the time when the Frankish Tower was constructed. Two members are to be made entirely of new marble. In 2012 the equipping of the worksite was completed in preparation for the intervention. Dismantling of the architectural members was launched in Septem-



Trial setting of the orthostates blocks of the north wall of the Parthenon cella. Photo V. Eleftheriou, 2013

ber 2012 and completed in March 2013. A total of 14 architectural members were dismantled. Nine had been wrongly placed and 5 were in situ. Their state of preservation necessitated their restoration on the ground. The removal of the architectural members from the southeast corner of the south wing revealed the corner, partly cut off, of the original construction in the area of its contact with the Mycenaean wall. Two blocks of the frieze and four architrave blocks—two from the north colonnade and two from the west façade—were dismantled as well. They had been restored earlier by Orlandos. This was preceded by an examination of the adequacy of the Stikas - Orlandos intervention in terms of static efficiency, since the architrave blocks would bear a greater load after the new intervention. The method of the earlier intervention was considered inadequate and a study for structural restoration was undertaken by V. Papavasileiou, in accordance with the methodology followed in the Acropolis works. Resetting began in June 2013 and to date, 7 architectural members have taken their final positions.

The study for restoration of the northwest corner of the Propylaia by K. Karanasos and M. Ioannidou was approved by the Central Archaeological Council at the end of 2012. Its application is to begin early in 2015. The main problem lies in the capital of the column at the northwest corner of the central building, which has a penetrating crack in the east side. The marble block from which the column capital had been carved had an inherent flaw that was countered already in antiquity by means of three iron clamps in the upper surface of the abacus. The southernmost of these clamps has pulled off, and the northernmost has rusted and swollen, causing the marble to break and a fragment to detach. Structural damage is evident also in the outer block and backer of the architrave of the north façade, as well as in blocks of the frieze. In accordance with the study, a total of 11 architectural members are to be dismantled from the northwest corner of



Dismantling the south architrave block of the west façade of the Propylaia south wing.
Photo K. Karanasos, 2013

the central building in order to be structurally restored and conserved on the ground. This intervention provides an opportunity to reset 3 authentic blocks of the north wall on the monument. It is planned in addition to reset 4 preserved drums from the colonnade of the west façade of the Propylaia and one of new marble. Apart from its rescue aspect, the intervention will assure the protection of ancient material by incorporating it in the monument.

By the end of the year the supply of 120 m³ of Pentelic marble for the requirements of work on the Parthenon and the Propylaia was depleted. A final stage has been reached in the process of awarding to an external partner the mechanical cutting of a limited number of fillings and new architectural members, which are too large to be handled in the worksite.

A series of interventions were carried out in the basement of the temple of Athena Nike,



Joining fragments of a block from the south wall of the Propylaia south wing.
Photo K. Karanasos, 2013



Dionysos quarries: choosing bulk marble for the restoration of the Acropolis monuments.
Photo V. Eleftheriou, 2013

where the poros temple is preserved, in order to confront the structural problems connected with the aging of building materials of the period 1935-1940, and to improve conditions for protecting the archaeological remains while making them accessible to visitors. A doorway was therefore opened toward the hall where the altars are preserved and a wooden crossway was constructed for visitors to the area. The old insufficient lighting and electrical installation was redesigned and replaced. The architect K. Mamaloungas supervised the work.

The works of surface conservation of the monuments continued during the past year with the chemical engineer Dr E. Aggelakopoulou as Head. New mixtures of mortar for sealing and for filling were designed, the physiochemical properties of which are being evaluated. In the Parthenon, with the conservator A. Panou in charge, support was given to the dismantling of the northwest corner and conservation interventions were carried out on 45 of the architectural members that had been lowered. In addition, conservation work on the hidden sides of 7 members of the north orthostate were completed and the joints of the marble fillings in the drums of the 4th, 5th, 6th and 9th columns of the north side were sealed.

In the Propylaea, with the conservator K. Frantzikinaki in charge, rescue conservation interventions were carried out prior to lowering the architectural members of the south wing, and systematic conservation of 31 architectural members was completed. Systematic interventions were likewise carried out on resting surfaces and surfaces subject to thrust on members in situ that will be inaccessible after the works of anastelosis. Conservation work on the 3rd, 4th and 5th drums of the north column of the west façade was completed.



In the temple of Athena Nike, with the conservator A. Tsimereki in charge, conservation of the east colonnade was completed and interventions continued on the inner sides of both the south and the west walls.

In the Erechtheion, with the conservator M. Frantzi in charge, the systematic conservation of 27 blocks of the inner side of the west wall was completed and work is continuing on 4 more blocks. The old mortar has been replaced in the coffered ceiling of the south porch, improving it aesthetically. The remnants of ancient iron clamps preserved in the south and west walls have been recorded and, together with this, research proceeds on how best to preserve them.

All the conservation interventions on all the monuments continued to be documented and entered in the YSMA database; an overall study of sealing and filling mortars used in the surface conservation of the monuments from 1991 to date was submitted by the conservation team.

In the field of research, special photography was conducted on the visible and in the infrared electromagnetic spectrum in order to determine the presence of ancient colour (Egyptian blue) on the coffered ceiling of



Wooden crossway for access of visitors to the basement of the temple of Athena Nike (left) and the poros temple, after completing works of enhancement (right). Photo T. Souvlakis, 2013

the south porch of the Erechtheion, on the northwest sima of the Parthenon and on blocks of the west frieze exhibited in the Acropolis Museum. In addition, trial shots were made in infrared wave lengths of the Erechtheion coffered ceiling and the Parthenon northwest sima in an effort to investigate new evidence related to polychromy. Fragments of poros architectural members were joined in collaboration with the Office of inventorying, documentation and classification of scattered architectural members.

The Office of inventorying, documentation and classification of scattered architectural members, headed by the archaeologist Dr E. Sioumpara and with the archaeologist Dr E. Salavoura, continued with the inventory and classification of material from the Arrephorion stone-pile. In the framework of the programme for joining the poros architectural members, the joining of small fragments without reinforcements was completed with the mending of 33 of a total of 54 members. The mending with mortar recommended by the Technical University of Crete is proceeding in a laboratory established in the northeast hall of the old



Mending a poros architectural member in the laboratory. Photo T. Souvlakis, 2013

Acropolis Museum under the guidance of the specialised marble technician L. Zacharopoulos. Likewise in process is the restoration of an archaic Parthenon triglyph (AE 21432), which is practically restored in its complete original form. The triglyph, with ten fragments belonging to it, had been mended with inappropriate materials. The fragments were dismantled from the cement base, to which they had been anchored, underwent conservation and fillings were made of fossiliferous carbonated material from Piraeus. The team of

the of scattered architectural members assisted the 1st Ephorate of Prehistoric and Classical Antiquities in the transport of 78 inscriptions to the old Acropolis Museum. Twenty-six inscriptions had been moved there sporadically in the past and the remaining 63 are to be moved in the immediate future.

Conservation and consolidation of the Acropolis circuit walls have been included in the programming of the works of the ESMA and the YSMA from the very beginning. In previous years work was focused on documenting the form, on research on the pathology and on monitoring the state of preservation of the walls, using the most contemporary technology. A problem in the south wall that became evident in February 2012, launched a series of actions both for the restoration of the span between the 6th and 7th buttresses, in the area of the Thra-syllos Monument, and for the drawing up of an overall study for confronting the problems of the fortification walls and the draining of rain-water from the entire surface of the Acropolis; the work is to be included in the next intervention programme of the YSMA. The problem in the area between the



View of the south circuit wall of the Acropolis from the S. Photo V. Eleftheriou, 2013

6th and 7th buttresses, i.e. stones falling from the wall, is connected both with earlier interventions in the area and with rain-water accumulating on the Acropolis surface around the old Museum. A 2 m protective barrier has been placed at a span of 10 m. below the affected area and a study on how to resolve the problem has been undertaken by the architect A. Hatzipapa. Identified in the study are the areas from which stones have fallen or spaces exist threatening new falls, a result of Ottoman reinforcing with rubble and mortar. It is proposed to reset stones that have been removed and to set new stones in the empty spaces. Scheduled in addition is the use of

The study of R. Christodouloupoulou, G. Christakopoulos and E. Alexandraki was prepared by the 1st Ephorate of Prehistoric and Classical Antiquities in December 2011 and the work was awarded in February 2013 after an underbid draft tender. The work comprised repairs to the damaged pathway for disabled going from the elevator at the north side of the archaeological area to the elevator of the old Museum at the location of the WC's for disabled, installed on the occasion of the 2004 Olympic Games. Crumbling parts or whole sections of the pathway were removed where necessary, new reinforced paving was introduced, the composition of

dition, the NTUA undertook research on the properties of titanium and on the resistance of the white cement pulp used for joining architectural members. After a draft tender the Geodynamics Institute of the National Observatory of Athens undertook development of the accelerographic network as well as modernisation of the existing system and utilisation of its databases.

In the framework of research, documentation and dissemination of the work of the YSMA, undertaken by the Documentation Office headed by the archaeologist Dr E. Lembidaki, the habitual routine was continued. This comprises the entering of data into the archive and database of the Service from the anastelosis interventions (on the Parthenon, Propylaia, temple of Athena Nike) and from the conservation works. The work in the main office of the YSMA archive is supported by the archaeologists Dr M. Katsianis and Dr A. Sophou in addition to G. Alexopoulos, technical engineer, in charge of the information website. The Office continued upgrading of the YSMA database – a project to be completed very soon – the digital recording of the library, the plans/drawings and audio-visual material of the works as well as the digitisation of conventional documentary material (films super 8 mm). Photographic documentation of the anastelosis was continued by the photographer T. Souvlakis and the documentary filming was awarded to an outside collaborator, K. Arvanitakis, who undertook the work after an underbid draft tender. Promotion of the works for the general public was continued as well. This comprised the management of the YSMA website with improvement and expansion of the application for virtual exploration of the Acropolis rock. Publication of “The Acropolis Restoration News” in Greek and in English is prepared by the archaeologist E. Petropoulou who also takes the minutes of the ESMA meetings.

A more extensive report on the publications of the Documentation Office is presented elsewhere in the present issue of



The pathway for the disabled west of the Erechtheion, after its repair. Photo V. Eleftheriou, 2013

stainless steel or titanium reinforcements where necessary, surface conservation of the poros stones, removal of crumbling mortar and the deep-sealing of joints with compatible new mortar. The proposals include measures for coping with the dampness by means of a new system for draining the space between the old Acropolis Museum and the fortification wall as well as the worksite necessary for the task.

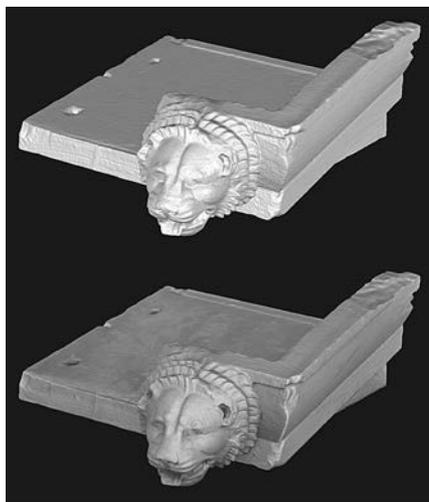
The current YSMA programme also includes repair of the existing pathways for the visitors and renewal of the roping in the archaeological area of the Acropolis.

which was decided among various samples submitted, and 350 stainless steel orthostates were made and set in place.

In the framework of research on materials and methods of application: a) the Polytechnic School of the University of Patras carried out experimental research on the mechanical characteristics of ancient and new marble, b) the Technical University of Crete did research on the composition of a mortar for joining poros, c) The National Technical University of Athens (NTUA) analysed the historical mortars from the circuit walls and the Propylaia and d) in ad-

“The Acropolis Restoration News”. The Documentation Office also organised the presentation at the Acropolis Museum of the two-volume book by A. Papanikolaou “The restoration of the Erechtheion (1979-1987): Final report on the Work” (in Greek with selected texts in English), in addition to assuming the greater part of organising the 6th International Meeting for the restoration of the Acropolis monuments.

The programme for photogrammetric plotting is also included in the framework of the documentation of the work. This is headed by rural and surveying engineer D. Mavromati, who completed in 2012-2013 the photomosaic of the west lintel and view of the west end of the entablature of the Parthenon south side. She also supervised the “Study of topographic and photogrammetric documentation at the Acropolis of Athens”, producing ground plans of the corners of the west side of the Parthenon before and after the dismantling of the blocks, at a scale of 1:20 and a plan and view of the entablature of the Parthenon north side, likewise at a scale of 1:20. In the Propylaia the four interior views of the south wing, before initiation of the works, were presented at a scale of 1:25. Photogrammetric imaging was made also of the wider area of the Propylaia and temple



NW sima with lion head: three-dimensional model with texture. 3d scanning A. Valani. Photo texture I. Kalispetrakis, 2013



Guided tour of the Parthenon interior for participants in the 6th International Meeting for the restoration of the Acropolis monuments. Photo T. Souvlakis, 2013

of Athena Nike at a scale of 1:100 and it was incorporated with the imaging of 2009, carried out in the context of the work “Study for the development of GIS at the Acropolis of Athens”. The rural and surveying engineer, Dr I. Kalisperakis, continued the scanning of chosen architectural members of the Parthenon.

In November 2012 the building at 13 Polygnotou street, known as the “Koletti House”, was granted to the Acropolis Restoration Service, which intends to restore it and to use it for housing the Archive.

The Information and Education Department of YSMA continued its activities, which are reported in another article of the present bulletin. The scholarly team of the Department comprises the archaeologists E. Kaimara, Head of the department, A. Leonti and S. Paraschou.

The Electromechanical Section supporting the YSMA, led by the electrical engineer D. Zois, provided the necessary assistance during the past year in all the worksites with monitoring and inspection of the electromechanical installations.

The contribution of the YSMA Accounting Office, headed by P. Katsimichas, was sub-

stantial during the past year in the particularly demanding task of managing the logistics and monitoring the community appropriations that fund the works. Important too was the contribution of the Secretariat, led by Ch. Papanikolaou and the Office for the Management of Materials, where A. Anagnostou was in charge.

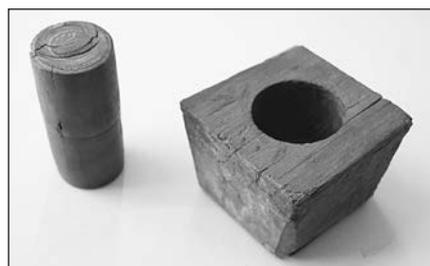
Having consumed half the time allotted for the present programme, with the expenditure of 60% of the funding, and with the plan to start immediately on resetting the architectural members on the west side of the Parthenon and continue intensively with resetting the architectural members at the south wing of the Propylaia, the course of the work to date is considered satisfactory, according to the schedule approved. Even so, the span of time until the end of 2015, when the anastelosis programmes now under way are expected to be finished, is limited. Good organisation and effectiveness are required if the aims of the Service are to be accomplished.

Vasiliki Eleftheriou
Architect
Director of the YSMA

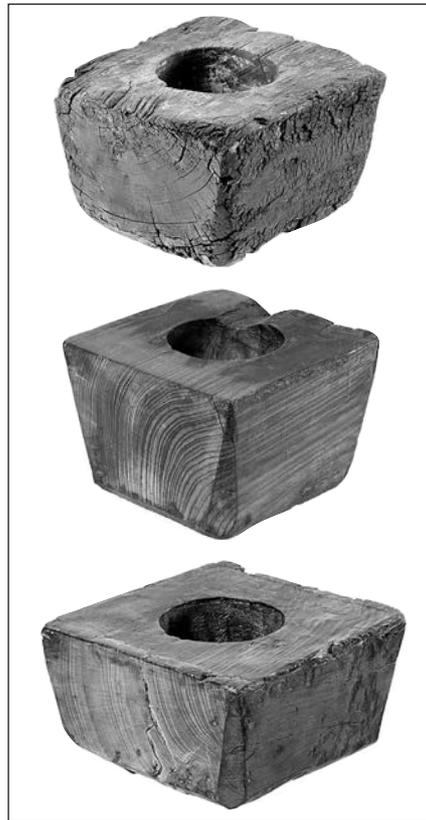
Empolia and poloi from the Acropolis monuments

In classical times, column drums were connected to each other by a system of wooden components, one polos and two empolia. Under the entry “empolion” in the “Lexikon of Ancient Architectural Terms” by A. Orlandos and I. Travlos, it is explained that the empolion was placed in the centre of the circular surface of the column drum and that it held the polos. From the end of the archaic and throughout the classical period, these poloi and empolia were made of wood: the poloi of wild olive or cornel (dogwood), the empolia of coniferous trees.

The empolia and poloi examined come from the Acropolis monuments. There is, moreover, precise information about those found in the Parthenon and the Propylaea during the past three decades. They were discovered with the dismantling of the capitals and drums, as required by the restoration works. On June 13, 1990 while the 7th column capital of the east wing was being dismantled, the polos-empolion system came to light; it was in a crushed condition. On August 21, 1992 the dismantling of the column capital of the 5th column of the south colonnade revealed the two empolia and one polos, all intact. On June 21 and 26, 2001 the wooden components of the three lowest drums of the 6th column of the Pronaos were recovered in fragments. According to the observations of the architect L. Lambrinou, lead sheets measuring approximately 12.5x12.5 cm were found in the 2nd drum of the 6th column of the Pronaos. They were folded in two and mounted on the west and south sides of



Empolion and polos “18121”.
Photo Z. Konteas, 2013

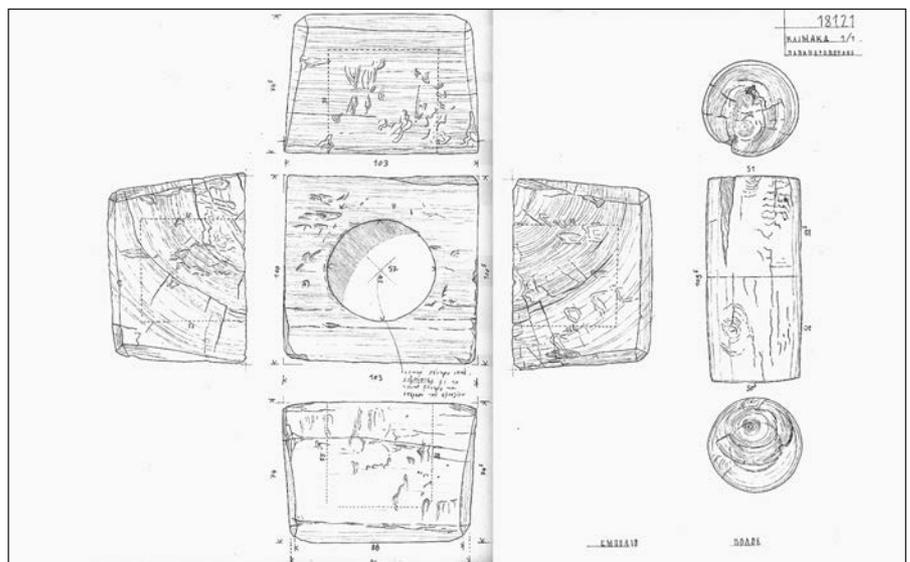


The empolia “2”, “20210” and “20211”.
Photo T. Souvlakis, 2013

the entormion of the drum, in order to stabilize the wooden empolion, a practice that has been observed in situations where the empolion was not well adjusted when initially set in the mortice. Until then, however, this practice had not been

verified on the Acropolis monuments. July 11, August 8 and September 17, 2002 saw the discovery of the wooden components that joined the column capitals of the Opisthonaos, O.KK.5 and O.KK.6, with the underlying drums, O.K.5.12 and O.K.6.11 respectively, and those of the drum O.K.5.12 with the underlying O.K.5.11. A few parts of the empolion appeared in the dismantling of the 6th drum of the 11th column of the north colonnade on 4 July 2002. Finally, on 5 July 2012, while the NW column capital of the colonnade was being dismantled, parts of the empolion and polos were discovered, likewise in fragmentary condition.

Evidence for the precise finding places of the wooden components found earlier (of which 13 empolia and 9 poloi are preserved today) is not strong. According to the catalogued information in the inventory of the Acropolis Museum, empolia “20210” and “20211” come from the Parthenon, but the monument from which the others came is unknown. In reference to his activity in the east portico of the Propylaea, in his report “The Anastelosis of the Acropolis Monuments, Propylaea, Erechtheion, Parthenon”, N. Balanos mentions finding many wooden empolia in the centres of the columns. He notes



Empolion and polos “18121”. Drawing by A. Papandropoulos



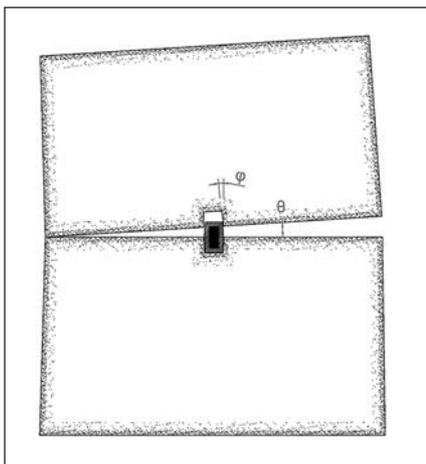
Empolion and polos “18122”. Photo T. Souvlakis, Z. Konteas, 2013

that a great number had been displaced as a result of the 1686 explosion. The empolion and polos “18122”, which were removed from the 6th drum of the 4th column in the east portico can be recognized on pl. 98 of his text.

On the basis of the above and given the variation in their preserved condition, due probably to the type of conservation applied at different times, we assume that the wooden components “1” to “11” come from the Parthenon, and the components “18121” to “18125” from the Propylaea.

Empolia

The empolia are truncated pyramids –approximately square– for which the ratio of the size of the bases, of the *horizontal surfaces* is close to the unit. Their side surface



Rocking of a column. The inclination of the side surfaces of the empolion φ , allows the opening of the horizontal joint at an angle of θ without loading the polos, (since $\theta < \varphi$).

Drawing Z. Konteas

forms four trapezoidal faces, the *lateral surfaces*. The circular-section hole that forms the cylindrical mortice holding the polos, is opened in the large base of the truncated pyramid, the *hole surface*. Opposite to this is the small base of the pyramid, the *solid face*.

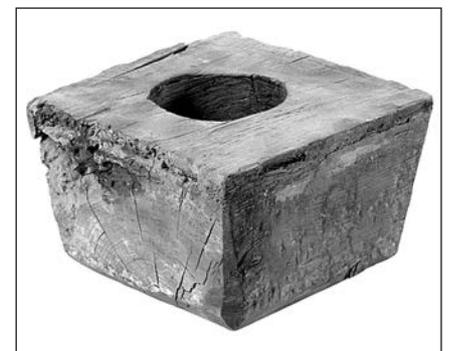
The edges of the empolia, except for those bordering the hole surface, are obliquely bevelled, probably to facilitate setting. The edges of the solid face are obliquely bevelled uniformly lengthwise, whereas on those bordering the boundary between the lateral faces, the bevelling is asymmetrical, fading out at the hole surface or slightly earlier. Thus the vertices of the empolion in the hole surface constitute points, whereas on the solid face the form of the vertices is more complicated, since it is determined by the junction of the bevelling.

The inclination of the lateral surfaces is a very significant feature of the empolia, since it is used while founding the columns to set the overlying members (drums or capital) with precision, guiding the centring in relation to the underlying drum. In case of earthquake, moreover, polos functions as a dowel, significantly limiting the relative horizontal displacement between the two members, as seen in the consolidated shape of the pair “18122”, shown above. It is likewise significant that when the columns are rocking, the inclination of the lateral surfaces allows the horizontal joint between the

members to open at an angle, without simultaneous stressing of the polos. During closing of the joint, the inclination of the lateral surfaces guides the two members into a position so that their centres coincide as accurately as possible, thus returning the column to its original form.

The empolia show only small deviations from their geometric characteristics and physical properties. The average length of the end of the hole surface is 113 mm, whereas the theoretical –ignoring the oblique– value of the average edge of the solid face is 101 mm. The average height is 75 mm. The average diameter of the hole is 55 mm. The average density was estimated at 550 kg/m^3 –with values from 430 kg/m^3 to 670 kg/m^3 – which is very satisfactory, especially for coniferous wood.

Cutting the wood from the trunk has been done without exception in such a way that the grain of the wood is oriented along one of the two horizontal axes of the empolia,



Empolion “10”. Photo T. Souvlakis, 2013

while the position of the centre of the trunk, the *pith*, is usually beyond the level of the hole surface and the hollows of the growth rings are therefore turned toward it. As a result of the first, the two side surfaces are longitudinal sections (mainly tangential and exceptionally radial), while the other two are transverse sections allowing a clear reading of the growth rings in the wood. Apart from the fact that it is both ergonomical and economical for the material, this choice has the advantage of assuring, along one axis



Empolia “2” and “4”.
Graphic estimation of the minimum number of growth rings of the trunk.
Photo T. Souvlakis, Drawing Z. Konteas

the greatest possible “resistance” (strength and stiffness) of the empolion, if the polos is subjected to shearing stress.

An even more careful choice of wood was observed in the attempt to include as few

knots as possible. This is evident not only in their limited number but also from the fact that characteristic irregularities of the growth rings are evident at the ends of the empolia, showing that a knot was avoided by cutting the wood appropriately.

The traces of red colour observable on the surfaces of the empolia are most likely pigment, and specifically miltos, from the process of leveling the surface of the drums. The possibility that it comes from a fungal attack should be excluded.

The position of the pith was graphically estimated from the direction of the radial cracks and it was possible to determine the minimum number of growth rings of the trunk and thus the minimum age of the tree. Minimum ages were estimated from 75 to 275 years, although the lower values are of no special significance, since they could simply indicate an origin close to the centre.

Poloi

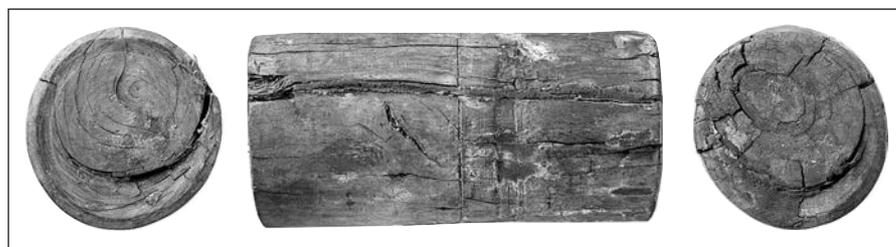
The poloi are cylindrical with ratio of height to base diameter close to 2. The edges of the cylinder are obliquely bevelled, probably to facilitate its insertion into the empolion and possibly to avoid stress concentrations as well. At mid-height in every case there is a horizontal groove (the *simeia*) that runs around the entire circumference and was evidently used in monitoring the depth of the hole in the empolion. The perfection of the work unquestionably indicates the use of a turning lathe for forming the cylinder, grooving the *simeia* and likewise for the oblique bevelling.

On most of the poloi one base is not entirely level, but has a low disk-shaped swelling in the centre, around which are concentric circles, traces left from the cutting of the base. This indicates that down to a depth corresponding to the diameter of the disk, the wood was cut on a lathe. There are no traces of concentric circles inside the disk. Quite the opposite, in some cases traces of linear cutting are visible, showing that a small cutting tool, probably a saw, was used to cut the surface in the area corresponding to the disk. This would explain why the disk projects above the rest of the surface; the height of the projection corresponds to the thickness of the cutting tool.

In the centre of the disk surface on quite a few of the poloi, a trace of a point can be seen, further confirming the use of a lathe. The fact that not all the poloi have such a point trace suggests that more than one polos would be produced from a piece of wood of larger dimensions.

Variations in the measurements are small. The average diameter is 51 mm, the average height 108 mm. The ratio of height to diameter is 2.1. There is greater variation in the density. Densities were estimated ranging from 450 to 910 kg/m³, with an average value of 680 kg/m³.

Wood originating in the trunk (or possibly in a large branch) is always taken from the centre, so that the main axis of the polos coincides in practice with the pith. The existence of small knots is only natural since the wood is juvenile core. It appears, however, that –as with the empolia– the wood



Polos “9”. Photo T. Souvlakis, 2013

has been carefully chosen since at the limits of the height the characteristic irregularities in the growth rings are evident, indicating the existence of a knot that was removed in the cutting.

There is no sense in measuring the growth rings since all poloi are limited to the centre of the trunk, thus the age of the tree cannot be determined.

The publication of I. Mariopoulos in 1937



Base of polos "18121": the forming of a disk and traces of concentric circles left by the cutting are visible.

Photo Z. Konteas, 2013

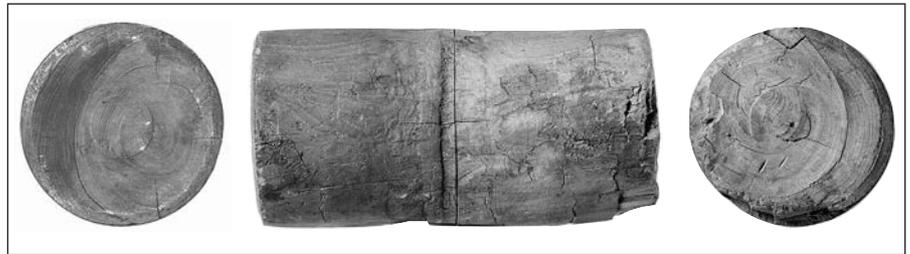


Base of polos "18124": similar to above, but the area of the disk is sunken due to the fact that the shrinkage of the pith area is greater compared to the rest of the polos.

Photo Z. Konteas, 2013



Base of polos "18123": traces of linear cutting within the disk are visible. Photo Z. Konteas, 2013



Polos "18123". Photo T. Souvlakis, 2013

in the *Praktika* of the Academy of Athens about research on astrometeorological periods is of considerable interest. He reports that he examined ten wooden connecting systems from column drums, thus thirty wooden components. They were in excellent condition and had been found in the columns of the Parthenon. These formed a valuable scholarly archive for determining the changes in the rings of trees that come from Greece in general, while the evidence was that they had probably come from Attica. Photographic material in the publication shows that the reference is to the empolia "20210" and "20211". The researcher concluded that both empolia belonged to the same tree, which was estimated as 200 years old.

In this same article it is reported that a microscopic examination was made by I. H. Politis, the results of which are reported in the *Praktika* of the Academy of Athens 1945. According to the sampling, the empolia came from cypress wood and the polos from cornus. The author clearly states that the pieces are empolia and polos from the Parthenon, without giving any further information or photographs. Observing today the remaining wooden elements, it seems probable that the empolion in question is "18123" (which we suspect comes from the Propylaea), in which the cutting is visible in one side surface.

The empolia and polos of the 5th column capital of the south wing of the Parthenon were examined microscopically in 2000. According to the results of the research carried out by the National Agricultural

Research Foundation (NAGREF), the empolia were of cypress wood (*Cupressus Sempervirens*) and the polos of maple (*Acer Sp.*).

Elena Karakitsou

Archaeologist

Zannis Konteas

Civil Engineer

Parthenon Restoration Project



Empolia "20210" (below) and "20211" (above). As is evident, they come from the same tree. Photo Z. Konteas, 2013



Empolion "18123". Photo T. Souvlakis, 2013

Design and evaluation of restoration mortars for the Acropolis monuments

Introduction

As is well known, the Acropolis monuments are built with the dry-masonry system, without mortar between their structural elements. One of the basic principles that inform the contemporary interventions is respect for and repetition of the ancient method of construction. Even so, the use of mortar is necessary in order to confront the various forms of damage seen in the monuments in their present condition.

In the context of the works of the Surface Conservation Section, restoration mortar is employed for sealing joints of small width (breaks in the marble pieces, joint of the surface that results from joining an authentic marble piece and a new filling, and so on), for filling in large spaces (mortises, large pieces of architectural members that have come apart, etc.) and for joining small fragments and scaling. In the case of scaling or peeling in particular, usually a paste is employed that is made of the material (binder with water) without aggregates, so that the joint to be mended is minimal and the original measurements of the joined stones are not altered.

Because of the progress that has been made in the field of conservation materials, it was considered worthwhile to conduct a series of trials for the purpose of improving the restoration mortars.

Criteria for evaluating restoration mortars

The restoration mortars come into direct contact with the authentic Pentelic marble and their composition must therefore be based on the principle of physico-chemical and mechanical compatibility with the adjacent building material, so that the preservation of the authentic structural material is assured.

The original mechanical strength of the authentic Pentelic marble is greatly

impaired and its original properties are downgraded through a combination of various types of damage, such as extensive cracking, peeling, fracturing, surface crumbling (sugaring) etc.

The mechanical strength of the mortars must therefore be much less than that of the damaged Pentelic marble, so that in the case of failure, it will be the restoration material that fails rather than the authentic material.

Yet the strength must be high enough to assure the coherence, the satisfactory joining and the durability of the interven-

tion mortars for the Acropolis may be described as follows:

- Compressive strength, $F_c=6-10\text{MPa}$ (smaller value than that of the damaged marble, sufficient strength and durability, easily removable if necessary).
- Flexural strength, $F_f>1.2\text{MPa}$ (satisfactory strength).
- Dynamic modulus of elasticity, $E_d<12.000\text{MPa}$ (and as little as possible so long as resistance strength requirements are met).

Apart from the mechanical strengths, physical characteristics that must be evaluated and be compatible with the adja-



Pilot application of mortars in the Propylaea. Photo K. Frantzikinaki, 2013

tion over time. The ability to absorb vibrations and minor deformations, that assure good compatibility of the mortar with the authentic structural material and thus its preservation, are characterised by the modulus of elasticity values, which must be sufficiently low.

On the basis of the above criteria and taking into consideration the bibliographical data of the international scientific community for the mechanical characteristics of sealing and filling mortars, the desired mechanical properties of the restoration

mortars, are those of the microstructure. With the term microstructure we refer to the structure of the materials on a microscopic scale (proportion of empty spaces that constitutes the porosity of the material, size and form of the pores, way in which they are interconnected, etc.), which affects the physical and mechanical properties of the material (mechanical strength, modulus of elasticity, hygro-metric behaviour, etc.). In terms of the microstructure and assuming that the criteria for mechanical strength are met, the

| A/A | Κωδ. | w/b | Binder percentage (%p.w.) | | | | | | Aggregates percentage (%p.w.) | | | | |
|-----|------------|------|---------------------------|----|----|----|-----------|-------|-------------------------------|------------|------------|------------|------------|
| | | | C | L | MK | EM | NHL 3.5-Z | NHL 2 | Sq-1 0-1mm | Sq-2 0-2mm | Sc-1 0-1mm | Sc-2 0-2mm | Sc-4 0-4mm |
| 1* | Sfr.LC.Sq1 | 0,62 | 7 | 7 | | | | | 83,5 | | | | |
| 2 | CBz.Sc1 | 0,71 | | | | | | 25 | | | 75 | | |
| 3 | Alba.Sc1 | 0,72 | | | | | | | 25 | | 75 | | |
| 4 | CBz.Sq1 | 0,68 | | | | | | 25 | 75 | | | | |
| 5 | LMK10.Sc1 | 0,88 | | 15 | 10 | | | | | | 75 | | |
| 6 | LMK5.Sc1 | 0,98 | | 20 | 5 | | | | | | 75 | | |
| 7 | Pl.CEM.Sq2 | 0,56 | 16 | | | | 3 | | | 81 | | | |
| 8 | CBZ.Sc2 | 0,68 | | | | | | 25 | | | | 75 | |
| 9 | CBZ.Sc4 | 0,68 | | | | | | 25 | | | | | 75 |

* Added also to this specific composition : CaCO₃: 0.25% p.w. (for carbonisation acceleration), crude Sienna: 1.6%p.w., Baked obra: 0.65%p.w. for colour harmonization

w/b (water/binder): ratio of the added water (gr) to binder (gr)

C: white cement, Aalborg white cement

L: lime hydrate in powder form, CaO Hellas

MK: metakaolin (Al₂O₃ 2SiO₂), Argical-M1000, Imerys Group.

EM: Lava Antica

NHL 3.5-Z: hydraulic lime, Chaux Blanche NHL3.5-Z, Lafarge

NHL 2: hydraulic lime, Calce Albazzana, BASF C.C.

Sq: Quartz sand

Sc: Calcareous sand

Mix design of restoration mortars: compositions 1-6 refer to sealing mortars and compositions 7-9 to filling mortars

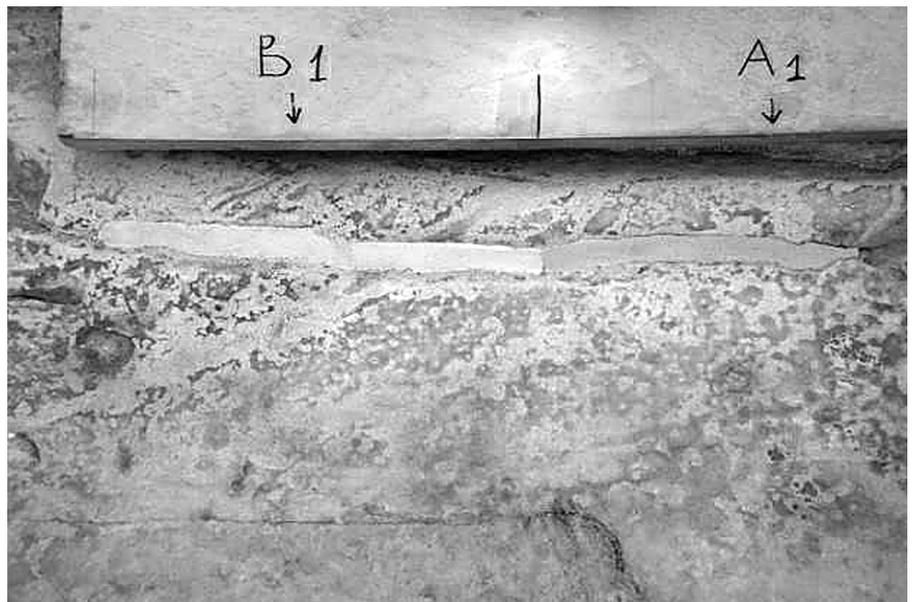
mortars must show a high percentage of porosity (~30%) and a pore radius average (>0.2µm), so as to assure a satisfactory absorption of retained water and humidity from the damaged marble or from the joints, as well as its swift evaporation from their mass. Water accumulation in the authentic structural material accelerates deterioration, mainly because of the action of microstress from the change in volume of hygroscopic salts, depending on the conditions of relative humidity and temperature and because of the growth of micro-organisms.

Materials and techniques

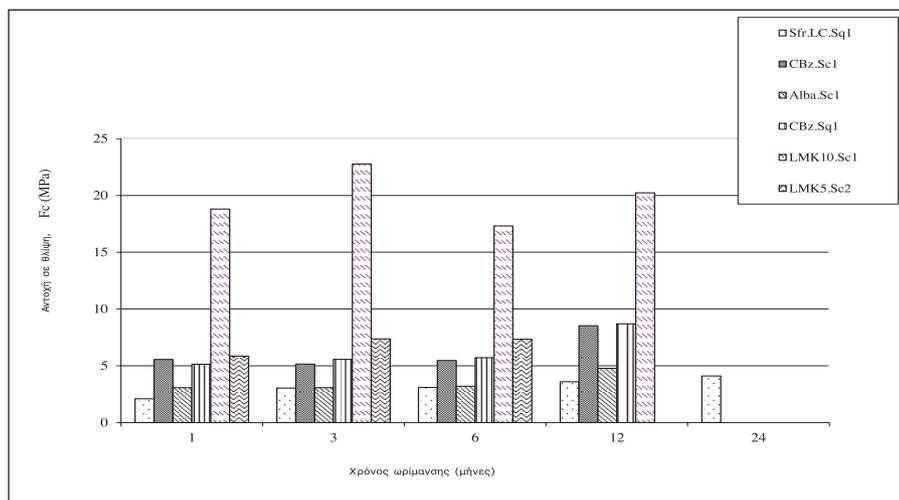
A total of nine compositions of restoration mortars were produced, six of which were sealing mortars and three filling mortars. For the sealing mortars, the composition that has been used to date on the Acropolis monuments was produced (Composition 1) with binder of hydrate lime and

white cement including quartz sand with a grain size distribution in the range of 0-1mm. Another six compositions were produced at the same time, with a binder,

either hydraulic lime of varying hydraulicity, or else hydrate lime/metakaolin in different proportions of mixture. The sand used in these syntheses was mainly



Pilot application of sealing mortars. Composition A₁: hydraulic lime mortar and composition B₁: lime hydrate/metakaolin mortar. Photo K. Frantzikinaki, 2013



Compressive strength of the sealing mortars

calcareous (0-1mm), given its chemical homogeneity with the building material of the monuments, Pentelic marble. For the filling mortars, the composition was produced and evaluated for filling mortar used in conservation with white cement, natural pozzolan (earth of Milos island), and quartz sand (0-2mm) (Composition 7). Produced also were two compositions with hydraulic lime and calcareous sand of two different particle measurements, 0-2mm and 0-4 mm, in order to evaluate the effect of a small change in the grain size of aggregates on the final characteristics of the mortar. A diagram shows the design of the sealing and filling mortars with the mixing ratios of the different ingredients (% p.w.), and the ratio of water to binder.

After production, the fresh mortar was cast in prismatic moulds measuring 4x4x16cm in order to evaluate the mechanical strength and the modulus of elasticity. The following techniques were employed for evaluating the mortars:

- Tests of mechanical strength to determine the compressive and flexural strength of the mortars over periods of 1, 3, 6, 12 and 24 months.
- The Ultrasonic technique (CNS Farnell-Pundit 6, frequency of terminals: 54 KHz) which is a non-destructive technique for monitoring the materials, for

evaluating the transmission velocity of the ultrasonic waves (Vu.s., m/s) and modulus of elasticity (Ed, MPa) over a period of 12 months in selected compositions of mortar. The rate of transmission of the ultrasonic waves on the material is related to the apparent density of the material and its elastic constants (dynamic modulus of elasticity, shear modulus). The dynamic elasticity modulus is the measure of rigidity of the material and it equates with the ratio of the tendency to deformation, when subjected to tests of free or enforced vibrations.

- Mercury Intrusion Porosimetry (MIP, Fisons, Porosimeter 2000) for evaluating the characteristics of microstructure in

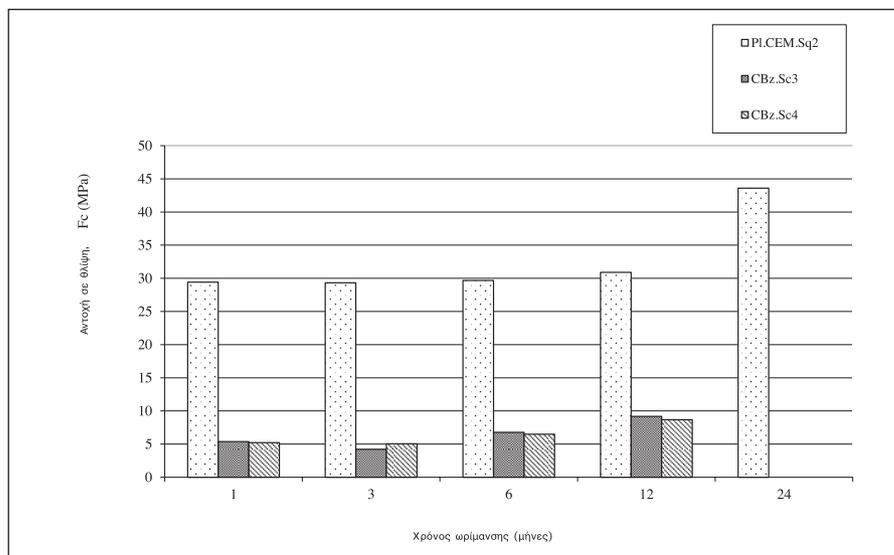
selected mortar compositions over a period of 12 months.

Results and discussion of the results

Mechanical strenght

Shown in a diagram are the results of the compressive strength of the six compositions of sealing mortar prepared, as they were evaluated over a span of 24 months. The compositions that appear to meet the criteria are those of hydraulic lime NHL3.5-Z (CBz.Sc1, CBz.Sq1) with a final compressive strength over 12 months of aging equal to 8.53MPa and 8.70MPa. From the final strength values it appears that the different nature of the aggregates (calcareous or quartz sand) does not affect the mechanical strength of the mortars.

The composition Sfr.LC.Sq1, with cement/hydrate lime that is already in use, as well as the composition of hydraulic lime of the type NHL2 (Alba.Sc1), showed low values of compressive strength equal to 3.59MPa and 4.77MPa over 12 months of aging, respectively. In the case of the use of metakaolin as a pozzolanic additive, it is observed that in the case of the composition LMK10.Sc1, where metakaolin was used in a ratio of 10% p.w., the compressive strength was very high, equalling 20.23Mpa over 12 months of aging. This



Compressive strength of the filling mortars

specific compressive strength is judged to be too high for use in contact with damaged Pentelic marble. If the metakaolin of the mortar had a ratio of 5% p.w. (LMK5.Sc1), the compressive strength declined to 7.34MPa over 6 months of maturation, thus meeting the criterion for compressive strength (6-10MPa). It is observed, moreover, that with the use of a different amount of metakaolin mortars can be designed with a broad range of mechanical strength.

As far as flexural strength is concerned, the values follow the same trend as do those for compressive strength. The compositions that fulfill the criterion of flexural strength >1.2MPa, are those containing hydraulic lime NHL3.5-Z (CBz.Sc1, CBz.Sc1) and those with the mixture lime hydrate-metakaolin (LMK10.Sc1, LMK5.Sc1). The mortar syntheses with hydrate lime-cement (Sfr.LC.Sq1) and with hydraulic lime NHL2 (Alba.Sc1), on the other hand, show low flexural strength values (<1MPa).

For the filling mortars, the mechanical

| Κωδικός | Χρόνος ωρίμανσης (μήνες) | dapp. (g/cm ³) | Vu.s. (m/s) | Ed. (MPa) |
|------------|--------------------------------|-------------------------------|----------------|--------------|
| Sfr.LC.Sq1 | 24 | 1,79 | 1797 | 4807 |
| LMK10.Sc1 | 12 | 1,82 | 2686 | 10952 |
| CBz.Sc1 | 12 | 1,95 | 2181 | 7724 |
| Pl.CEM.Sq2 | 12 | 2,16 | 4053 | 29592 |
| CBz.Sc2 | 12 | 1,95 | 2527 | 10386 |

***dapp.: apparent density (g/cm³)**
Vu.s.:ultrasonic transmission rate (m/s)
Ed: dynamic modulus of elasticity (MPa)

Velocity of ultrasound transmission and dynamic modulus of elasticity

strength of the mortar with white cement (Pl.CEM.Sq2) is very high, with a final compressive strength $F_c=43.60\text{MPa}$, and flexural strength of $F_f=6.84\text{MPa}$, over 24 months of aging. The specific strengths are too high for both the adjacent authentic marble, which may be crumbling and fractured, and for the sealing mortar, which will be set over the filling mortar so as to seal the final joints. The mortars with hydraulic lime (CBz.Sc2, CBz.Sc4)

show satisfactory strength from the first month of aging. The use of aggregates with a greater granulometric gradation increases minimally the final strength and mainly the flexural strength.

Modulus of elasticity

The results of the ultrasound tests show that the transmission velocity of the ultrasonic waves follows the same tendency as for mechanical resistance, a tendency to be expected given that the rate of transmission is connected with the apparent density and the microstructure of the material, characteristics that also determine the mechanical strength. Thus the value of the ultrasonic and the apparent density is recorded as greater for the filling mortar with white cement (Pl.CEM.Sq2) while the sealing mortar with white cement and lime hydrate (Sfr.LC.Sq1) is recorded as lower. As for the dynamic modulus of elasticity, the filling mortar with white cement (Pl.CEM.Sq2) presents a very high rate (29,592MPa) whereas all the other compositions meet the criterion that has been set for $Ed < 12,000\text{MPa}$. Research is under way, while evaluation of the lime hydrate-metakaolin composition (at a ratio of 5% p.w.) over a 12-month aging period is outstanding.



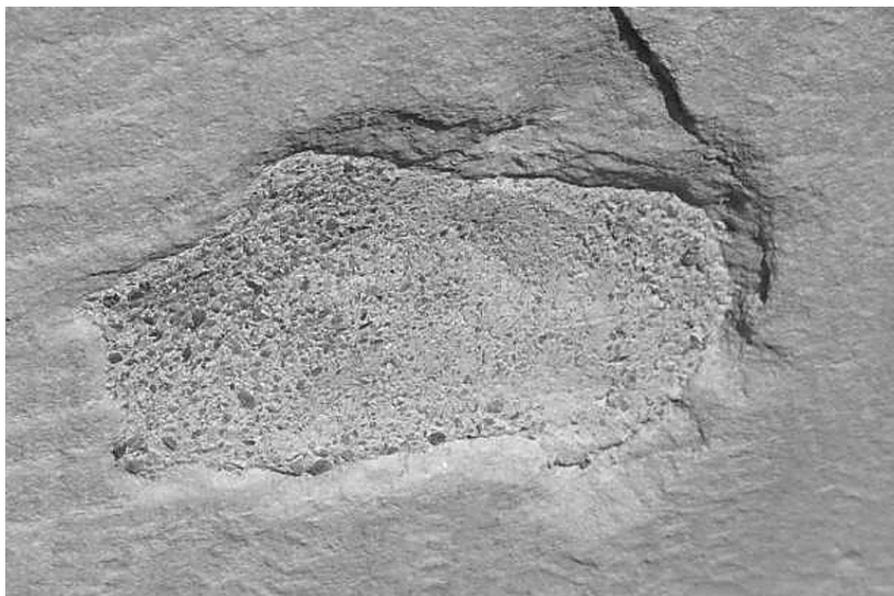
Pilot application of mortars in the Propylaia. Photo K. Frantzikinaki, 2013

Mercury intrusion porosimetry measurements

From the results of the mercury intrusion porosimetry measurements it is evident that the three compositions of sealing mortar (Sfr.LC.Sq1, LMK10.Sc1, CBz.Sc1), generally speaking, presented satisfactory values for microstructure with relatively high porosity values (24-29%) and total specific volume (120-159mm³/g). The mortar with white cement that is already employed in the filling mortar, showed a very low porosity value (~11%) and total specific volume (~48mm³/g), values not compatible with those of the damaged Pentelic marble to which it would be adjacent after the intervention. Evaluation of the composition hydrate lime-metakaolin (ratio of 5% p.w.) over 12 months maturation is outstanding.

Conclusions

- The type of sand (quartz or calcareous) was not observed to have any effect on the mechanical characteristics of the mortar. Thus a calcareous sand, which is chemically and aesthetically compatible with Pentelic marble, can be used.
- The use of aggregates of greater grain size distribution increases by a small percentage the final strength and especially the flexural strength.
- Mortar with white cement must be avoided as a filling mortar because of its physico-mechanical incompatibility.
- Mortar compositions that will be used as filling and sealing mortars should have the same binder with a calcareous aggregate of different grain size distribution. The grain size range of 0-1mm is to be used in sealing mortars and the range of 0-2mm or 0-4mm in the filling mortars, depending on the size of the space to be filled. The aggregates will thus form the suitable skeleton of the mortar volume so as to avoid micro-cracks and failures during shrinkage.
- Mortars that have been prepared without the addition of cement, with hydraulic lime NHL3.5-Z (CBz.Sc1,



Pilot application of filling mortars. Composition of hydraulic lime. Photo E. Aggelakopoulou, 2013

CBz.Sq1) and hydrate lime-meta-kaolin: 20%-5% p.w. (LMK5.Sc1), meet the physico-mechanical criteria and can be used in the conservation interventions of the Acropolis monuments. Small-scale pilot applications have already been carried out on the monuments with the mortars under discussion so as to evaluate their behaviour on a real-time scale.

Eleni Aggelakopoulou

Dr Chemical Engineer

*Head of the Technical Office for the
Acropolis Monuments'
Surface Conservation*

Acknowledgments

The preparation and evaluation of the mechanical properties of the mortars was carried out in the laboratory of the Directorate for Technical Research on Anastelosis of the Hellenic Ministry of Culture and Sports and at the mortar laboratory of the cement industry TITAN S.A., at the factory of Kamari in Boeotia. The ultrasound velocity measurements and the mercury intrusion porosimetry measurements were performed at the National Technical University of Athens (NTUA), in the laboratory of the Section Materials Science and Techniques of the Chemical Engineering School.

| Κωδικός | TCV (mm ³ /g) | As (m ² /g) | r _{av} (μm) | P (%) | d _{bulk} g/cm ³ | d _{cor} g/cm ³ |
|------------|-----------------------------|---------------------------|-------------------------|----------|--|---------------------------------------|
| Sfr.LC.Sq1 | 157,48 | 3,17 | 0,47 | 28,69 | 1,82 | 2,56 |
| LMK10.Sc1 | 158,80 | 11,34 | 0,03 | 28,87 | 1,82 | 2,56 |
| CBz.Sc1 | 120,23 | 3,09 | 0,27 | 24,04 | 2,00 | 2,63 |
| Pl.CEM.Sq2 | 47,92 | 2,34 | 0,26 | 10,72 | 2,24 | 2,51 |

TCV: Total specific volume of mercury (mm³/g)

γ: apparent density (g/cm³)

P%: total porosity (%)

As: Specific surface (m²/g)

r_{av}: average pore radius (μm)

Microstructure characteristics (Mercury intrusion porosimetry measurements)

The Reuse of Values: from gathering to systematizing and to the Project of the Scattered Architectural Members of the Acropolis

The time-honoured history of the Athenian Acropolis, before and after its Periclean grandeur, is captured in the best possible way by the thousands of marble fragments that surround the classical monuments. While these have been freed of their subsequent historical mantles, the myriads of scattered stones that form an inseparable part of the landscape and leave their mark on the experience of the visitor to the archaeological site of the Acropolis, they are the last witnesses of the age-long history of the Sacred Rock and at the same time part of the history of the capital of Greece.

In the scattered architectural members of the Acropolis the centuries are garnered through a distance of only a few metres: in a few seconds only the eye passes over the poros bases for metal tripods of the early 7th c. B.C., for many the first monumental sculptural works, over the inscribed marble base of the great bronze Trojan horse in the area of the Brauronion, Strongylion's work dedicated by Chairedemos from the deme of Koile at the end of 5th c. B.C., over the members from the pulpit of the Panaghia Atheniotissa with the transformation of the Parthenon into a church and on to the characteristic crowns from the monuments of the Ottoman cemetery on the east slope of the Areopagus.

Added to all that unalloyed acropolitical historical evidence thousands of scattered stones were collected on the rock just after the founding of the Greek State in order to protect them from the gale of reconstruction of the then-new capital, or are products of subsequent excavations, small or large. Their adventures through the pas-

sage of time follow the events themselves of the modern Greek State.

In May 1827, with the siege of the Fortress of Athens at an end, the Acropolis was the picture of a tremendous pile of ruins. The houses of what was to then the Ottoman settlement had been destroyed and only the ancient monuments still stood upright. From the ashes of the aftermath of the Greek revolution and in the scattered stones on the rock, the systematic efforts of individual leading figures of Archaeology stand out, such as Kyriakos Pittakis, and pioneers of research, such as the general Ephor of An-



The Erechtheion with the stone piles from the W. In the background right the house that held the first archaeological collection. J. H. Stilling 1853

tiquities Ludwig Ross who, together with the Bavarian architect Leo von Klenze, sought the promotion and restoration of the Acropolis monuments. In 1833, K. Pittakis begins to collect systematically many valuable antiquities from the areas around the Acropolis, some lying out in the open, some already sheltered under ancient monuments, and still others in more recent buildings. Thus the first archaeological collection was formed, initially in the mediaeval tholos that covered the Pinakotheke of the Propylaia (1833) and in the mosque of the Parthenon (1836/7) and later on in the cistern that existed in front of

the west side of the Parthenon. When the cistern was demolished, inscriptions were recovered from its walls comprising psephismata, sculpture fragments and the inscribed bases of statues. The antiquities were transferred at that time (1858) to the Turkish powder storeroom east of the Erechtheion which in turn was also to be demolished during the great excavation of 1885-1890. Many ancient marble pieces, moreover, gathered by K. Pittakis for protection on the rock, were incorporated into a wall near the south side of the rock which was to be dismantled in 1888 by P. Kavvadias. They were at that time transferred to the then new Museum, on the

tower that was later called the Belvedere and in the outdoor space between them.

After the antiquities were cleaned, moreover, two collections emerged: one in the central part of the Propylaia and the other in the Pinakotheke, creating, in Pittakis' words, "antiquity within antiquities". For protection against easy thievery, many small pieces were placed in special cases with wooden frames, mounted

together with mortar and iron nails; these ended up in the Acropolis Museum.

Together with collection and protection of the scattered material during the first years after the Greek War of Independence, a reverse movement was taking place that bears witness to the contradictions in the Greek process of coming into being. It concerned the removal of numerous pieces of building material from the demolished Ottoman buildings that inevitably included ancient members as well. In 1835, the General Ephorate of Antiquities tendered a series of public auctions of building ma-



Ancient and Byzantine sculpture and architectural members built into the nearby circuit wall of the Acropolis. A. Kokkou 2009, fig. 70 UPenn Museum, Philadelphia

material from the Acropolis rock and its environs. The original idea came from Ludwig Ross and Leo von Klenze and it was carried out by K. Pittakis. Some 2,400 horse-loads from the area outside the gate and 1,600 loads of material from within were auctioned.

Much of this was sold to private individuals in order either to use it as building material or to resell it. The case of Manolis Afthonides, a Phanariote comrade-in-arms of Alexander Ypsilantes is characteristic. He arrived in Athens in 1832 and built his house of material from the auction described above in the area that is now Plateia Klafthmonos. Otto also stayed there for a short time and today the building forms part of the Museum of the City of Athens (Vourou-Afthonides residence). Such building material is very probably what was used for the Piraeus Road and for the construction of the Ottoman barracks in the site of Hadrian's Library. One thousand two hundred fifty poros blocks (*πορία*) and probably another 1,400 marle blocks (*αγγωνάρια*) were needed for the building of the military hospital by Lieutenant W. von Weiler. Between January 1836 and April 1837 a large amount of material was made available without auction, for constructing the royal palace, now the Parliament.

Similarly, in 1849 "left-over stones" of the

Acropolis were used for building the Ar-sakeion Megaron. This does not diminish the overall work of the above-mentioned archaeologists and the rest of their accomplishments, given the circumstances. Rather it reflects the climate of a time when the engineers were hunting for whatever supplies of building material could be found, mainly for the construction of public buildings. This effort also functioned most likely as an early form of conscious recycling of "useless" material. Its systematic recording in the history archive of the Archaeological Service shows, for yet another time, the great value of documentation, through which information is preserved that facilitates the understanding of events.

With the beginning of the 20th c. and until the Second World War, the scattered members follow the course of works on the Acropolis, when the anastelosis of Nikolaos Balanos was dominant. In the 1st International Meeting in Athens, April 1905, between the polemical disagreement on the principles and limits of anastelosis interventions, a more general consensus emerged on the resetting of scattered material on the monuments being restored, while at the same time the need was underscored for scholastic study, survey and

cataloguing of the scattered members, their identification and their restoration to their specific original position on the monuments. Despite the fact that only after many decades was this principle to be realized, it is most significant that the great anastelosis programmes provided the foundation for systematic management first of the future of the classical monuments and subsequently of all the scattered stones of the Acropolis, even though incorrect settings of members on the monuments or the replacement of missing parts with ancient material of various and haphazard origin were tolerated. Thus a great percentage of the authentic material was set again in the monuments, saving it from further damage.

During the Second World War, and particularly during the Civil War, the scattered members, together with the monuments themselves, were converted into protective shields for armed soldiers, while photographs of this time show others reposing beneath the gaze of the archaic pedimental figures in the Acropolis Museum.

After the war, the Acropolis enters a new cycle of life. As Ephor and Director of the Acropolis Museum, Ioannis Meliades extended the Museum and exhibited the Acropolis masterpieces in an exceptional



The Pinakothek with the temporary exhibition of antiquities. E. Bréton 1868, p 46

way. At the same time he inaugurated new storage areas for the sculpture and architectural members. Only a small number of the scattered stone finds of the Acropolis could be accommodated in the underground storeroom, mainly the fragile poros pieces that preserve in good condition their painted decoration. Most of the scattered finds continued to lie piled up in the open air. The sculpture will be moved to the new Sculpture storeroom, east of the Museum, and on shelves south of the Museum where the collection "Cour Anglaise" was created.

Assiduous documentation with analytical descriptions, drawings and photographs, and the arrangement of thousands of fragments and complete scattered architectural members have been a basic priority of the ESMA ever since its formation. The work began with the first entries in 1977. The initial aim was to support the works of anastelosis which were resumed at that time, by identifying the architectural members so that the authentic material could be used in the classical monuments being restored. Up to now this purpose has been fully justified and indeed the identifications lead to the recognition of fragments from many well-known Athenian monuments, inside and outside the Acropolis. The fragments are then handed over to the corresponding work-sites for further evaluation. At the same time, however, categories of material have now surfaced into scientific focus that had disappeared in the shadow of Periclean light, such as the Frankish architectural members of the Acropolis, grave markers from the Ottoman cemetery or marble and poros members of the archaic constructions of the Acropolis, demonstrating anew the diachronic and variant activity on and around the Sacred Rock. Even the most delicately carved traces of games on scattered stones is of value for making new copies in marble for educational purposes. Public buildings with ancient material built into their very core were re-examined, such as the Arsakeion, where 482 were recorded and 47 acropolitical stones were removed



The Acropolis during the events of the December uprising: the architectural members used as a rampart by armed men.

M. Tiverios, *Praktika of the Academy of Athens 2013*, p. 192

from the walls during the decade of the 1980's, or the old National Printing House in which 128 fragments were located, dismantled and transferred to the Acropolis where they were recorded, with 27 of them attributable to the Parthenon.

The thousands of scattered members recorded are divided into groups and arranged in newly organised piles according to categories and date, given the lack of available closed storage space on the rock. A basic disadvantage, however, of the methodology is the difficulty, at times impossibility, of access to the recorded material in the stone-piles.

To date some 24,000 members have been recorded and over 10,000 shapeless mem-

bers have been separated from the rest of the material, the numbers speaking for themselves. It was therefore considered absolutely imperative to enter the data into the digital indexing and documentation management system of the YSMA, which assures speed in finding the information, organization and classification of the evidence, and analysis as well as immediate access to the content.

The archive of the scattered members of the YSMA database has been organised on the basis of the same principles as those followed in a conventional archive. For each member, which is represented by its own inventory number, information is given that is relevant to its material, date, measurements, description and characteristics of the member, its origin (for those which can be attributed to specific monuments), how the surface has been worked, identification if possible or joining with other members and especially its location on the rock (whether in a numbered stone-pile, transferred to the Acropolis Museum or in an YSMA worksite for use in anastelosis). Each member is accompanied by photographic documentation, while further characteristics are correlated with drawings and bibliography.

From June 2011 to date, data has been entered into the digital database corresponding to some 8,000 members. Information can be accessed on the basis of search cri-



Children playing in the north porch of the Erechtheion with a new marble copy of the game found in one of the scattered-members piles. Photo T. Souvlakis, 2013

teria, simple or composite. With a simple search it is possible at any time to find where each recorded member is located on the rock, at a work-site or in the Museum. Apart from single members, it is possible to search for wider categories of members and to combine the search with criteria chronologically (for example archaic simas, Ionic capitals, Roman sarcophagi, early Christian screens, Ottoman grave columns), to search members on the basis of origin, the monument to which they belong, or the material of which they are made.

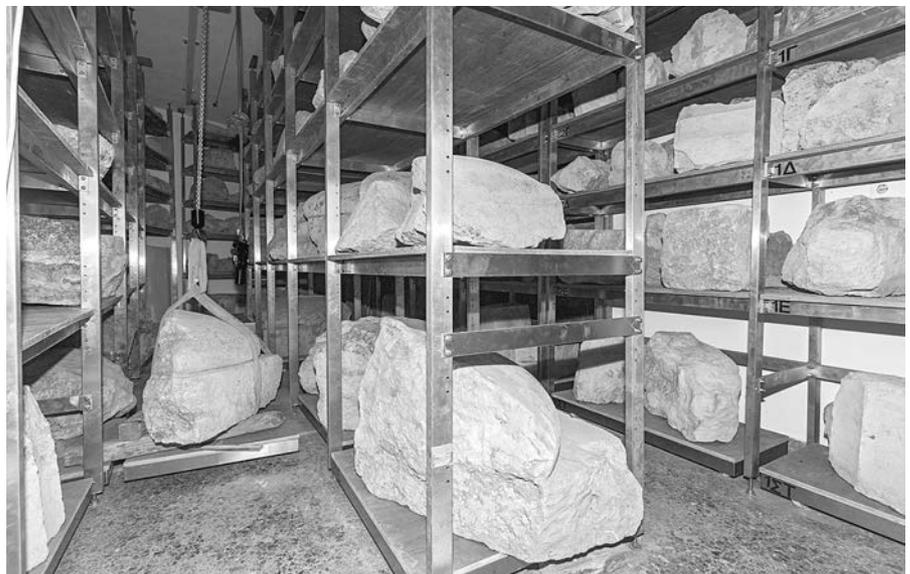
Today the Work of Scattered Architectural Member of the Acropolis has completed the separation and recording of the marble members, of practically all the stone-piles of the rock. This has led to greater emphasis during the last years on the programme for recording and arranging the poros scattered architectural members, thus also promotion of the archaic buildings of the Acropolis sanctuary of the 6th c. B.C. The recording and assiduous study of the specific material, for yet another time in the last 130 years, and with many unanswered questions about the historical topography of the sanctuary during the 6th c. B.C., yielded to begin with many new identifications of fragments that belong together, totaling 117, and new interpretations in reference to the earliest buildings of the Acropolis. The first results, especially for the first monumental, stone Doric peripteral temple of Athens with its impressive pedimental compositions of lions devouring a bull, were announced at the 6th International Meeting of the ESMA and YSMA in October, 2013.

Yet each voyage has its port of destination, and in this case it is the successful fulfillment of the programme as a whole. And while the scholarly aspect of the work never ceases, the “measurable” part of the work leads to an end, and herein lies the greater challenge.

With the functioning of the new Acropolis Museum, new situations came into exist-

tence. The transfer of the exhibition and a large portion of the antiquities from the storerooms of the old Museum to the galleries and storerooms of the new Museum, left behind 1,200 m² and a section of the storeroom space of the old Museum free. The 1st Ephorate of Prehistoric and Classical Antiquities had already transferred the sculpture collection from the shelves south of the Museum (Cour Anglaise) to the so-called Sculpture storeroom, in order to avoid their further deterioration from the soot of the Athenian atmosphere. Transferred to the same space was also the pottery from the storeroom next to the

years of work and pioneer archival documentation, and with the recent digitization and electronical entry into the database, the scattered stones of the Acropolis await a final place to be protected and exhibited, just as modern archaeology demands. Priority is for the most fragile, such as the poros architectural members, followed by the marble *membra disjecta*, as they have been termed and classified up to now, still in the open air. Their protection and promotion is now the greatest challenge and perhaps the last port in their voyage through the centuries, within and out-



*Interior of the small Belvedere storeroom with the poros architectural members.
Photo T. Souvlakis, 2013*

Belvedere tower, thus freeing 27 m² of closed space, where 564 well-preserved poros architectural members have been stored on new shelves and with a new system of organization. The next priority was the transfer of the inscribed stones from the archaeological site to closed exhibition areas in the old Acropolis Museum. One hundred thirty five of the 167 moveable inscribed stones have already been moved and the last phase of the transfer is under way.

In the recent past, the use of the freed storage space has given rise to questions about its further designation. After many

side the sanctuary of the Sacred Rock, an anchorage that will share in and contribute decisively to the overall promotion of the archaeological site of the Acropolis.

Elisavet P. Sioumpara

Dr Archaeologist,

Head of the Project

of Scattered Architectural Members

of the Acropolis

Eleni Salavoura

Dr Archaeologist

Documentation Office

Current challenges in documenting the restoration works on the Acropolis of Athens

The digital management of the documentation from the restoration works of the Acropolis monuments was initiated over 25 years ago. The maintenance and gradual expansion of the necessary technological infrastructure in this period contributed to the effective management of a growing volume of information. Nevertheless, as digital technology progresses rapidly, new challenges must be addressed principally with respect to the emergence of new data types and the guarantee of their long-term preservation. The Documentation Office of YSMA, in an attempt to confront these challenges, formulates the essential course of action in this direction.

The database of YSMA

During this period the main computerized system for the documentation of the works, the electronic database of YSMA, went through three major upgrades and many minor improvements that have been presented in previous communications. In its current form, the database is organised around the archive of the architectural members, the structure of which reproduces the architecture of ancient Greek articulated buildings by implementing a hierarchical partitioning system of the monument from the whole (e.g. Parthenon) to horizontal subdivisions (e.g. wing), building components (e.g. colonnade), architectural elements (e.g. column) and, finally, individual architectural blocks (e.g. drum A.K.2.2). The architectural members archive is connected to the archives of related documents (photographs, drawings, texts), which record information (e.g. drawing type, photographer, date of creation) about each object. A similar link exists between the scattered architectural material archive and the aforementioned archives of related documents. All archives receive coded values and restrictions from controlled vocabularies that can be further extended by the users.

The interface uses the hierarchical division of monuments as a navigation tool to access monument sections or a selected architec-

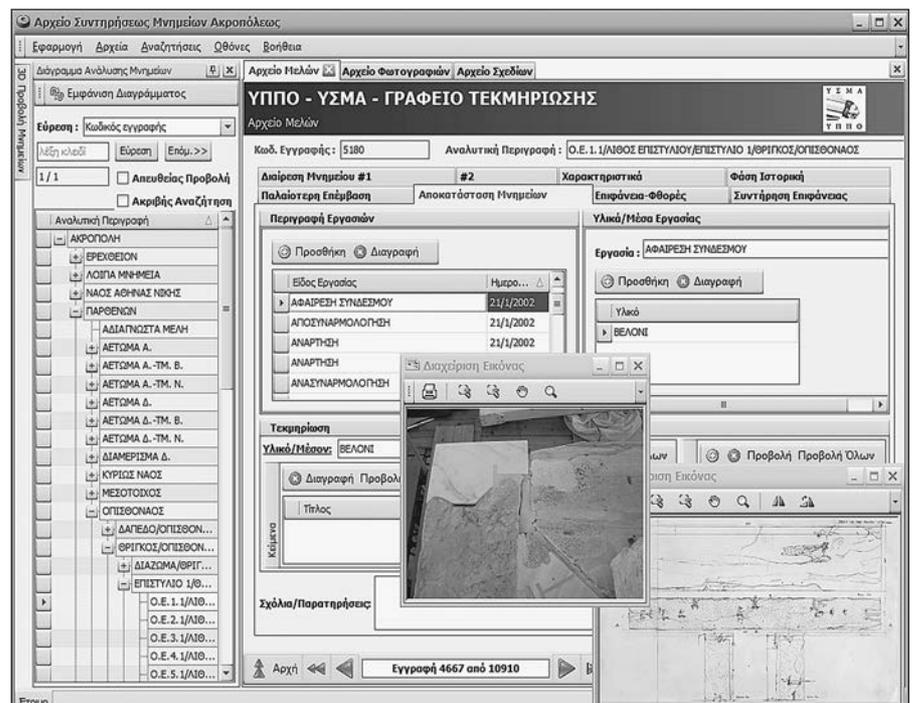
tural member and to examine the relevant record. In addition to information related to its position within the monument or to conservation and restoration interventions, all relevant documents are included (photographs, drawings, texts). These can be selected in order to access their respective records from the corresponding archives containing descriptive information. Search mechanisms allow further investigation of the database through complex query formulation (e.g. identify all photographs depicting the repositioning of entablature pieces on the north colonnade of the Parthenon).

With respect to the size of the database, content volume grows at a geometric rate, as the documentation is intensified through the use of digital recording media (laptops, digital cameras, laser scanners). The photographic archive constitutes by far the largest part of the database, including more than 110,000 records. Next follows the drawings archive (11,000), while in the process of the restoration works new entries are still created in the archive of architectural members (10,900).

Currently the system is undergoing the latest upgrade focusing on a number of issues, such as the addition of user auditing mechanisms to increase data security and facilitate statistical monitoring of the database usage, the enhancement of the graphical user interface for content access using three-dimensional models of the monuments, the improvement of the system transaction speed through programming interventions and, finally, the development of a web interface for remote access to database records. Despite these regular and vital improvements, after 25 years of systematic data entry and subsequent software upgrades, the demands on the functionality of the system still continue to grow.

The new digital data

The situation becomes even more pressing given the new circumstances that have arisen over the last decade in respect to adopting digital modes for documenting the restoration works. The spread of digital technology during this period led to the intensification of documentation and contributed to the gradual replacement of conventional documentation production pro-

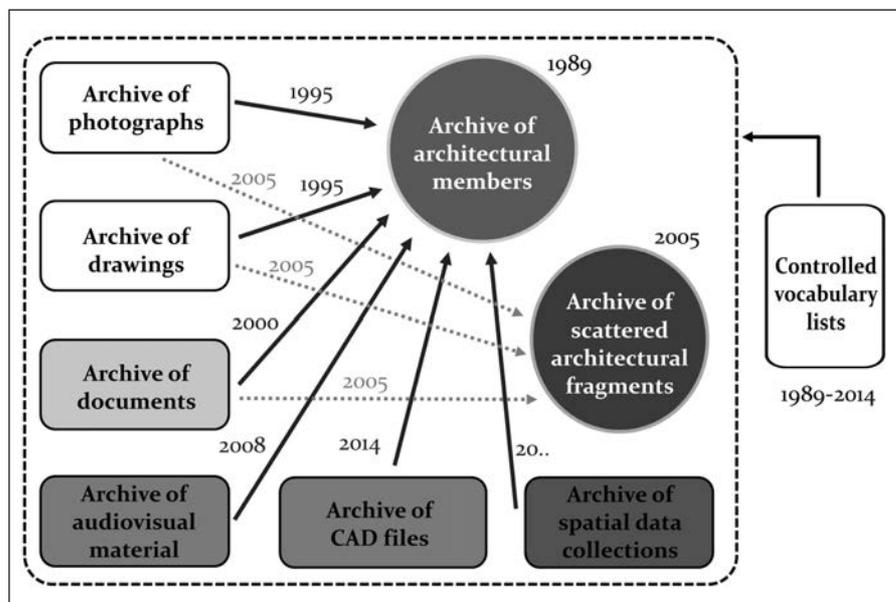


Access to a database record through the monument division diagram and display of relevant documents from the archives of photographs and drawings

cedures. For example, the use of digital cameras has facilitated direct, cheap and extensive photographic documentation of the works, at the same time contributing to a sharp increase in digital data volume. In addition, optional recording of the same activities using a camcorder or other portable devices means that the volume of data aggravates all procedures in their processing, storage and retrieval within the existing infrastructure.

These problems are even more serious in connection with digital spatial data, as their production through successive processing stages complicates their integration into the main electronic data archive for the restoration interventions. For example, in the last decade, the technology of computer assisted design (CAD) tends gradually to replace manual drawing. CAD models require particular diligence with respect to storage and preservation, given the volume and complexity of the information contained. A CAD model stores graphics in two or three dimensions, arranges information into different layers and may include external data, such as scanned drawings often used as background for digitization. The archiving of CAD files is fundamental, as their information can be updated or integrated with other models.

Between 2007 and 2008, under the “Information Society” programme, a project for the geometric registration and the development of Geographic Information Systems (GIS) applications for the Acropolis of Athens led to the production of a large volume of digital spatial data and still more digital derivatives. The photogrammetric mapping of the Acropolis relief and the circuit wall produced a series of high resolution orthophotos. The same project included the three-dimensional scanning of the Erechtheion, the restoration of which had been completed, as well as of the circuit wall and the physical rock below, contributing to accurate three-dimensional textured models.



Successive extensions of the database structure of YSMA

Apart from this large-scale project, YSMA regularly employs photogrammetric documentation techniques. Geometric documentation is carried out in sections of the monuments, before and after the restoration works, to record current structural condition (structural damages, changes in the geometry), to plot visible archaeological features and to assess the accuracy of the intervention during and after completion. Similarly, case-specific laser scanning is performed on a smaller scale depending on the requirements of the works. The products of this process can be used in the studies for the restoration of monuments, e.g. to simulate micro-sliding effects in the drums of the columns on the Parthenon.

In both cases, the production process involves several separate processing stages resulting in large data volumes in various formats, each of which may be used to extract further by-products. Consequently, the archiving of each finalized model requires the storage of all intermediate outputs and their documentation with appropriate complementary information, called metadata, in order to be able to reproduce and control the entire manufacturing process for future reference.

Overall, these new digital data types pose very different issues concerning their management and their connection with the main documentation data archive of the restoration works. A key factor in the successful functioning of every digital data archive is the accessibility and usability of its collections regardless of potential changes in technology. It is then understood that preserving the content of a digital archive is a demanding task that requires constant upgrading of the information carriers of both physical storage media and relevant software.

Aligning digital management procedures with present requirements

In this context, the challenge is shifted from establishing a functional digital archive to ensuring the long term preservation of digital content. The obvious answer to the problem and at the same time a great opportunity, as many experts on the subject constantly stress, is associated with the reuse and dissemination of digital archives within broadly accessible data collections. It follows that by giving a greater emphasis to the creation of compatible digital datasets and their documentation with appropriate metadata structures, the potential for further exploitation and diffusion of the information they include is greatly enlarged.

In combination with the continuous upgrading of the main information system, digital management must be expanded to other categories of documents so as to assemble separate (yet interrelated) digital data collections suitable for dissemination. Steps in this direction have already been taken by the Acropolis Restoration Service. For example, the set of geospatial information generated under the development of GIS applications was combined and it has been made publicly available on the internet, immediately after the completion of the project. At the project's webpage, the visitor can zoom into the orthophoto map of the Acropolis, select and examine parts of the walls, interactively explore a simplified version of the three-dimensional model of the Erechtheion and browse videos of the full model of the Erechtheion and the digital reconstruction process of the Caryatids.

The orthophoto map of the Acropolis relief and the photo-mosaics of the circuit wall have also been used in the recently developed web application "Virtual tour of the Acropolis monuments", which includes a range of 360° panoramic images at various locations onsite and is supplemented with high-resolution photos for viewing significant details on the monuments. The ground plan view of the Acropolis was incorporated as an interactive map that allows the user to orient and navigate to individual viewpoints, while selected views of the walls support high resolution zooming capabilities.

At the same time, the structure of the main

database is expanded to incorporate audiovisual material in video format and CAD models within the system. Likewise, photogrammetric surveying and laser scanning products may be organized as distinct data collections by adopting appropriate metadata and developing tools for their effective management. This will allow their seamless future integration within broader cultural heritage digital repositories, such as Europeana, the official European culture resources online collection portal.

In this context, recorded datasets associated with completed restoration projects

and testing of mechanisms for the automated mass extraction of records from the main database.

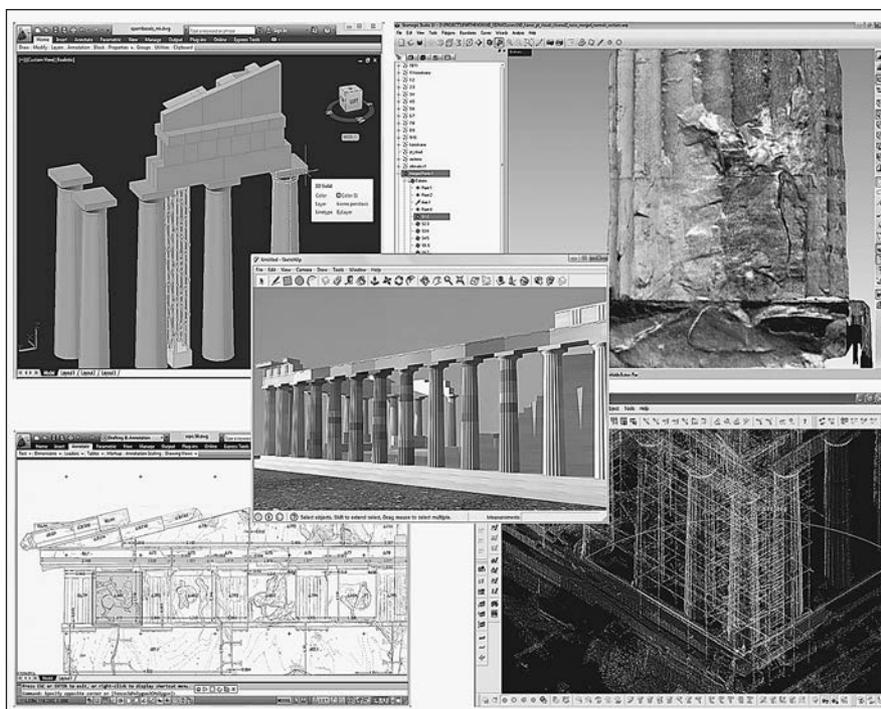
At the same time issues related to the provision of multilingual support should be investigated. Most content held in the core of the digital infrastructure of YSMA is currently only in Greek and the prospect of its dissemination presupposes the translation of at least basic information fields. To this end, controlled vocabulary lists should be associated initially with existing thesauri of ancient architecture terminology and be translated. As a next step, the potential for

the mass automated translation of database records using relevant software solutions should be explored, so as to limit manual content editing.

Accordingly, in an effort to promote the collection of the audiovisual material held by YSMA, the pilot dissemination of indicative recent and archival footage from the restoration works on the Youtube video-sharing platform has recently been approved. Videos will be orga-

nized by theme and they will be complemented with explanatory information as well as brief viewing statistics. In view of the possibilities for video-sharing on various social network media (e.g. Facebook, Twitter) the dissemination of the audiovisual material from the restoration works is expected eventually to reach a broader audience.

Finally, the holdings of the Library of the Documentation Office can be used for setting up a digital library for the restoration



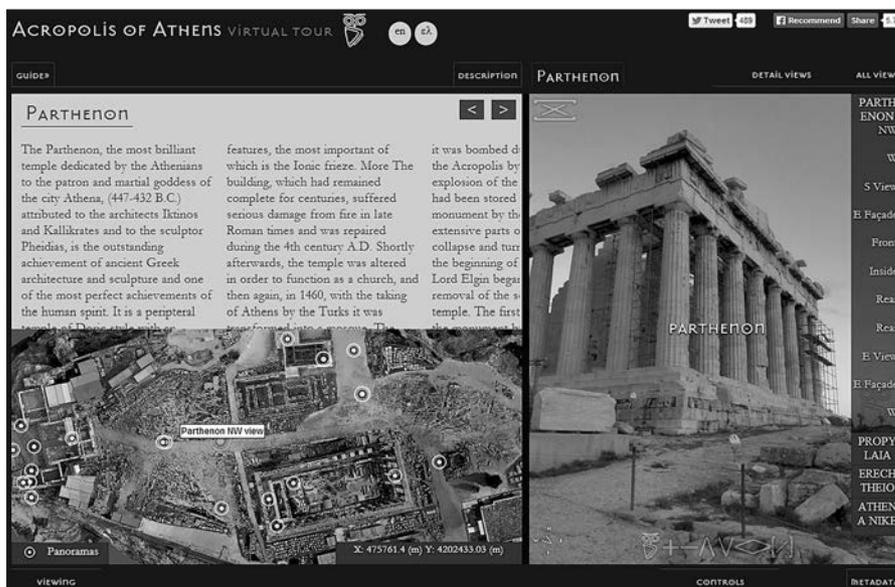
Examples of digital spatial data types

could be directly promoted. For example, parts of the content from the main database that have already been made available through the complementary CD-ROM of the publication of the Erechtheion restoration can be integrated in an online repository. This work can provide an opportunity to examine the compatibility of our recording with available international documentation standards that facilitate the exchange of information between digital systems, such as the Dublin-Core or CIDOC-CRM. Moreover, it will contribute to the development

works. As a first step, the publications of YSMA (~100), internal reports (~2000), reprints (~500), books and periodical volumes (~1,700), and worksite logbooks (~250) have been catalogued in a simple database application. Selected reports (>1100) have been digitized and attached to the respective database record, while all new productions by the members of staff are being deposited in digital form. The design of the database allows data export to common reference management applications (e.g. Endnote) or data file types compatible with the MARC 21 bibliographic standard used by most digital libraries. The collection can be connected at any point to the online Greek Academic Libraries Catalogue (Zephyr) allowing its content to be searchable on the internet or comprise an autonomous online repository providing access to selected parts of the material. Part of the archive collection of YSMA associated with educational resources about the restoration projects is already managed and distributed through an online repository platform provided by the National Documentation Centre.

Conclusions

The long-term efficiency and sustainability of digital systems for documenting and archiving activities related to the protection and enhancement of cultural heritage monuments depend on a number of factors. Of foremost importance are the functional assessment of the information system used and the continuous monitoring of its performance, so as to identify opportunities for improvement especially with a view to ensuring information accessibility and exchange. Meanwhile, at the operational level, the relevant software and hardware upgrades should be scheduled at regular intervals, in order to keep track of advances in digital technology and avoid costly re-engineering solutions and data migration. Established recording procedures should also be continuously monitored in order to detect changes associated with digital technology (e.g. new data types, software or devices) and timely update archival

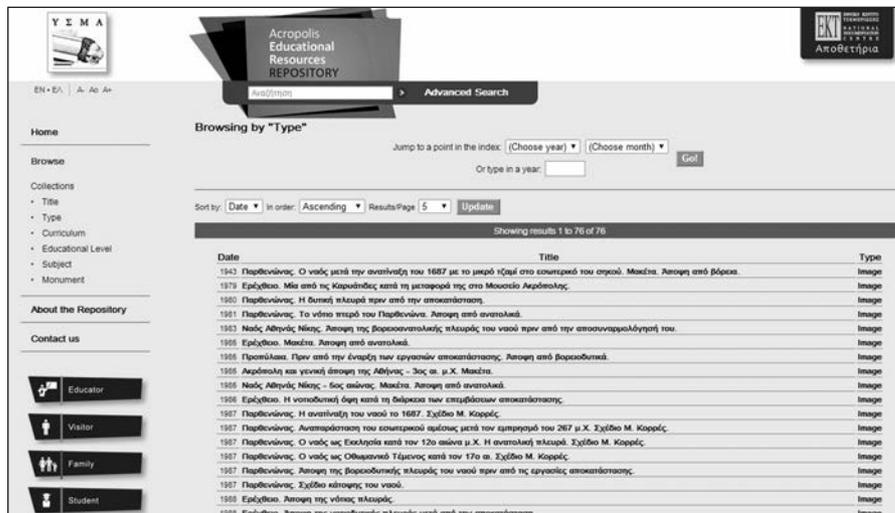


Using the ground orthophoto map of the Acropolis in the virtual tour application to navigate to selected viewpoints

management practices. Finally, with a view to ensuring the desired reversibility of interventions for the protection and promotion of cultural heritage monuments, concern for documenting these interventions should be complemented with similar attention to the dissemination of the recorded information. In the new digital world this practice comprises the utmost method for ensuring long-term preservation of an archive's contents.

** This article is an edited version of a presentation delivered at the Seminar on Information Systems in Archaeology and Cultural Heritage organised under the research project NARNIA (New Archaeological Research Network for Integrating Approaches to Ancient Material Culture), University of Paris West, Nanterre (France), 27-29 May 2013.*

Markos Katsianis
 Dr Archaeologist
 Documentation Office



The repository of educational resources for the Acropolis restoration

News from the Acropolis

For yet another year the YSMA responded to the undiminishing interest of the public –general and specialised– in the Acropolis restoration works. The effort of the Service to contribute to informing the public led to the organisation of a series of activities, programmes and events that are described below. Not only this, but the YSMA scientific personnel willingly responded to invitations from elsewhere.

Educational activities

During the second half of 2012 and in 2013, the Information and Education Department of the YSMA carried out educational activities for educators, pupils and for the general public.

To be precise, 188 educational programmes were conducted with 3,859 pupils attending from 100 schools and 14 anniversary programmes were attended by 380 children. The Department's museum kits for schools were used by 14,364 pupils from 255 schools all over Greece. The educational folder "Acropolis and Anastelosis" was published in English. The museum kits designed for families (family packs), were used in the Acropolis Museum by 5,456 families (3,840 from Greece and 1,616 from abroad), that is to say, some 16,368 children. Seminars were held for 1,024 people, comprising educators and students from Greece and abroad, who were given educational material as well.

The Department participated in two one-day seminars of the ICOM-CECA (International Council of Museums - Committee for Education and Cultural Action) on the subject "Printed and digital educational publications for promoting cultural heritage" and "Educational activities for special social groups", a one-day seminar on the subject of "Digital knowledge and open technologies: bridges to research, education, culture" organised by the EKT-EIE, a one-day seminar on the subject "The Educational Museum: innovations and technologies that transform the educational programmes of the museums", organised by the Benaki Museum, the

USA Embassy and the British Council. In addition it participated in the 6th International Meeting for the restoration of the Acropolis monuments.

The Department's digital educational applications were expanded with the new application "The Glafka Project" for children over age 12 (<http://www.ysma.gr/theglafkaproject/>). It consists of a multi-level digital game with Glafka, a flying owl robot, as the star. The purpose of the application is for children to learn about the restoration works on the Acropolis monuments. They are presented in five thematic units: a) The Journey (damages and causes of the interventions), b) The Help (types of interventions), c) the Crew (the people who carry out the works of anastelosis), d) The Action (restoration works on each monument separately), and e) In the Future (machines and new technologies that are being used in the anastelosis of the Acropolis monuments). Each unit includes the preparation, the brief presentation of the subject and the testing-game. When the child has won through the five trials, he participates in the final stage of his mission, which is to

draw the robot and to receive his prize. The application ends with the unit "Learn More", which comprises the Library of Glafka for those who are interested in more information. During the period February-December 2013 the application had 8,272 visitors.

Other digital applications were visited as follows: "The Parthenon Frieze" (www.parthenonfrieze.gr) recorded 81,686 visitors and the application about the goddess Athena (www.acropolis-athena.gr) noted 23,745 visitors. The "Repository of educational material about the Acropolis" (<http://repository.acropolis-education.gr>) was also completed, in collaboration with the National Documentation Centre (EKT) of the National Hellenic Research Foundation (EIE). The repository incorporates all the material of the Department so as to assist educators to enrich their school lessons or their visits to the archaeological site and the Acropolis Museum. During March-December 2013, the repository was visited by 16,582 users. Digital plans of lessons for educators and exploration leaflets for the pupils were also made available. The purpose of these plans



Education programme "Periods of crisis and acme in ancient Athens: reflections on the Acropolis". Photo S. Paraschou, 2012

is to facilitate the educator in organising and conducting a lesson about the Acropolis. Included also are instructions for arranging the theme in three stages: before the visit, in the course of the visit and after the visit. The leaflets for the pupils can be used in the archaeological site to reinforce the experience of their visit.

The ESMA/YSMA International Meeting

There is no doubt that the most significant event of the past year was the 6th International Meeting on “The restoration works on the Acropolis”, which was held on October 4th and 5th, 2013. The Meeting was organised by the ESMA and the YSMA in collaboration with the 1st Ephorate of Prehistoric and Classical Antiquities and the Special Service for the Sector of Culture. It took place in the Auditorium of the Acropolis Museum. The Meeting revolved around two thematic axes: first, the theoretical concern about the restoration of the monuments and second, the discoveries of recent research and the special problems of technology and applications.

Included in the Meeting’s programme was a visit to the archaeological site and the work-sites of the monuments, giving the delegates the opportunity of being informed about the results of the interventions and about the programmes under



GLAFKA programme, an internet game about the restoration of the Acropolis monuments

way by those carrying out the work. In the afternoon of the first day, two comprehensive reports were given, entitled “The restoration work on the Acropolis monuments, 2000-2010” (by M. Ioannidou) and “The current restoration work on the Acropolis monuments” (by V. Eleftheriou). In addition, Ch. Vlassopoulou reported “From the work of the 1st Ephorate of Prehistoric and Classical Antiquities relating to the Acropolis monuments, 2003-2011” and Prof. D. Pandermalis spoke on “The architectural sculptures of the Acropolis in the New Museum”. The first day closed with a film by K. Arvanitakis about the anastelosis works on the Acropolis, which was produced on the occasion of the Meeting and elicited very favourable comments from the delegates. The morning of the second day of the Meeting was devoted to the new programmes and to the special issues that have been confronted, with presentations by those carrying out the works. The President of

the ESMA, Prof. Emeritus Ch. Bouras, spoke on “The new programmes for the work on the Acropolis”, R. Christodouloupoulou spoke on “Theoretical and methodological issues arising from the restoration programmes of the Parthenon”. She was followed by D. Michalopoulou who spoke on “The restoration work on the Propylaia”, E. Aggelakopoulou with a report on “Conservation interventions on the surface of the Acropolis monuments”, and Prof. M. Korres, who contributed a report on “The Acropolis circuit wall”. The afternoon of the same day was dedicated to documentation of the works, display of the archaeological material, and education. E. Lembidaki spoke on the subject of “The documentation of the restoration projects at the Acropolis and its digital management”, D. Mavromati on “Topographic and photogrammetric documentation at the Acropolis of Athens”, E. Sioumpara gave a report on “The archaic Acropolis based on the poros architectural members – proposals for the display of the material” and E. Kaimara reported on “Acropolis restoration for kids... on site and online”. The reports were followed by a lively discussion in which the proceedings of the Meeting were summarised and the opinions of the delegates about the future of the works and the archaeological site were offered. In another area, along with the conduct of the Meeting, there was a poster exhibition presenting special topics of the anastelosis and photogrammetric surveys produced by the YSMA.

The delegates received a digital publication (double DVD) containing a volume entitled “Interventions on the Acropolis monuments 2000-2012: the completed programmes», containing final reports on the works accomplished, and three volumes of studies for the restoration of the Acropolis monuments.

Awards

It was a special honour during the past year that the Acropolis works were awarded two prizes for cultural heritage by Eu-



Guiding the participants of the 6th International Meeting for the restoration of the Acropolis monuments in the Propylaia. Photo T. Souvlakis, 2013

ropa Nostra: the Committee for the Conservation of the Acropolis Monuments was awarded the Grand Prix in category 3 (Dedicated Service) for the total of its work and “the 37 years of dedicated service in planning and guiding the conservation of one of the most iconic sites of European culture”. The anastelosis of the Propylaia, moreover, won the award in category 1 (Conservation) as a work “enhancing the inherent formal and social values of an iconic monument”. The Propylaia project also received the public choice award, since the work proved to be the most popular in an online poll on a European level. The Europa Nostra awards were announced and awarded on June 16, 2013, in a moving ceremony that took place in the theatre of Herodes Atticus, which was full to overflowing. The awards were received on behalf of the ESMA by its President, Prof. Emeritus, Ch. Bouras and for the Propylaia by the former head of the project, Dr T. Tanoulas. The world of anastelosis was present to honour the contribution of those who work intensively and responsibly for the protection of the Acropolis monuments.

We must mention also the most significant distinction of a man whose name is inseparably tied to the Acropolis works. On 8 November 2013, Prof. M. Korres was awarded the “International Feltrinelli Prize” for his entire contribution to the fields of Archaeology and Restoration. The award is the utmost distinction and it is given by the Academia Nazionale dei Lincei of Rome for major contributions to art, history, literature, philosophy, medicine and mathematics. It is awarded once every five years for each specialty and it is accompanied by a monetary prize. M. Korres has devoted a great part of his life to the study and anastelosis of the Acropolis monuments and to the Parthenon in particular. His contribution to the works of the Acropolis continues unabated today, through his energetic participation in the Committee for the Conservation of the Acropolis Monuments.



Poster exhibition in the Acropolis Museum, held on the occasion of the 6th International Meeting for the restoration of the Acropolis monuments. Photo T. Souvlakis, 2013

Publications

One of the basic principles of the ESMA that has been followed faithfully since the Acropolis works began is publication of the results of the interventions. Greeted in this spirit were two very significant YSMA publications that circulated recently. The first is the exceedingly important book of the late A. Papanikolaou “The restoration of the Erechtheion (1979-1987): Final report on the Work” (in Greek with selected texts in English), which was published in December 2012 under the scholarly supervision of F. Mallouchou-Tufano and Ch. Bouras. It is a two-volume work comprising mainly the final report of the work as prepared by A. Papanikolaou, accompanied by an introductory note, a time-frame

and appendices for the purpose of integrating the intervention into the theoretical and historical/scientific framework of the period. The publication is accompanied by a DVD with a special application providing access to all of the photographic and graphic documentary material.

The presentation of the work on the Erechtheion was also of symbolic importance, since it was the first final report of an anastelosis work on the Acropolis. It took place in the amphitheatre of the Acropolis Museum on 10 April, 2013. The event was greeted by the General Secretary of the Ministry of Culture, Dr L. Mendoni. The speakers were the Director of the YSMA V. Eleftheriou, the President of the ESMA Prof. Ch. Bouras, Dr K. Zam-



From the presentation of the book “The restoration of the Erechtheion (1979-1987): Final report on the Work”. Visible (from the right): K. Zambas, Ch. Bouras and F. Mallouchou-Tufano. Photo T. Souvlakis, 2013

pas civil engineer responsible for the work of restoration of the Erechtheion and a close colleague of A. Papanikolaou, and Prof. F. Mallouchou-Tufano. The presentation was held in a most moving atmosphere, with references to the special difficulties of the project, with comments on the personality of the author himself and with occasional anecdotes from daily life on the Acropolis rock.

Especially important was the digital publication on the occasion of the 6th International Meeting which, as mentioned above, has been distributed to the participants in a double DVD. The publication includes the volume entitled “Interventions on the Acropolis monuments (2000-2012): completed projects” (in Greek with abstracts in English), published under the scholarly supervision of Ch. Bouras and V. Eleftheriou, which comprises 35 articles summarising the results of a decade of systematic works of anastelosis on the Acropolis monuments. Moreover it includes the “Studies for the restoration of the Acropolis monuments” (in Greek with abstracts in English), published under the scholarly supervision of the same, which consists of three volumes of studies approved by the KAS. With these publications, which were edited by the YSMA Documentation Office, the original aim of the ESMA for publication is fulfilled, while the quality of the interventions is open to the judgment of the scholarly community.

Exhibitions

In July 2013 the exhibition with the theme “Parthenon-Architecture and Art” was inaugurated at the National Museum of Architecture at the “Pallazo de Bellas Artes” of Mexico. It was organised by the Greek community of Mexico. The YSMA, responding willingly to the request of the Community cooperated with the Board of Greek community by providing material from its Archive. Collection, choice and annotation on behalf of the YSMA was car-



Awarding of the Europa Nostra prize to the ESMA President, Prof Ch. Bouras. Visible at the right is the Europa Nostra President P. Domingo and the E.E. deputy A. Vasiliou. Photo Studio Panoulis

ried out by the archaeologist E. Karakitsou, and overall custody of the exhibition was in the hands of A. Apostolakis, archaeologist and member of the administrative board of the Greek Community. While the exhibition was enthusiastically received by the public, the purpose of the Greek Community was not only to pro-

mote the monument and its influence on architecture and art, but also to expedite a revised image of modern Greece in Central America.

Lectures – Publications

During the year just past, the scholarly staff of the YSMA took part in scholarly dialogue, presenting the progress of the works of anastelosis and the results of research. In addition to the 6th International Meeting, which provided the YSMA with the opportunity for an overall presentation of the work, the YSMA scholarly personnel took part in Greek and foreign events with reports, lectures and publications.

The YSMA Director, V. Eleftheriou, together with D. Mavromati, collaborated in an International Symposium entitled “2nd International Symposium on Cultural Heritage, Conservation and Digitization”, which took place in Beijing on 18-19 October 2012, with a report entitled “The Acropolis of Athens, the restoration project and contemporary technology”. They also delivered a report entitled “Methods of documentation using contemporary technology. Application and evaluation of the



From the presentation of the book by A. Papanikolaou in the Acropolis Museum. Visible in the first row (from the right): D. Pantermalis, President of the Administrative Board of the Acropolis Museum, L. Mendoni, General Secretary of the Ministry of Culture and Sports, V. Eleftheriou, Director of the YSMA, M. Andreadaki-Vlazaki, General Director of the GDAPK, M. Ioannidou, Director Emerita, K. Liakopoulou-Papanikolaou. In the second row (from the right): the children of A. Papanikolaou, Konstantinos and Kleoniki-Elena. Photo T. Souvlakis, 2013

monuments of the Athenian Acropolis” at the 3rd Panhellenic Symposium on Anastelosis of the Society for Research and Promotion of the Scientific Anastelosis of Monuments (EETEPAM), held in Athens on 1-3 November 2012. The architect L. Lambrinou likewise participated in this Symposium with a report on the subject “East porch of the Parthenon or Pronaos: intervention choices and implementation”. On 14 December 2012, V. Eleftheriou and D. Mavromati gave a lecture on “The work of the YSMA and the contribution of the rural and surveying engineer to the geometric documentation of the monuments”, to students at the School of Rural and Surveying Engineering of the National Technical University of Athens, in the framework of the lesson “The Surveying of Monuments”.

On 23-24 November 2012, an international symposium was held in Agrigento, Sicily, on the subject of the anastelosis of ancient monuments (Giornate Gregoriane 2012: Il restauro dei monumenti antichi. Problemi strutturali: esperienze e prospettive). On behalf of the YSMA the following reports were presented: V. Eleftheriou (The recent intervention programs on the monuments of the Athenian Acropolis), K. Karanasos (Criteri di reintegrazioni strutturali nel restauro dei monumenti dell’ Acropoli de Athene. Problemi metodologici-scelte progettuali) and A. Vrouva (Calculating reinforcement for fragmented architectural members. A three-dimensional approach). K. Karanasos had in addition given a lecture shortly before this, on 5 November 2012, on the subject of the restoration works on the Acropolis monuments in a seminar at the Italian School of Archaeology that was held in the framework of the 6th Travelling Master of the Academia Adrianea di Architettura e Archaeologia of Rome.

M. Ioannidou participated in the postgraduate programme of the University of Athens entitled “Museum Studies” with two lectures on 28 April and 5 May 2013. The lectures were entitled “Principles and

methodology of interventions on the monuments” and “Research and contemporary technology in the anastelosis of the Acropolis monuments”.

F. Mallouchou-Tufano lectured on the subject of “Documentation requirements in restoration projects: the case of the Acropolis of Athens” by invitation from the seminar “Information Systems for Archaeology and Cultural Heritage” of the network of excellence NARNIA, that was held in Paris at the Université Paris X (Nanterre), 27-29 May 2013. At this same event, M. Katsianis gave a lecture about “Information technology in the documentation of the Acropolis restoration project”.



Exhibition on the subject of the “Parthenon: Architecture and Art” in the National Museum of Architecture of Mexico. Photo A. Apostolakis, 2013

E. Lembidaki contributed to the volume “Ε Π » Π / „ ^ `”, 24 studies for the teacher Petros Themelis from his students and his colleagues”, Athens 2013, with an article entitled “The cult of Athena Nike on the Acropolis of Athens. From Athena the Nike to the Wingless Nike”.

Members of the Office of the Surface Conservation took part with their reports in the 5th International Round Table for Greek and Roman sculptural and architectural polychromy, which was held in the Acropolis Museum Auditorium on 7-8 November 2013. G. Frantzi and A. Maridaki together with E. Papaconstanti-

nou, G. Verri, S. Soteropoulou and H. Brekoulaki presented a report on “The revelation of the decorative pattern of the coffered ceiling of the Maidens’ porch in the Erechtheion”. The head of the Office, E. Aggelakopoulou with the antiquities conservators A. Panou and I. Kotsifakos took part in the Round Table with a report on the “Technical investigation of the polychromy of the NW raking sima of the Parthenon”.

M. Ioannidou participated in a one-day seminar entitled “Seismic protection of monuments”, which was organized by the Organisation for Antiseismic Planning and Protection (OASP) and the European Center on Prevention and Forecasting of Earthquakes, on December 2, 2013. Her

report was on “Seismic actions of the Acropolis monuments. Scientific and technical choices during the restoration interventions”.

The year closed with the lecture of E. Sioumpara on the “Archaic Acropolis. New research and results”. The lecture, in the series of lectures of the Society of the Acropolis Friends (EFA), was given on 13 December 2013 in the Auditorium of the Acropolis Museum.

Evi Petropoulou
Archaeologist
Documentation Office

6η ΔΙΕΘΝΗΣ ΣΥΝΑΝΤΗΣΗ ΓΙΑ ΤΗΝ ΑΠΟΚΑΤΑΣΤΑΣΗ
ΤΩΝ ΜΝΗΜΕΙΩΝ ΑΚΡΟΠΟΛΕΩΣ

6th INTERNATIONAL MEETING FOR THE RESTORATION
OF THE ACROPOLIS MONUMENTS



Μουσείο Ακρόπολης
Αμφιθέατρο
Acropolis Museum
Auditorium

4-5 Οκτωβρίου 2013

4-5 October 2013



ΥΠΟΥΡΓΕΙΟ ΠΟΛΙΤΙΣΜΟΥ ΚΑΙ ΑΘΛΗΤΙΣΜΟΥ | ΕΠΙΤΡΟΠΗ ΣΥΝΤΗΡΗΣΕΩΣ ΜΝΗΜΕΙΩΝ ΑΚΡΟΠΟΛΕΩΣ
ΥΠΗΡΕΣΙΑ ΣΥΝΤΗΡΗΣΗΣ ΜΝΗΜΕΙΩΝ ΑΚΡΟΠΟΛΗΣ | ΕΙΔΙΚΗ ΥΠΗΡΕΣΙΑ ΤΟΜΕΑ ΠΟΛΙΤΙΣΜΟΥ
HELLENIC MINISTRY OF CULTURE AND SPORTS | COMMITTEE FOR THE CONSERVATION OF THE ACROPOLIS MONUMENTS
ACROPOLIS RESTORATION SERVICE | SPECIAL SERVICE FOR THE SECTOR OF CULTURE



Group photograph of the Parthenon personnel on the occasion of the 6th International Meeting for the restoration of the Acropolis monuments. Photo T. Souvlakis, 2013



The YSMA personnel: group photograph during visit to the Acropolis Museum on the occasion of the 6th International Meeting for the restoration of the Acropolis monuments. Photo T. Souvlakis, 2013



Group photograph of the Propylaia personnel on the occasion of the 6th International Meeting for the restoration of the Acropolis monuments. Photo M. Toufeklis, 2013

News Letter of the Acropolis
Restoration Service of the Hellenic
Ministry of Culture and Sports

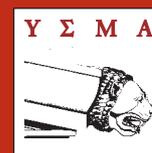
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The Acropolis Restoration Service
10 Polygnou Street
GR-10555 Athens
Tel/fax: (30)210 3243 427/3251 620
e-mail: ysma@culture.gr
www.ysma.gr

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