ΥΣΜΑ ΥΠΠΟ

The Acropolis Restoration News

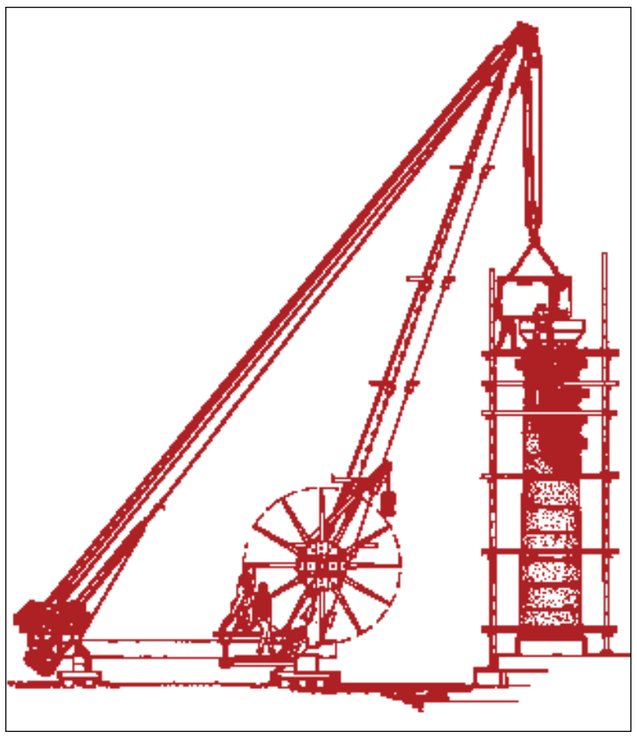
2 • July 2002

General principles of organisation of work-sites for restoration of the monuments

Whoever embarks on the restoration of a monument must, to be sure, diagnose the damage and explore methods of confronting it. He has also, however, to resolve the extremely important problem of chosing the technical means by which the intervention is to be carried out. The work-site of a monument is the agregate of a material and technical infrastructure that serves the work of conservation and restoration of the monument. It includes the choice of technical equipment to be used, the organisation of working areas and places where the mechanical equipment is to be installed and, finally, the work programme itself for intervention on the monument.

Organising a work-site for a technical work is complex in itself, but it is all the more so when it is a question of restoring a monument. In this case, the area and space available for setting up the technical means are apt to be limited. Moreover the approach and transportation of technical equipment and supplies to the work area are usually difficult. Even the presence of visitors while work is in process requires special arrangements. Yet it is respect for the historical and artistical value of the monument that demands that the whole of the material and technical infrastructure be studied especially carefully. Thus, while the technical means used on an ordinary construction project are as a rule well known and fixed, in the work-sites of monuments systems suitable for carrying out the work must be chosen that will not create problems in connection with the monuments themselves.

Among the technical equipment of the work-site are the hoisting systems (cranes, bridge cranes) that are indispensible for dismantling and resetting the architectural members of the monuments, equipment for the structural restoration of the members (pantographs, pointing devices, specially built fixtures for repairing fragments of the ancient members), systems for moving stones and transporting material and equipment, the indispensible equipment for measuring and plotting, laboratories, workshops and offices for the personnel, special tools, etc.



Ancient hoisting machine. Study-drawing by M. Korres,1982

The basic technical means in use today for restoration projects are the counterpart of the ones that were used in the construction of the monuments themselves. Despite the progress of technology in our time, we have not surpassed the ancient Greeks in terms of original ideas for completely new hoisting systems, or systems for moving and transporting. Significant development there has been in the motive power used for the systems and in the choice of materials. There is also a significant difference of another sort. If some architectural member was destroyed by poor handling during cutting or in transportation, the ancient Greeks could correct it or make it over again. For us, however, the monuments are unique. They are irreplaceable and invaluable in their entirety and this applies likewise to their individual architectural members right down to the smallest fragment lying on the ground. We are therefore obliged to conserve them and to restore them without destroying any of the historical, scholarly and artistic information that they bring with them. Thus the

basic criterion for choosing the work-site equipment for restoration of the monuments is whether it can leave the monuments completely unharmed after the work is finished.

Manolis Korres in his book From Penteli to the Parthenon shows, in excellent drawings, the systems employed by the ancient Greeks for transporting and hoisting marble architectural members onto the monuments of the Acropolis. They used wooden scaffolding, cranes, hoists and devices for moving things that worked according to rules of mechanics known from the earliest times. Similar systems were employed also in earlier restoration interventions on the monuments. The scaffolds continued earlier tradition and they were extraordinarily well constructed. They were made of straight wooden pieces, large in cross-section and equipped with fitted joints, while iron screws made it possible to join adjacent scaffolding. These hoisting systems had many disadvantages. They were financially inexpedient and they were detrimental to the appearance of the monuments, as can be seen from the old photographs, where the monuments themselves can barely be discerned behind the bulky wooden scaffolding.

The Parthenon from the E. Photo S. Mavrommatis, 2002

Today's steel hoisting systems are lighter, they have greater strength and they can be installed faster than the old wooden ones. Electricity enables hoisting and handling to be done more easily and quickly. The continuing development of technology has brought impressive improvements to the realm of machinery, making possible operations of great accuracy. Modern technology likewise offers the possibility of constructing special devices that are helpful in carrying out a number of special operations.

The choice of location for the work-site is a very serious matter for the engineer in charge of the work. Various factors come into play, of which the most important are as follows:

a) the peculiar characteristics of the monument, that is, its extent, the material it is made of, its state of preservation and its immediate environment. Of great importance is whether there are ancient remains in the area of the monument and the possibility of their being damaged by the loads imposed by the installations or by mechanical or chemical factors.

b) the morphology of the ground in the area of the monument, that is the extent, slope, form and composition of the earth and the surface available for installing the work-site.

c) the extent of intervention on the monument and the total volume of architectural material that has to be dismantled and restored.

d) the existing possibilities for transporting material and equipment to the area of the work, which many times dictate specific solutions. It is evident that in work sites unapproachable by vehicles, such as those on the Acropolis, where transportation has to be done by manual operation or by carefully pre-arranged means, such as a lift crane or a forklift, the factor of transportation becomes exceedingly important; the weight of the accessories of the work-site equipment plays a very large role as well.

e) the time-scheduling of the work as a whole, that is its division into programmes, the way in which they are carried out, simultaneously or not, and the time-span of each programme.

These factors clearly are interrelated with each other in many ways and they affect each other. The extent of the work-site, the way it is organised and the choice of hoisting means, for example, depend on the scale of intervention, the existing possibilities for transport and the length of time scheduled for the work. Likewise the time-scheduling of the works depends on the area available for organising the works and on the extent of the intervention.

Together with the choice of work-site equipment, there are a number of prerequisites and aims to be fulfilled such as:

a) the technical means to be employed should be handy, easy to install and operate at any moment.

b) the appearance of the installation and its material should induce the least possible aesthetic interference with the monuments. That the aesthetic aspect of the monuments suffers during such interventions of restoration is unavoidable fact. Even so, we try to reduce this problem and there are various ways of doing this. Thus, constructions that are both massive and tall are to be avoided, especially when, for practical reasons, they have to rise above the monuments themselves. The aesthetic problem is reduced also by using a suitable colour for painting the various parts of the hoisting equipment and workshops, and by installing the auxilliary equipment in places where they are out of sight.

c) preservation of the monument itself and of other ancient remains in the area. Any damage to the monuments or to the antiquities in the area as a result of work connected with the installation of work-sites is unacceptable. Thus we must avoid supporting any part of the equipment (scaffolding, bridge cranes etc.) on parts of the monument or on any of the ancient remains without placing a protective soft padding between them (rubber or lead sheets where the scaffolding rests against the walls of the monument, wooden blocks at the seat of the scaffolds on the Rock itself or on the monuments, etc.).

d) safety of the workmen and also of visitors while work is going on. For the safety of those working on the monuments, it is imperative that the code having to do with the safety of workmen in construction works in our country and with handling loads, be followed scholastically. The safety of visitors can be controlled by banning their access to the work-site. If this is not feasible, it is best to isolate the work area from the area open to visitors with protective fencing.

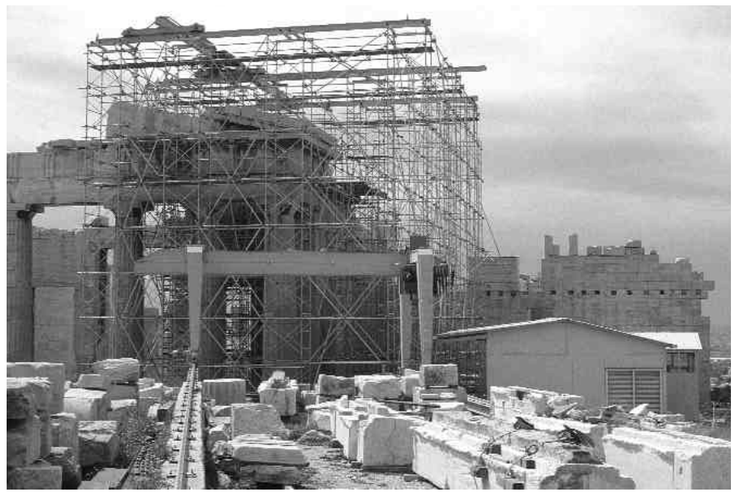
Particularly important for using the construction-site systems productively is good organisation of the restoration work on the monuments by the engineer, who has the overall responibiliity. The time allotted for the work, the overlapping of work, correct use of the available equipment and, above all, love and enthusiasm for the work at hand provide the driving force of the entire effort.

Necessary prerequisite for harmonious function and full use of the work-site is the choice of personnel, which must answer to the needs of the work. Our ancient ancestors were very fortunate in this respect. All the participants, from the chief architect to the last stone-cutter, combined a formidable talent with theoretical knowledge and brilliant technical skill, which enabled them to participate in all phases of the work. Without such men, indeed, we would not have today these monuments we so admire and want so much to preserve.

Yet today in the Acropolis, in the spirit of modern times to be sure, the choice of personnel for the work of restoration follows much the same criteria. The scholarly personnel and technicians who carry out the work, together combine great ability, special concern for the object and the feeling that they are carrying out a work of great value and national importance.

These are indeed necessary elements, for without them even the most sophisticated installations of the work-sites would remain silent and unexploited.

Maria Ioaannidou
Civil Engineer
Director of YSMA



The Propylaia from the E. Photo T. Tanoulas, 1992

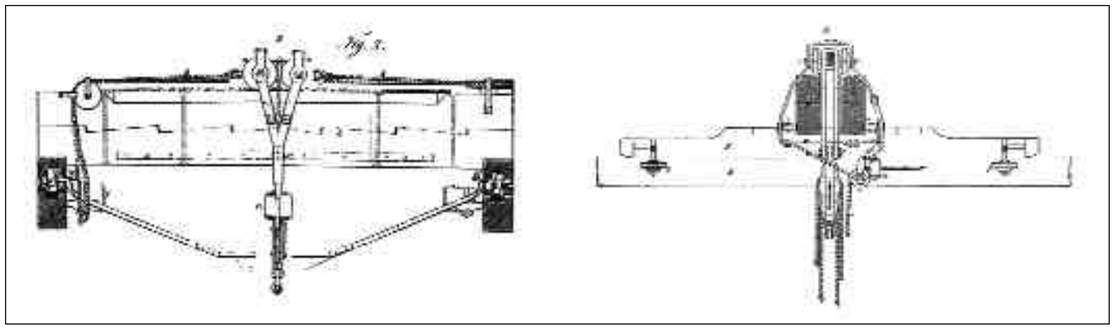
Historical Review

On observing the monuments of the Acropolis, today's visitor cannot but be perplexed: how did the Athenians of the classical period manage to haul up all those huge blocks of marble and especially how did they set the architectural members of the monuments in place, tens of metres above the ground level of the Rock? The question becomes all the more acute if one considers the tremendous size and weight of the blocks. Take for example the architrave (epistyle) blocks of the Parthenon, which weigh around 9 tons and were set at a height of 15m accurately to the millimetre, to say nothing of the extraordinary example of the lintel block of the opisthonaos, which is 7,7m long and weighs around 12 tons. For these works, it is quite clear that hoisting machinery was employed. The driving force was of course human muscle or, perhaps, animal power, always greatly multiplied by systems of levers and pulleys in order to cope with loads of such magnitude.

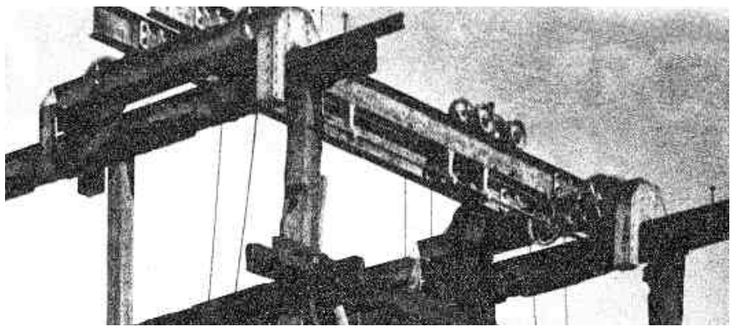
The probable form of such a hoisting machine has been reconstructed some years ago with creative imagination by the architect Manolis Korres, then in charge of the restoration of the Parthenon. His drawing, reproduced here, shows the great length of the bars, with the force of workmen applied to the ends in order to wind the rope onto the drum. The diameter of the drum is significantly less than the length of the bars in order to multiply in inverse proportion the force applied to the rope. The rope itself is reeved through many pulleys in order to raise the hook. Thus here too available power is multiplied, but with a corresponding loss of speed. Half-worked column drums even provide the counterweight! Since these constructions were made of wood, unfortunately not a single fragment of them has survived.

Then and Now

Today it is equally evident that hoisting machines must be employed in the work of anastelosis on the Acropolis monuments. The same ancient architectural members must be dismantled, receive the necessary repairing, reinforcing and restoring, and then they must be placed again in their original positions on the monument. Now, as then, the hoisting machines comprise: the chassis, that is the basic structure –in antiquity made of wood, today of steel– the pulleys, the ropes –then made of natural fibers, today of steel wire– and the gears for increasing force and lowering speed. In fact the only real difference lies in the motive power.



Hoisting machine for work on the Parthenon in the 1840's. Drawing by L. von Klenze, 1837



The hoisting machine of the restoration works by N.Balanos on the Acropolis. From the firm De Fries & Co, Düsseldorf. Photo: Balanos Archive, Athens Archaeological Society

Selection points of hoisting machines

The market today provides a great variety of hoisting machines for many different applications. The engineer in charge of anastelosis is obliged to chose from among all these the one that will enable him to carry out his task with speed, accuracy and safety. The sort of task that has to be performed determines the hoisting machine to be used, that is whether it is a machine with linear or rotary motion, or a combination of the two. There are also other factors affecting the engineer's choice, such as the maximum load to be raised, the per diem operating hours, the frequency of operation in the range of maximum load and the expected physical obstructions in the area of operation. For motive power, electricity is to be preferred since it is silent, easy to operate and it does not pollute the environment.

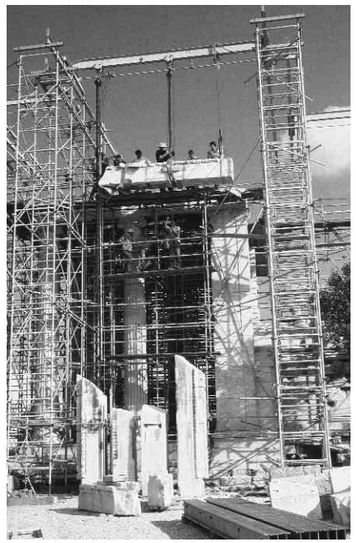
Bridge Cranes

When the work is best served by a linear movement along a main axis (and a shorter course along a transverse axis) bridge cranes on rails are employed, either on the ground or elevated.

The portal crane with its rails on level ground, is the classic choice for handling and supporting structural restoration of architectural members in a rectangular or square area. This is because it takes in the entire area and has equal lifting capacity everywhere. For aesthetic reasons, the height of the steel structure of these bridge cranes must be as low as possible; short headroom hoists are useful in this respect. Frequently the deposited loads prevent the operator from being able to view the space in which the bridge crane is moving. It is therefore equipped with a buzzer alarm and safety devices that stops it from travelling if it meets a stationary impediment on the rail.

This type of portal crane is used at the Parthenon work-site (with a 5-ton lifting capacity) and at the Propylaia work-site (with two hoists, of 12,5 and 3,2-ton capacity).

Bridge cranes on elevated rails are employed particularly in restoration works, since they provide a simple and trustworthy solution for working the length of a long construction with a narrow span such as, for example, a colonnade or a wall. Bridge cranes of this type are supported at both ends on two rows of heavy duty scaffolds, which rise above the monument and on both sides of the section to be worked on. The scaffolding rows are connected in such a way that the rails of the bridge crane maintain a constant gage. Struts against fixed points limit the possibility of transverse movement. If the inherent advantage of the limited length of the free suspended rope from hook to hoist is coupled with hoists and travelling gear with continuously controlled variable speed, remarkable stability is assured, the load can be easily handled without oscillation and the work performed accurately to the millimetre. The chief disadvantage of using the elevated bridge crane is that it is obtrusive aesthetically with its massive scaffolds, which rise around and above the monuments, even though there are in any case some scaffolds providing the technicians with access.



The bridge crane on elevated rails used in the restoration of the Erechtheion. Photo A. Papanikolaou, 1981

Bridge cranes of this type have been used for the restoration of the Erechtheion (1979-1987) and for dismantling the temple of Athena Nike (2000-2001). Likewise, bridge cranes with lifting capacity of 12,5 and 8 tons respectively were used for dismantling the ceiling of the central building of the Propylaia and the south wall of the east stoa of the same building. The same cranes will be employed for restoring the blocks to these parts of the Propylaia and the temple of Athena Nike.

Slewing cranes

A versatile solution for the projects of anastelosis of the monuments is provided by the slewing crane. This is produced in a variety of forms for different uses. At present, two slewing cranes serve the needs of the work-site of the Parthenon: one is installed in the interior of the monument and another is outside and travels on rails along the north side of the temple.

The decision, in 1983, to install a crane within the Parthenon was primarily favoured for aesthetic reasons: the alternative choice of bridge cranes with the heavy type of supporting scaffolds which would have surrounded the building, would have greatly overburdened the Acropolis, given the size of the Parthenon and its dominating position in the centre of the Sacred Rock.

Special operating parameters were defined for the crane. These were imposed by the very nature of the task of dismantling and remounting the architectural members of the monument, such as accuracy in the handling of architectural members, inching at low speed and, to the extent possible, elimination of any oscillation of the load.

The portal crane on ground level rails of the Propylaia work-site. Photo S. Mavrommatis, 2002

These are features of little importance for cranes used in ordinary building construction where, by contrast, high speed is sought in order to increase productivity.

The type of crane chosen at that time and set up in the interior of the monument was a derrick crane made by the Haulotte company. This is a type of crane with a steady frame, a slewing platform and post and a luffing jib. It is known particularly for its sturdy construction, the strength of its steel structure and its rigidity, which in turn reduces load oscillation. This particular crane has a maximum lifting capacity of 12 tons (for a radius of up to 18m) and a maximum working radius of 39m, two slewing speeds, a single luffing speed and two hoisting speeds, the lower of which, around 0,8m/min, meets the special requirements for operating precision in the work. Since the lifting capacity depends on the working radius, the crane has been retrofitted with a special electronic weighing and safety device which enables the operator to control any violation of the safe working load. In case this is exceeded, the device automatically halts any movement, such as hoisting up the hook and luffing the jib down, that might lead to a dangerous situation. Basic disadvantages of the crane are the 260° limited slewing angle and the difficulty in moving the base with auxiliary towing gear, such as a crank or chain block.

With the extension of restoration to the north colonnade of the Parthenon, the need for a second crane became evident in 2001. The pressure of a time schedule for completion of the work dictated the choice of a crane that could be found "ready" on the market, such as construction-site cranes. A slewing construction crane was chosen, an MR90 of the Potain company, with a low mast, a 30m luffing jib, and an electrically powered travelling base on rails. The crane has a hoisting capacity of 10 tons for radiuses up to 15m, gradually decreasing to 3,6 tons for a radius of 30m.

The standardised construction of the crane had still to be modified in order to meet the special aesthetic and practical requirements of the work. Thus the height of the floor of the slewing platform was reduced to 4,7m from the rail level of the crane, so that it would not be visible from the city. For the same reasons, the crane's luffing jib can be lowered, when not in use, down to 10° below the horizontal level. With additional limit switch contacts and a modification of the control circuit, a gradual deceleration of slewing was achieved to reduce torsional stress on the mast, to define accurately the limits of the slewing angle and to reduce load oscillations. The hoisting winch for the hook, that had originally been fitted, had to be replaced by a new one, operating on a principle different from that of the original, with inverter frequency control on the motor that provides a ratio of min/max speed of 1: 30, in 5 steps, with the min. speed of 0,6m/ min, steady and independent of the load. The luffing of the jib is likewise in 5 steps, from 1,4 to 22,5 m/min.

The derrick crane in the interior of the Parthenon. Photo K. Zambas, 1985

The crane has two operating controls, one is a conventional joystick wire control, the other a radio remote control with digital load indicator. The radio control is a most important accessory since it enables the operator to stand close to the job site and to have direct surveillance of the motion of the load and direct contact with the technicians on the monument. Reaction time is thus reduced, and with the devices and gears already mentioned, operating precision is down to a millimetre. This crane too is equiped with safety devices, both against exceeding the max. load (10 tons) and against passing the tipping moment (150 t·m) for any position of the luffing jib.

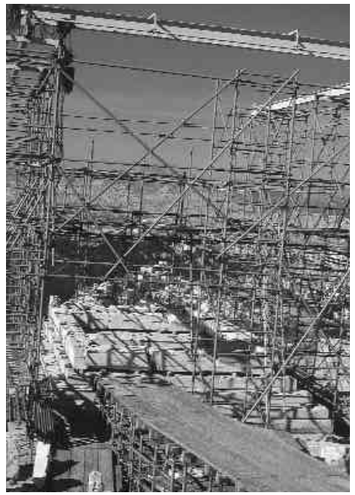
Each of the two cranes at the Parthenon construction-site are of lattice steel structure. These are preferable from the aesthetic standpoint since they are more "transparent" and conceal less of the monument. From the practical standpoint, they are preferable because they are lighter and the mass of preassembled parts is less. They are assembled in place at the work-site of the monuments, a great advantage taking into consideration the difficulties of transporting assembled machinery to the area of the Acropolis. Finally, the lattice steel construction, with less surface to be exposed to the wind, greatly reduces wind pressure in a particularly wind-beaten area such as the Acropolis. Correspondingly reduced as well is the torsion stress produced in the structure and slewing gear by the wind force.

The slewing construction crane outside the N colonnade of the Parthenon.
Photo A. Papandropoulos, 2002

The development of hoisting technology from ancient wooden machinery to modern electrically operated cranes, illustrates the age-old urge of man to surpass his own natural powers in creating that which, in the case of the Acropolis Monuments, combines deep spirituality with exhalted cultural significance.

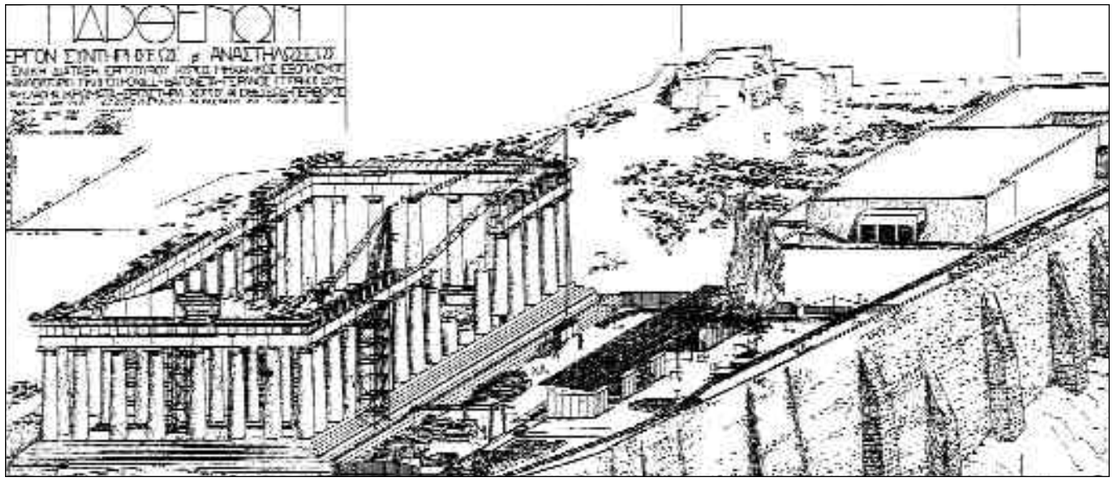
Spyros Oikonomopoulos
Mechanical and Electrical Engineer
In charge of the electromechanical
support of the Acropolis
Restoration Works

Slewing construction crane of the N side of the Parthenon. To the right the operator with radio control. Photo L. Lambrinou, 2002



The hoisting and handling equipment of the temple of Athena Nike work-site.
Photo C.Mamaloungas, 2002

Since the year 2000 the work of restoring the Parthenon, just as the other restoration projects, has entered a new phase. The acquisition of continuous and adequate funding with the entry of the Acropolis programmes into the 3rd Community Support Framework, the structural changes that accompanied work on the projects with the establishment in 1999 of the Acropolis Restoration Service, established specifically for this purpose, and the possibility of renewing the depleted work force and scholarly personnel, has revitalised the projects. Accompanying this came new obligations. Tight time-schedules for finishing the works were put in force; with this, the obligation to absorb the allotted funding in a strictly defined period, while retaining the same high quality of work.



The Parthenon work-site. Study-drawing by M. Korres, 1983

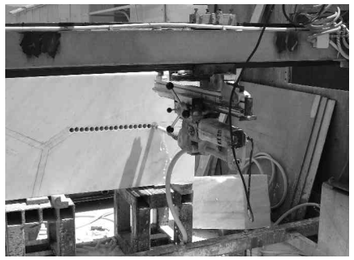
The programme of work on the Parthenon, up to 2004, includes completing the restoration of both pronaos and opisthodomos and the reworking of past restorations of eight centre columns in the north side of the monument together with the corresponding section of the entablature and the partial anastelosis of the cella side walls.

Clearly, the new scheduling of the work implies also reorganisation of the work-site, including existing substructure and equipment, and procedures and rate of productivity. Reorganisation implies in turn training and adaptation of new personnel, reorganisation of the area to be used as the work-site, restructuring of its mechanical equipment and production systems, together with adequate safety measurements for both personnel and monuments.

A special implement of the Parthenon work-site: drilling tool used also as pointing device. Photo L. Lambrinou, 2002

Organisation of the area for carrying out the work must always adhere to the principle that the work-site and work under way be as unobtrusive as possible to those visiting the monument and the Acropolis Rock. To increase the sheltered area for work and personnel, a steel elevated platform was devised inside the Parthenon cella, capable of supporting 70 tons of marble. Two prefabricated laboratories were also erected for the conservators. The area beneath the platform will be equipped so as to provide an enviromentally controlled area for the marble cutters.

In reorganising the work-site, ways of improving productivity were especially emphasised. Existing mechanical equipment was therefore restructured and also considerably improved by the addition of new machines. New shoe-pads were made for the derrick crane within the monument, thus increasing its travelling ability and enabling it to be moved easily between the pronaos and opisthodomos without loss of time. For the requirements of restoring the north colonnade a second construction crane, from the Potain company, designed especially to meet particular needs of the work, was installed outside the monument on the north side, on a base of reinforced concrete and on wheels, enabling it to travel by electrical power for a length of 18 m. The possibility of running the two cranes in combination in order to accelerate the work has been considered – in particular after the interventions on the pronaos and opisthodomos have been finished.



The drilling tool of the Parthenon work-site. Photo, S. Mavrommatis, 2002

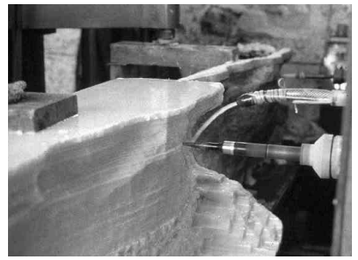
Marble-cutting is now done with greater speed and more easily since the acquisition of a marble cutter with revolving head and two disks. It has a travelling wagon with an hydraulic motor. This has been installed in the work-site. The cutting system was soon retrofitted with an hydraulically revolving table which is set on the wagon. This can be used to produce column drums or to make additions in new marble for filling in the column drums. The acceleration of work by means of the new marble-cutting machine was spectacular. The marble-cutting and chiselling process stops 4 millimeters short of the final surface, so that the finishing of the surface can be done by master stone-cutters using the traditional technique.

To accelerate the making of marble additions to the ancient members from their plaster casts, a special implement was contrived. A device with an arm ending in a point is added to a drill of the type used for making holes in the marble for inserting titanium reinforcements. This device is parallel to the drill itself and at a specific distance from it. The new marble that has been chosen as a filling, is placed over the cast. The special implement thus works as a pointing device: the drilling tool marks, point by point onto the new marble, the surface of the cast, above which the needle moves. This saves a significant amount of time and work; for example, thirteen days work can be done in three. Here too, the final working of the marble is done by hand by master marble-cutters.

Horizontal joining of architectural members on steel wagons travelling on rails in the Parthenon work-site. Photo, S. Mavrommatis, 2002

The joining of architectural members is greatly simplified by placing the pieces to be joined –ancient fragments or ancient fragments and additional pieces of new marble– on steel wagons of equal height, travelling on rails, so that the pieces can be joined horizontally. In the future, working methods are expected to be facilitated and the time spent on a given task reduced even more with proposed improvements to the existing means of transport and handling of loads. Examples are the installation on the SE slope of the Acropolis of a special crane of 8-ton lifting capacity, for moving and arranging the supplies to be raised by the hoisting crane at the SE corner, or by increasing the lifting capacity of the bridge crane at the south side of the Parthenon to 7,5 tons and by increasing its height.

The marble-cutter of the Parthenon work-site. Photo, S. Mavrommatis, 2002



Pantograph for the construction of new marble fillings from mouldings in the Parthenon work-site. Photo, S. Mavrommatis, 2002

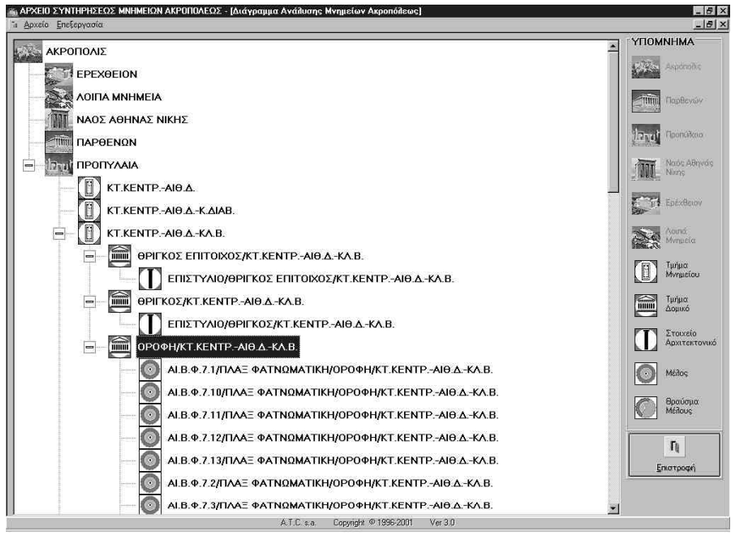
Finally, a dramatic improvement is expected in the time needed for producing new fillings in architectural members with the use of an entirely automated cutting and milling machine equipped with a laser scanner for scanning directly the surface to be copied. The use of casts can thus be eliminated. The acquisition for the work-site of such a scanner in the near future is being seriously considered.

Nikos Toganidis
Architect in charge of the Parthenon restoration project

In today's world it would be very difficult –if not impossible– to find a field of human activity that is not connected with information technology. Thus the activities of all kinds, involved in the Acropolis restoration projects, are, to a greater or lesser degree, applying technologies that have to do with computers.

Information technology came to the aid of the CCAM's restoration work quite early. Computer technology was already being used in drawing up the first restoration studies, where it was employed especially for determining and solving problems of static strength in the monuments. From the first prototypical application of this technology, computers were used in composing the special studies for combining, identifying and discovering the original position of the architectural members of the monuments that were still lying on the ground, whether preserved entire or in fragmentary condition. Examples are provided by the blocks from the side walls of the cellas of both Erechtheion and Parthenon and blocks of the Propylaia's coffered ceiling.

Indeed the use of information technology provides a very helpful base for studies of this sort, in that measurements and classification of the material being studied can be systematised according to predetermined criteria. This provided the point of departure for the work that followed. Fundamental was, and continues to be, the ability of scholars working on the material to utilise, compare and connect the various features of these ancient marbles on the basis of their own knowledge, experience and familiarity with the ancient members, the traces of all kinds preserved on them and their original form and arrangement.



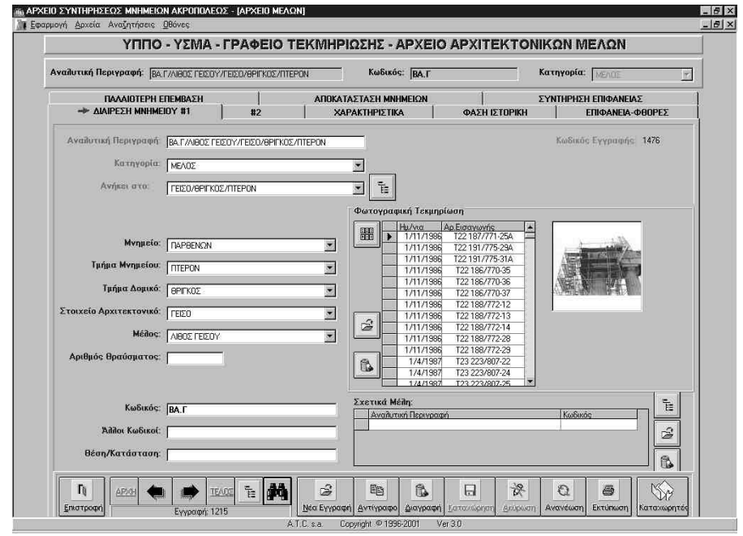
Panel showing the analysis of the monuments in the data base for the documentation of the Acropolis restoration work

Information technology has been utilised primarily for handling the documentation of the work. As we know, systematic documentation of all phases of the work is one of the main and most significant features of the restoration now being carried out on the Acropolis. This documentation comprises records in daybooks, drawings –surveys of the state of preservation of the monuments, plotting of damaged areas of the surface, drawings of new metal reinforcements or of marble additions to ancient members, plans and drawings of work-site installations and mechanical equipment– and systematic recording of the works by photography and cinematography.

By 1987 already, when restoration work on the Erechtheion had been finished, the documentation compiled was enormous. It was evident that this collected information must be available and accessible by automated means. The computer programme Sigmini was used for establishing the first data base for documenting the Acropolis restoration works. The programme had been developed by the École des Mines de Paris and the Union Minière of Belgium. Sigmini was chosen in 1987 because with it a single data base could be created that could handle all types of documentation, providing a graded organisation together with association of information. The data base for documenting the restoration of the Erechtheion was established with the Sigmini programme.

For computerisation of the documentation of the rest of the Acropolis works, it was decided to change the programme. The reason for this was that Sigmini –a university programme, which was not developed further– could not be adjusted to the new capabilities provided by the further development of computers, the data bases of which could now handle pictures and graphic material. With the acquisition of new applications, a unified data base was created, based on analysis of the monuments themselves and on information from the restoration documentation, which is more directly connected with the architectural members of the monuments.

This new data base, developed by the Athens Technology Centre (ATC), comprises three interconnected archives: architectural members, photographs and drawings. The archive of architectural members is arranged in order going from the whole (the monument) to the separate architectural member. In the archive of architectural members, every entry is accompanied by groups of thematic sections describing the member and its position in the monument as a whole, the characteristics of its construction, the traces preserved of its history, the preserved traces of earlier interventions, features and damage on the surface of the marble, the present structural restoration of the architectural members and the conservation of the surfaces of the monuments. The photographic and drawing archives, apart from the usual analyses and documentation, include also the pictures in digital form. These archives are directly connected with the archive of architectural members.



File from the archive of the architectural members accompanied by the relevant photographic records in digital form. Data Base for the documentation of the Acropolis restoration work

With the correlating ability of the programme, all documentation, according to its contents, can be connected with every bit of relevant information in the above thematic sections. The advantage of the new organisation of the data base is evident, since it can present the architectural members or larger sections of the monuments together with their entire documentation, both as a picture and as information held in the data base. Thus the documentation entered in the computer is directly related to the performance and development of the interventions. The data base itself is a powerful tool for monitoring and supporting the works, useful for both the engineers and the conservators. As examples, some of the capabilities of the data base are: immediate retrieval of information (together with relevant pictures) connected with existing photographic and graphic documentation of the members, monitoring stages –whether complete or in process– in the interventions on members receiving conservation or structural restoration, immediate retrieval of information about the particular structural features and damage to architectural members, all data that are of basic importance in putting together the studies for intervention on the monuments.

The data base has recently been installed at the work-sites of the monuments so as to make full use of its possibilities. In 2001, personnel were added with special training in computerising in situ newly acquired documentation and the daybooks of the work as it progresses. Installing the data base at the work-site was possible by connecting the technical offices of the monuments on the Acropolis Rock to the supporting services at the YSMA offices down below. This was done through the establishment of a computer network, incorporating radio links.

During recent years the use of information technology is the rule in all branches of the work done by the YSMA, in the technical offices of the work-sites, at the secretariat, in the educational programmes section, in the accounting office and in the photographic laboratory. With the installation of the network, computerisation was greatly enhanced. The result is that in the framework of the YSMA some forty computers are working at present with all kinds of programmes, ranging from word processing, computerisation, accounting of funding and salaries, management of the storeroom to the processing of pictures, computer graphics or programmes for calculating static efficiency.

Recently the YSMA computer system was connected to the ODYSSEUS network of the Ministry of Culture. This has facilitated direct communication with the services of the Ministry and has made possible full exploitation of the computerisation programme of the YSMA secretariat. Finally, in the framework of this network connection, a special accomplishment is the YSMA web site, completed in March 2002.

Yiannis Alexopoulos
Information Technology Specialist
Documentation Office of YSMA

The Work of the Acropolis Restoration Service during the Year 2001

This year too, I wish to thank the Friends of the Acropolis* for the opportunity they have provided me to make a brief yearly report on the works carried out by the Ministry of Culture on the classical monuments of the Acropolis Rock. And to start with, I thank likewise all who have taken part in any way in carrying out this project.

The restoration of the Parthenon pronaos. General view from the W. Photo Ch. Bouras, 2001

The year 2001 was significant indeed for the Acropolis. This is due to the productivity of the Acropolis Restoration Service in its new form, to decisions taken in the year 2000, to the securing of funding and especially to the enthusiasm and diligence of the entire staff. Let me remind you that with the publication of a Presidential Decree in May, 1999, the Acropolis Restoration Service (YSMA) was established. This was in fact the prerequisite for both a rational system of organisation and administration of the works and the establishment of economic motivation for increasing productivity. Continuous, unhindered funding was guaranteed by the 3rd European Community Support Framework. For the inclusion of the Acropolis programmes in this framework, as well as for understanding, direct interest and continuous support of our efforts, we owe thanks to the Ministry and its General Secretary, Mrs. L. Mendoni.

The Committee for Conservation of the Acropolis Monuments (CCAM) has the scholarly responsibility for the works carried out on the Acropolis; it supervises the work and directs it. The members are: Professors Th. Skoulikidis, V. Lambrinoudakis, P. Themelis, C. Syrmakezis and M. Korres, also the Ephor of the Acropolis Mrs. A. Choremi, the Ephor Emerita Mrs. E. Touloupa, the Directors of the Ministry of Culture N. Valakou, D. Giraud, N. Minos and the present speaker. Mr. E. Kakavoyiannis took part also for a number of months as director of the Ministry of Culture. The term of the Committee was renewed last June with only one change, Professor G. Despoinis, who retired, was replaced by the Ephor of Antiquities A. Mantis. During 2001, our Committee met in session twenty-five times and met the requirements of an independent service thanks to the efforts of the secretariat and, of course, the secretary Mrs. Maria-Xeni Garezou. To her we owe the drawing up of the extensive minutes of each meeting, which makes yet another weighty tome for 2001. I must note that during the past two years collaboration between the Ministry and the Committee with the 1st Ephorate of Prehistoric and Classical Antiquities and, to be sure, with the Ephor Mrs. Choremi and with Mr. Mantis has been harmonious, pleasant and productive. And for this I thank them.

Cutting the fluting on the 3rd (from N) column of the Parthenon Pronaos. Photo ChBouras, 2001

We have already mentioned the reinstatement of a productive system for executing the works successfully. In applying the Presidential Decree, a pyramid of jurisdiction and reponsibility was created. This has worked very well during the past year, directed from September 2000 on by Mrs. Maria Ioannidou, a civil engineer with twenty-five years of experience in the Acropolis works. The CCAM owes special thanks to Mrs. Ioannidou for her zeal, for her hard work and for her continuous efforts in administrative and economic matters. At the same time she pursued her work in her own technical field with equal productivity. We note especially her coordination of the work groups, her reports to the Committee and her drawing up of the extremely complex tables and reports demanded by the European Community in connection with the 3rd Community Support Framework.

In addition to the architects and civil engineers taken on during the year 2000 with a seven-year contract, new personnel was added this year, with shorter contracts, to handle the increased needs of the big work-site of the Acropolis: the architects V. Manidaki and A. Papandropoulos, the civil engineer V. Paschalidis and the archaeologists E. Petropoulou, E. Karakitsou, E. Kaïmara and A. Leonti. Mrs. A. Mertzelou took on the position of head of the accounting office. There are at present some 230 people working in the Acropolis Restoration Service (YSMA), 15 engineers, 8 archaeologists, 89 marble technicians, 44 workmen, 30 conservators, 8 cast makers and 36 assistants. The possibility of hiring a large personnel, of programming part-time work outside the Acropolis and of paying for over-time have finally guaranteed the meeting of scheduled deadlines, completion of the works and the covering of depreciation in value of machines that have already been purchased.

In order to complete the organisation and to improve the performance of all those people, in 2001 it was proposed to draw up a code which, on the basis of the Presidential Decree, the Civil Service Code, and the experience of members of the CCAM, would define the functions, procedures and duties down to the last detail. The arduous task of compiling this was undertaken by the secretary Mrs. M.-X. Garezou and the extensive text that resulted is now in the stage of review and supplementation by the Director and members of the Committee.

Here I must bring to an end this description of means and ways and proceed to the matter itself, to the activities and actual interventions on the monuments of the Acropolis during 2001.

I shall review briefly a number of things that are already known about the nature of the works and the method. The rusted reinforcements from earlier anasteloses are removed, the structural function of the marble members, which had been disturbed for many reasons, is restored, by placing again in the monuments architectural members that had fallen or been removed. Finally, the surface of the marble, where damaged by atmospheric pollution, receives conservation. In order to accomplish this, all parts of the monuments that had earlier been restored are dismantled, cracks and breaks are repaired, the pieces are filled in where necessary and the process is completed by restoring the members to their original positions.

Three "fronts" have been opened in the Parthenon with an extensive programme of research and study.The experienced architect N. Toganidis, is in charge of this. Collaborating also are three other architects (R. Christodoulopoulou, L. Lambrinou and A. Papandropoulos) and two civil engineers (M. Mentzini and E. Toubakari). I must note that all, and especially Mr. Toganidis, made superhuman efforts in furthering the works of this year in the Great Temple.

Continuing in the pronaos is the anastelosis programme that had been devised by Mr. Korres and which scheduled the restoration of nineteen column drums, the addition of twelve completely new drums and the anastelosis of their architrave. The construction or restoration of two Doric capitals proved to be very time consuming and dismantling the sixth (of the last column to the S, which had been restored in the manner of N. Balanos) raised new, unpredicted problems. The result of all this has been a delay of many months in the pronaos project. It should also be noted that the fluting has not been made either in the new column drums or the restorations. These will be carved at the end, with the column drums in situ despite the fact that the temporary appearance of the columns without fluting and without

Filling a capital of the Parthenon pronaos with new marble. Penultimate phase of the work. Pho - to Ch. Bouras, 2001

Dismantling the entablature of the Parthenon N colonnade.
Photo C. Karanasos, 2002

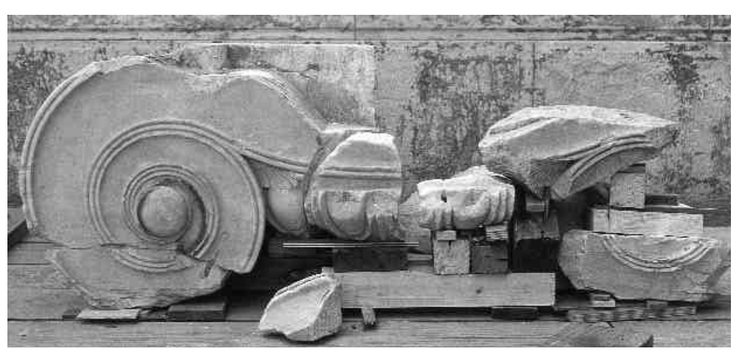
Dismantling the cornices of the Parthenon N colonnade. Photo Ch. Bouras, 2001

patina, especially along the west side of the pronaos, may somewhat offend the viewer.

Special advisor for the opisthodomos is the architect P. Koufopoulos, who has specialised in the restoration of ancient monuments. He made the relevant study that was accepted by the Central Archaeological Council many years ago. After the removal of the Pheidian frieze and the stabilising of the cracked columns by injections of a special compound, the systematic restoration of the overlying members of the frieze has now been finished after a period of four years. There remains the restoration of the architrave and column capitals, the setting in place of copies of the frieze and completion of the work with the resetting of all the members including the beams that supported the coffers.

Mr. Koufopoulos and his colleagues have already dismantled the entire architrave, beginning in March of last year. Unfortunately they are in bad condition as a result of the ancient fire, the explosion of 1687 and various earthquakes. It is sufficient to note that one of the architrave blocks was found in 18 large and 80 small fragments. The tasks of recording the evidence (by Mrs. R. Christodoulopoulou), removing Balanos' rusted clamps and mending, with accompanying small restorations, are already under way but will not be finished quickly. Likewise found to be in poor condition are the column capitals beneath, two of which contain inserted metal pieces from the Balanos intervention (1899) and two others have large pieces missing altogether that will have to be restored. The problems are multiplied when we consider the small working space available, the necessity of moving the derrick crane and the necessity of pursuing special research on the stability of the columns and the material for making copies of the frieze, undertaken by Mrs. Toubakari.

The third extensive programme in the Parthenon is being carried out along the north side of the building. The part of the colonnade restored by Balanos at the beginning of the decade of the 1930's, is now ready to collapse not only because of the rusting of beams and clamps, but also because of the surface disintegration of the drums that were made of cement. The restoration study had been made in 1997 by Mr. Costas Zambas, then director of the YSMA. It was approved by the Central Archaeological Council in 1998, but was only in 2000 included in the programme to be carried out, again by decision of the Central Archaeological Council. This is a very serious and thorough work calling for supplementary studies especially of the entablature, the elaboration, by Mrs. Lambrinou, of a complex programme of dismantling and reconstituting the eight columns (in such a way that impression of lowering the colonnade would be reduced) and for increasing the mechanical equipment in the work-site. Thus two more tables for mending large architectural members were ordered, a big elevated platform was made in the cella and yet another crane was purchased. This was installed in the north side of the temple thus resolving the problems of moving architectural members safely. Archaeological research on the passageway in which the crane was to move was carried out first, together with a survey of the Rock, with the valuable help of Professor Manolis Korres. The crane was set in place between July and September and last October dismantling of the cornice ("geison") began. Special arrangement for safely suspending the members with cracks was worked out by N. Toganidis. A range of electrical machinery was used for accurately cutting the filling pieces, with cutters, disk-saws and so forth under the guidance of the mechanical and electrical engineer, S. Oikonomopoulos. The photographs of the cornice (geison) blocks that were taken down bear witness to the unacceptable damage these members suffered, seventy years ago, in order to fit them into the building.



Assembling fragments of an Ionic capital of the Propylaia. Photo T. Tanoulas, 2000

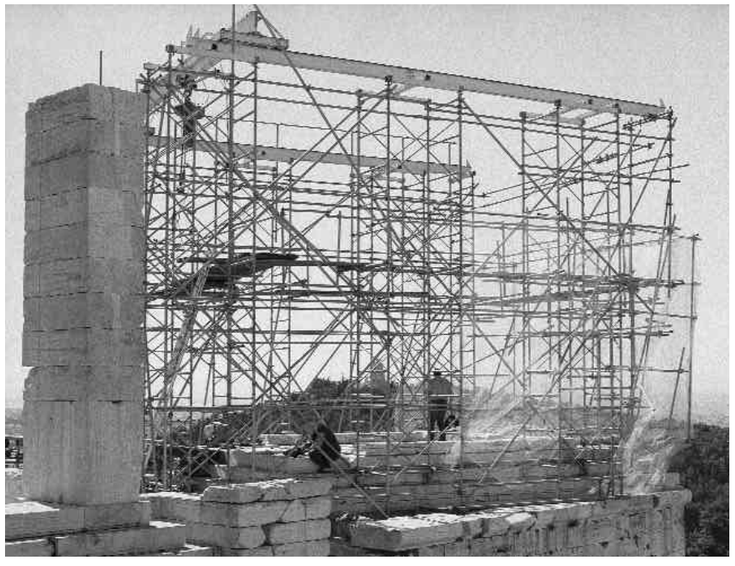
Completed with very satisfactory results during this past year was the research programme for matching the wall blocks in the restoration of the south wall of the cella. The programme had been advanced by N. Toganidis and it was now carried through to completion with the valuable cooperation of the architect Mrs. C. Paraschi. During the present month it will be presented to the CCAM and then to the Central Archaeological Council for final approval.

A change was made in the work on the Propylaia: beginning last March, the architect T. Tanoulas was appointed as director, given the overloaded schedule of Mrs. Ioannidou, who had been director up to then. Working also on the Propylaia are the architect C. Karanasos and the civil engineer V. Paschalidis. Author-

The S wall of the E stoa of the Propylaia restored. Photo C. Karanasos, 2001

The restoration of the ceilings of the central building of the Propylaia. Above: as restored by N. Balanos; below: proposal for the new restoration. Study by M. Ioannidou and T. Tanoulas, 2000

isation had already been given for the project in 2000. Expansion of the infrastructure, however, was greatly needed in order to begin dismantling part of the six-column interior colonnade of the building. The scaffolding inside the central hall was extended in order to take down all the members of Balanos' anastelosis that still remained there, as well as in the east stoa toward the interior façade. A new table was set up for mending large architectural members, a new and stronger bridge crane was acquired, the workshop and offices were enlarged and a system for storing the architectural members of the Propylaia that cannot be reset in the building was devised. From the practical standpoint, finished in May were both the restoration of the southeast corner of the central building and the stabilising and conservation of the central lintel of the Propylaia, which, as noted last year, was done in situ. The actual programme of restoring the large beams and architrave blocks of the central hall is progressing.



The "crepis" and the scaffoldings of the temple of Athena Nike after its complete dismantling.
Photo Ch. Bouras, 2001

A continuous concern of those in charge of work at both the Parthenon and the Propylaia is the finding of marble suitable for restoring and for making new architectural members. Fortunately, in 2001 marble was found in the Dionysos quarries that is of suitable quality and obtainable in large pieces; the process of supplying the marble is under way. A successful search was initiated for suitable outside workshops in order to speed up the cutting of new members and additional pieces for restorations. As part of this ouside collaboration, it was decided to make two copies of Ionic capitals that are needed for restoring the ceiling in the central building of the Propylaia. As for the column capital used by Balanos, which, as you know, was made up of four quarters all taken from different capitals, it was restored, joined with many other fragments of similar ones and kept for exhibition in the new Acropolis Museum.

The problems of the little temple of Athena Nike have been presented repeatedly. The total dismantling that began in 2000 was finished last December. In charge of this intervention is Mr. D. Giraud, Director of Anastelosis of Prehistoric and Classical Monuments of the Ministry of Culture and responsible for the study made for the work. Other members of the group are the architect C. Mamaloungas, the civil engineer D. Michalopoulou and the archaeologist E. Lebidaki. The problems of the little temple of Nike that confront us today concern mainly its conservation. After three dismantlings and two rebuildings, the architectural members are seriously damaged, have useless incisions and metal supports, small pieces have been cut off and, especially, cement plaster has been added that is very difficult to remove. There is also a problem of space because scaffolding cannot be erected west of the temple, outside the bastion on which it stands. The present programme includes, in addition to conservation of the architectural members, a study for correcting the errors in positioning the members made during earlier interventions and replacement of the slab of reinforced concrete that surrounds the temple area.

The Erectheion lies outside the jurisdiction of the YSMA. This year, however, the Committee was involved because there are four small programmes that for years have not been carried out, to the detriment of the monument's appearance. By agreement with the 1st Ephorate and with the direction of M. Korres, the architect V. Manidaki undertook these four subjects and presented studies for three of them: a) in the interior of the cella of the temple inert material will be used to form a neutral flooring. The work has been postponed so that systematic conservation of the lower parts of the side walls can be carried out first by the conservators, work already under way, b) in the Pandroseion, a number of architectural members remain supported on a temporary scaffolding and the lower sections must be restored so that they can be used. The relevant study has already been approved by the Central Archaeological Council and the necessary funding is awaited, c) above the coffers of the north porch, the double pitched roof has to be restored, evidently of modern material, in order to protect them from rain. The study has been approved by the Committee and approval is awaited from the Central Archaeological Council. Finally, d) the little sheltered courtyard north of the temple was in antiquity paved with slabs and it is suggested that this be restored. The work has been postponed as not urgent.

The archaeologist C. Kissas, with a small team, is continuing the recording, classification and referencing of the thousands of scattered fragments that cover the Rock and for a long time have lain in stone-piles. In February 2001, the Committee decided on the reestablishment of a system of recording the scattered fragments and gave directions for specific groupings (such as the large poros column capitals of the "Archaios Naos" (Old Temple), some of which have been delayed by the continuous occupation of the team with their main work. Raised again with much urgency during this year was also the question of protecting the inscriptions which are still outside in the open air. As we all know, some of the inscriptions can no longer be read because of surface erosion of the marble caused by pollution. In order to confront the problem, even if late, Mr. Kissas suggested building new storerooms on the Acropolis or below, at the foot of the Rock, while Mr. Korres returned to his old proposal of making large underground spaces in the ground of the Rock that had been excavated years before. Both proposals were rejected for many reasons by the Committee and finally, with the agreement of the General Secretary of the Ministry of Culture, Mrs. Mendoni, we returned to another of Mr. Korres' previous proposals, the utilisation of the Belvedere tower, which can be satisfactorily roofed. A second place in which fragile inscriptions can be stored is the north tower of the Beulé Gate, at the entrance to the Acropolis. This has been meticulously studied by the Director of Anastelosis of the Ministry of Culture, Mr.Giraud. Both these proposals are at present in process.

Related to the scattered members is also the problem of the rapid deterioration of the foundations of the smaller monuments of the Acropolis, such as those of the Arrephorion, which are made of crumbly poros and have remained exposed to the elements since their excavation. A study is already under way to cover them. The south Wall of the Acropolis is being surveyed, the work being entrusted since last June to a specialised topographer-engineer, under the supervision of Mr. Korres.

The subject of the surface conservation of the marble of all the monuments is being handled by the chemist-engineer Mrs. E. Papakonstantinou in close collaboration with Professor Th. Skoulikidis and with a large group of conservators and stone conservation technicians. A sub-committee under the presidency of Mrs. Choremi has been authorised to inspect and guide the work.

Block VIII of the Parthenon W frieze. Photo German Archaeological Institute at Athens, 1976

There are, and always will be, the usual tasks of conservation of all the monuments, priority being given to blocks that are taken down temporarily to receive stabilisation treatment, such as the architrave blocks of the opisthodomos of the Parthenon. We have already mentioned the conservation programme for the interior of the Erechtheion, which is being carried out under the guidance of the conservator Mrs. G. Frantzi. Another group is working on the Propylaia under the direction of Mrs. C. Babanika and yet another group is working on the temple of Athena Nike under the guidance of Mrs. A. Tsimereki.

In 2001, we believe that research of definitive significance was conducted on the most precious and fragile monument of the Acropolis, the Pheidian west frieze of the Parthenon. This unique composition, 20 metres in length, has remained since 1993 inaccessible to the general public in the conservation laboratory that has been arranged in the Acropolis Museum. Unfortunately, it cannot be exhibited in the condition in which it has survived. The unsuccessful earlier attempts at conservation and the thoroughly polluted atmosphere of Athens have considerable worsened the effects of natural phenomena and the ancient fire. Not only is general conservation necessary, but as a result the reliefs have also to be cleaned of pollutants and incrustation. The artistic and historical value of the frieze is so

great as to inspire reverential fear in those responsible for the conservation, they who have spent many years on research alone. At the end of 1999, the Central Archaeological Council approved three of the four methods of cleaning which Mr. Skoulikidis had decided on and in 2000 a research programme was inaugurated in the Foundation for Research and Technology (Professor C. Fotakis) for the application of the fourth method, with laser rays, improved for Pentelic marble and the special problems of classical monuments. Last June the results of this programme came in and they are very encouraging. Mr. Fotakis and his colleagues (Mr. V. Zafiropulos, Mrs. P. Pouli, Mrs. E. Maravelaki) asked that the relevant discussion be open to the public, in the form of a report. This was held under the supervision of the secretary M.-X. Garezou, in the amphitheatre of the Ministry of Culture, on the 28th of June. Speaking at this scholarly meeting in addition to the above were Mr. Skoulikidis, the director of the conservation section Mrs. E. Papakonstantinou, and the conservators Mrs. A. Panou and Mrs. C. Frantzikinaki. The result was that the lazer ray method was accepted and a special machine was rented with which final tests would be conducted on parts of the Parthenon. We await the final report of the conservation section, to be submitted to the Central Archaeological Council. In the meantime, mortar, Meyer glue, useless nails from old interventions and so on, have been removed on a large scale from the blocks of the west frieze. We hope that after so much effort the method will be approved by the Council and that the modern technology of laser rays will allay hesitation and speed up the cleaning process so that in 2004 the west frieze will be the number one exhibit of the new Acropolis Museum.

Finally, we should note the presentation of an analytical report on the issue of biological causes of marble erosion on the Acropolis by three conservators, with relevant proposals for dealing with the problems.

Technical also is the work of the six-member team of cast makers. This work is carried out in the basement of the Centre for the Acropolis Studies (Weiler building) under the supervision of the archaeologist and ephor A. Mantis. Auxilliary but important work is being done also by Mr. S. Mavrommatis, who is making use of the modern digital technology and has made a great number of photographs of excellent quality for the publications that have appeared during the past year.

Conservation work on an "orthostate" block of the Parthenon south wall. Photo A. Panou, 2001

The archaeologist F. Mallouchou-Tufano is head of the documentation department, which has the data base (using modern electronic technology), the plans archive, the photographic archive, the film archive and the library. Working in the documentation office are also the information technology specialist Mr. Y. Alexopoulos and two administrative employees. During the past year the department catalogued, recorded and referenced publications including everything produced by the various researchers, studies, plans, photographs, films, photographic negatives and so on. Responsible work was done as well on coordinating the cinematographic documentation of all the Acropolis works. In addition during 2001, the general network system was completed with the installation of 35 computers providing wireless communication with both the top of the Rock and below it. In addition, the data base for documenting restoration works has been installed at the Parthenon work-site, the Propylaia and the temple of Athena Nike. New personnel were instructed in the direct recording of documentation at the work-sites of the Parthenon and Propylaia. Problems of all types with the computers of the service had also to be faced.

It was quite natural that during a year of intense activity in the work-sites, there should be renewed interest in publicizing and providing information about the work of the Service. So too with scholarly exchange between archaeologists in the same field and with technical experts. Under the supervision of F. Mallouchou-Tufano, the first number of The Acropolis Restoration News was circulated in July in both Greek and English. This is a news letter for the wider public which the CCAM had planned to publish for some time. During the summer a three language pamphlet was issued giving some information about the work being done. This was funded by the Archaeological Receipts Fund and it is distributed free of charge to visitors to the Acropolis. In November the little book The Work of CCAM on the Athenian Acropolis came out, with texts by C. Zambas and the present speaker, photographs by S. Mavrommatis, and the overall supervision of C. Hatziaslani. This too was published by the Archaeological Receipts Fund and is to be brought out also in English and in German. It is addressed to the numerous Acropolis visitors. Also intended for general information is a web-site to be established by the Acropolis Restoration Service on the Internet through the network of the Ministry of Culture. This has been composed with great care by the secretary M.-X. Garezou, with excellent photographs by S. Mavrommatis. It will also appear in English and it is now in the final stage of preparation by the Ministry. Likewise released in 2001, under the scholarly supervision of F. Mallouchou-Tufano, is the film The Erectheion and Time, under the direction of A. Dracopoulou. The film shows the history of the monument through time including its recent restoration, the first intervention carried out by the CCAM (1979-1987).

Scholarly reports on the Acropolis works were given in 2001 by F. Mallouchou-Tufano in Florence and by N. Toganidis in Madrid. C. Hatziaslani spoke at the National Technological Centre on the use of visual material in school libraries. An interview with F. Mallouchou-Tufano and G. Alexopoulos on the subject of the CCAM data base came out in the periodical Archaeology and Arts ("Archaiologia kai Technes"). Decisions were also made on the publication of a number of books, research for which was carried out in the framework of the service.

Of greatest importance is a decision made in May to hold the 5th International Meeting for the restoration of the Acropolis Monuments during the first week of October next. I note that the last such meeting was held in 1994 and that we have an obligation both to inform the international community of archaeologists and restorers about the intervention on monuments of universal impact and to exchange ideas with them about policy toward such monuments and about modern technology. With the assistance of the secretary M.-X. Garezou, the International Meeting has already been announced, funding has been requested from the Ministry and all those working on the material have been informed about the reports expected from them. In connection with this event, by agreement, there is to be a photographic exhibition at the Benaki Museum by Mr. S. Mavrommatis showing the works on the Acropolis monuments. For both we have the accord and encouragement of the political leadership of the Ministry of Culture.

The department of information and education is directed by the architect-archaeologist Mrs. C. Hatziaslani, assisted by Mrs. E. Kaïmara and Mrs. A. Leonti. During 2001, educational programmes about the Acropolis were carried out in 102 classes of students. Museum kits and educational folders were distributed to 245 schools. These served some 16,000 children. The museum kit with the Parthenon frieze travelled to 52 schools in Cyprus. In May an one-day session was attended by 155 educators at which 17 papers were read, now published in the Proceedings. In cooperation with the Union of Art Teachers, an exhibition was organised in the Municipality of Athens, in which 20 schools took part. Another was held in the Municipality of Byron with the participation of 19 schools.

General Information publications on the Acropolis restoration of 2001

The new museum kit "Let's go to the Acropolis" produced by the Information and Education Department of the Acropolis

At the same time, the department prepared four new museum kits in quantity. Two of these (Let's Go to the Acropolis and An Ancient Temple) were funded by the Stavros S. Niarchos and the Bodosakis Foundations, assisted also by the Friends of the Acropolis. Exhibitions of these new museum kits were held at the Centre for Acropolis Studies, the "Gaia" Museum in Kifissia and at the International Exhibition at Frankfort. It should be noted also that the educational folder The Twelve Gods was chosen by the Educational Institute for a pilot programme to be run in 200 schools. Finally, the department published new books: An Ancient Temple and The Frieze of the Parthenon, a photographic assembling of the frieze arranged by S. Mavrommatis. These were published also in English.

As has already been noted, during 2001, earlier ideas and studies were put into practice. It was a productive year with very few theoretical problems, and those confined to surface conservation. Let us hope that the October 2002 International Meeting will provide an opportunity again for profitable discussions on all subjects connected with the restoration of the monuments, and that this, together with the new Acropolis Museum, will renew international interest in the monuments of the Rock and the classical past of Greece and Europe.

Professor Emeritus
Charalambos Bouras
President of the Committee
for the Conservation of the Acropolis
Monuments

* Report read at the meeting of the Friends of the Acropolis on 20 February 2002.

5th International Meeting for the Restoration of the Acropolis Monuments
4-6 October 2002

Friday 4 October 2002
Morning session: General information about the works

8.30 am Registration
9.00 Greetings
9.30 Inaugurational Speech by M. Ioannidou, Director of YSMA

General view of the N colonnade of the Parthenon from the SW. Photo S. Mavrommatis, May 2002

9.50 Inaugurational Speech by A. Choremi, Ephor of Acropolis
10.10 Inaugurational Speech by Ch. Bouras, Prof. Emer. President of CCAM

11.00-14.00 Visit to the worksites of the monuments of the Acropolis

Afternoon session: Issues relating to the surface conservation of the Acropolis monuments in general and, especially, to the conservation of the Parthenon west frieze.

17.00 Th. Skoulikidis, Methods for the conservation of pentelic marble
17.30 C. Babanika-G.Frantzi-A. Panou-A. Tsimereki, General survey of the conservation work on the monuments and sculpture of the Acropolis
17.50 E. Papakonstantinou-C. Frantzikinaki, Assessment of the cleaning methods proposed for the west frieze
18.20 P. Pouli-V. Zafiropulos-C. Fotakis, Combination of IR and UV laser pulses for cleaning sculptured surfaces: preliminary tests for the West Frieze of the Parthenon
18.40 Chr. Vlassopoulou, The conservation of the Parthenon West Frieze: an archaeological perspective
20.30 Inauguration of the photographical exhibition of the Acropolis Restoration Works in the Benaki Museum. Reception.

Saturday 5 October 2002
Morning Session: Recent research and work in the Parthenon.

9.00 am N. Toganidis, The restoration projects of the Parthenon in progress
9.30 P. Koufopoulos, The restoration project of the Parthenon opisthodomos
9.45 R. Christodoulopoulou, Restoration work by N. Balanos in the opisthodomos of the Parthenon
10.00 E. Toubakari, Structural restoration of the architectural members of the opisthodomos
10.15 N. Miltiadou-E. Papakonstantinou-C. Zambas-A. Panou-C. Frantzikinaki, Structural restoration of the columns of the opisthodomos with injections of highly penetrating hydraulic mortar: research and application

10.30 Coffee

11.00 C. Zambas, Proposal for the restoration of the north façade of the Parthenon.
11.30 L. Lambrinou, The entablature of the north façade of the Parthenon: identification of architectural members and repositioning of the cornices
12.45 C. Paraschi-N. Toganidis, Proposal for the restoration of the Parthenon south wall
13.15 N. Toganidis-Kl. Matala, Proposal for the restoration of the Parthenon north wall
13.30 M. Mentzini, The comparison between the fracture levels, the orientation and the geological stratification of the architectural members of the Parthenon. Case study: the 6th column of the pronaos

13.45 Questions-Comments

Afternoon session: Recent research and work in the Propylaia. Mechanical and electrical equipment of the monuments worksites.

16.30 T. Tanoulas, The restoration project of the Propylaia in progress
17.00 M. Ioannidou-T. Tanoulas, Proposal for the restoration of the superstructure of the central building of the Propylaia
17.30 C. Karanasos, Restoration of the blocks of the superstructure on the south wall of the western hall of the Propylaia
17.45 T. Tanoulas, Recent indentifications of architectural members of the Propylaia

18.00 Coffee

18.30 M. Ioannidou-V. Paschalides-M. Mentzini: Restoration of ancient beams with titanium reinforcements: a new approach
19.00 Sp. Oikonomopoulos, Specific requirements concerning the mechanical and electrical equipment of the worksites of the Acropolis.

20.15 Projection of the film "The Erechtheion and Time" (in Greek and in English)

Sunday 6 October 2002
Morning session: Recent research and work in the temple of Athena-Nike. Activities of the various departments of the YSMA and archaeological issues.

9.00 am D. Michalopoulou, The restoration project of the temple of Athena Nike
9.15 D. Giraud-C. Mamaloungas, New conclusions on the dimensions of the temple of Athena Nike
9.30 D. Giraud, The positioning of the blocks of the frieze of the temple of Athena Nike
9.45 F. Mallouchou-Y. Alexopoulos-E. Lembidaki, The documentation of the Acropolis restoration works and its computer-controlled management
10.00 C. Kissas, The work of inventorying, documenting and organising the scattered architectural members on the Acropolis plateau. The future of the scattered ancient blocks on the Acropolis

10.15 Coffee

10.45 M. Korres, Restoration and final presentation of the Acropolis plateau
11.15 V. Manidaki, Proposals for the restoration of the Pandrosseion and the Arrephoreion
11.30 A. Choremi, 1995-2002: Archaeological research on the Acropolis
12.00 A. Mandis, Copies in artificial stone of the architectural sculpture of the Acropolis monuments
12.30 C. Hatziaslani, The work of the Acropolis Information and Education Department

12.45 Questions-Comments

16.00-20.00 Afternoon session: Discussion and Conclusions, general and specific, of the Meeting.

Specific session on conservation

Sunday 6 October 2002
9.00 am D. Damianos-Ch. Laskarides-G. Marakis-M. Naka-E. Tzoumousli, State of preservation of the Parthenon architectural members: pronaos, opisthodomos, north façade
9.15 C. Babanika-E.Frangiadaki- E. Georgiou-F. Katevas, Conservation work in the Propylaia
9.30 A. Hatzipappa-M. Loukma-A. Tsimereki, State of preservation of the architectural members of the temple of Athena Nike
9.45 G. Frantzi- D. Garbis-A. Maridaki, The conservation programme of the Erechtheion
10.00 A. Panou-C. Frantzikinaki, Structural restoration and conservation work on the Parthenon west frieze

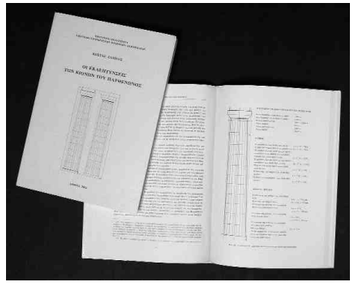
10.30 Coffee

11.00 V. Zafiropulos-P. Pouli-K. Fotakis, Combination of IR and UV laser pulses for cleaning sculptured surfaces: Laser ablation mechanisms
11.20 Discussion of specific issues: a) coating of the monuments' surfaces, b) biodeterioration problems, c) conservation of poros stone

12.30 General discussion – Conclusions

The new publications of the CCAM

Just published:
• C. Zambas, Refinements of the columns of the Parthenon, Athens 2002 (in Greek with an English summary).
• C. Zambas, Study for the structural restoration of the North façade of the Parthenon, Athens 2002 (in Greek with an English summary).



The study of the refinements of the Parthenon columns by C. Zambas

In press:
• M. Korres, Ancient column construction.
• T. Tanoulas-M. Ioannidou, Study for the restoration of the superstructure of the central building of the Propylaia.
• C. Paraschi-N. Toganidis, Study for the restoration of the south wall of the Parthenon.
• E. Papakonstantinou-K. Frantzikinaki-A. Panou-P. Pouli, Study for the cleaning of the Parthenon west frieze.

Prize awarding to a film of YSMA

The Prize for the Best Film Script has been awarded to The Erechtheion and Time, a film produced by YSMA in 2001, written and directed by A.Dracopoulou under the scholarly supervision of F. Mallouchou-Tufano. It was given at the 4rth International Meeting of Archeological Films of the Mediterranean Area "AGON", organized in Athens by the magazine "Archaeology and Arts", from the 16th-19th May 2002. The 25′ film is dedicated to the memory of A. Papanikolaou, architect in charge of the restoration of the Erechtheion, carried out from 1979 to 1987 under the scholarly supervision of the CCAM.

In praise of the marble-cutters of the Acropolis
The Medal of Honour of Europa Nostra awarded to Yiannis Arbilias

Yiannis Arbilias, marble-cutter technician, head of the crew of the Parthenon restoration programme from 1983 to 2000, was awarded the Medal of Honour of Europa Nostra/ IBI for 2000, «for having dedicated himself over 18 years to the restoration of the Acropolis of Athens, and the Parthenon, using his first-class craftsmanship, his impressive diligence, his love and respect for monuments and materials, his abilities to train and bring on young craftsmen, and his responsibility for and commitment to the principles of exemplary conservation."

Yiannis Arbilias was born in Athens in 1940. Coming from a family of marble-cutters, he began at an early age to learn the technique of stone-cutting from his father and grandfather. At the same time he studied drawing at the Diplareion Technical School.

In 1954 he began to be involved in restoration work on ancient monuments, among which were the rebuilding of the Stoa of Attalos and the anastelosis of the Odeion of Herodes Atticus, the theatre at Epidauros, the temple of Poseidon at Sounion, and the construction of a new coffered ceiling for the opisthodomos of the Parthenon.

In the following decades he was employed, as an independent professional, on ecclesiastical architecture and on modern sculpture, in collaboration with prominent sculptors. From 1980 on, he took part in the restoration of the Acropolis monuments, where, because of his extraordinary technical, artistic and organising abilities, he was appointed in 1983 as head of the restoration crew of the Parthenon. He held this position until his retirement in 2000.

As head of the crew of the Parthenon project he had direct responsibility, in cooperation with the engineers in charge, Manolis Korres and Costas Zambas, for a series of exceedingly difficult and complex operations. These included the installation of the hoisting crane of the NE corner of the Acropolis and the derrick crane inside the monument, the safe removal of hundreds of fragmented architectural members, the mending of their scattered pieces or their restoration in new marble, and the removal of architectural sculptures.

Carving a new marble filling in a "thranos" of the Parthenon opisthodomos.
Photo P. Koufopoulos, 1993

In carrying out his duties Yiannis Arbilias distinguished himself for the high sense of responsibility that guided him, his excellent and foresighted understanding, planning and organising of complex operations, which he executed safely and with great precision. Especially for his diligence, his integrity of character, his strictness coupled with his sense of fairness, his rare morality. He has made a significant contribution to progress on the restoration of the Parthenon and to the recognition and full appreciation of the profession of marble-cutting, setting a brilliant example for the emulation of his contemporary and younger colleagues.

The awarding of Yiannis Arbilias was suggested to Europa Nostra by the Committee for the Architectural Heritage of the "Elliniki Etairia", The Hellenic Society for the Protection of the Environment and the Cultural Heritage. The award was presented to Yiannis Arbilias by the President of Europa Nostra Mr. D. Cardon de Lichtbuer at a special ceremony, on 19 October 2001, at the Centre for the Acropolis Studies. The following were present and spoke at the ceremony: The Minister of Culture, Mr. E. Venizelos, the President of the Acropolis Committee Professor Ch. Bouras, the President of the "Elliniki Etairia" Mr. C. Carras and the President of the Committee for the Architectural Heritage Mr. A. Symeon.

In his talk, Prof. Bouras praised the contribution of the marble technicians to the Acropolis projects, referring to the continuous effort made during the past 25 years to attract and keep the best of those in a specialty which Greece feared might disappear: we achieved this to a satisfactory extent and the works are proceeding all according fully with the specifications of quality that we had demanded from the beginning. This we owe to a group of marble technicians who worked productively on the Acropolis, adapting to new technological methods, and taught the newly enlisted, thus reviving an old tradition of craftsmanship that is peculiarly Greek. As for the honour of the award to Yiannis Arbilias, this reflects on all who are participating in the Acropolis works: on the Acropolis, from 1975 until today, perhaps for the first time systematic studies have been made and theoretical principles followed for intervention on monuments of such great artistic and historical significance. Thousands of man-hours have been expended in the interest of making correct decisions and thousands of pages of theoretical speculation have been written. All that

would have remained empty words and drafting-room exercises without the collaboration of the technicians, without their inventiveness, their effort and their love of the ancient monuments. Today a pan-European organisation has honoured an exceptional representative of that group. And the honour is reflected not only on his colleagues, but on us too, who for many years had the privilege of working with him.

Award to Y. Arbilias on 19 October 2002

Expressing his thanks, the receiver of the award, Yiannis Arbilias, referred to his colleagues and to his predecessors as well: I feel that the honour you have given me is really an honour for the entire group of marble-cutters and especially those who are no longer living. One of them was my father. They were splendid artisans in both quality and quantity of production. They worked beneath the sun; they took the formless stone and gave it life. They remained in obscurity. As a rule they died in poverty. I believe the distinction you have given me goes back by right to those men. Let us hope that my award will mark a new beginning with full recognition for those who are following now this difficult and rare profession and for those who will come in the future.

Fani Mallouchou-Tufano
Archeologist, Head of the
Documentation Office of the YSMA

Y. Arbilias on the day of his awarding with his colleagues from the Acropolis and Professors Ch. Bouras and M. Korres. Friday, 19 October 2002

A workman's basket (zembili) attached to a wire rope, hanging from a wooden beam, was for many years the winch for hauling up the necessary supplies to the Acropolis. When, in 1975, the first work on conservation began, the wooden beam was replaced by a steel one and the system was upgraded with a pulley block.This was the method used for hoisting whatever was needed for the restoration of the Erechtheion, scaffolding, marble, titanium, plaster, even the copies of the Caryatids. With this improvised hoisting winch, placed at a point on the SE Wall, the materials were loaded into a little waggon that was pushed along rails by the workmen to the work-site. All this until 1983, when preparations were made for intervention on the Parthenon.

The great temple of Athena was not to be covered with scaffolding for the duration of the work, as was the Erechtheion. It had been decided, not without objection, that the necessary dismantling of the architectural members and their anastelosis was to be done with a crane, installed inside the cella. The order was placed, in accordance with the instructions of M. Korres, at Chambéry in France. In the meantime, another crane had been installed on the SE corner of the Wall, a hoisting crane of Greek construction following again the design of M. Korres. This was to hoist the French derrick crane to the top of the Rock. A forklift truck, gift of an English company, was hoisted first. This was to facilitate transport on the Rock. Like a toy the lift swung in the air and we watched it from above with awe. Yet our real agony was when a piece of marble weighing 12,5 tons had to be lifted. It was designated to replace the concrete lintel block over the west door of the Parthenon. We held our breath and breathed again only when we finally saw the valuable piece of marble resting safely at the end of the Rock.
Other tasks that had to be finished beforehand were to determine the static efficiency and to devise a protection for the marble floor in the Parthenon. After drill cores had been taken at a great depth, the floor surface was covered with layers of various synthetics and concrete. When the French

technicians brought the crane in sections, the members of the CCAM asked to have the first trials run on the level area below the SE corner of the Rock. The entire task of assembling and disassembling the machine took place in pouring rain and while the Frenchmen worked in their fine yellow waterproofs, our technicians, who had to learn how to run the machinery, were in their work clothes ... Everything went well and the big crane was hoisted up piece by piece, with the help of the corner crane and the forklift, to be assembled inside the Parthenon. While inspection and trials were being made by the technicians, we, the archaeologists, from time to time found a chance to go up, taking advantage of a metal cage that had been placed on the boom. We flew over the walls of the cella, once outside, once inside, once outside again close to the west frieze, like doves we flew ... until the CCAM forbad romantic flights of this sort.

Recently, when it was decided to begin work on the restoration of the north colonnade of the Parthenon, based on the study of the civil engineer C. Zambas, again we turned to the crane as a solution. The order for a third construction-site crane from the Potain company, was made through a representative in France. A dilemma arose as to whether the crane should be placed inside or outside the Parthenon. Placing it inside created a circulation problem with the other crane, ouside ... with the visitors. The second was considered preferable. People are astonished, they stop, they watch, they become accustomed to it ...

So how will the Acropolis seem when one fine day all the cranes have gone away?

Evi Touloupa
Ephor Emerita of the Acropolis
Member of the CCAM

www.culture.gr is the website of the YSMA. It was inaugurated last March.

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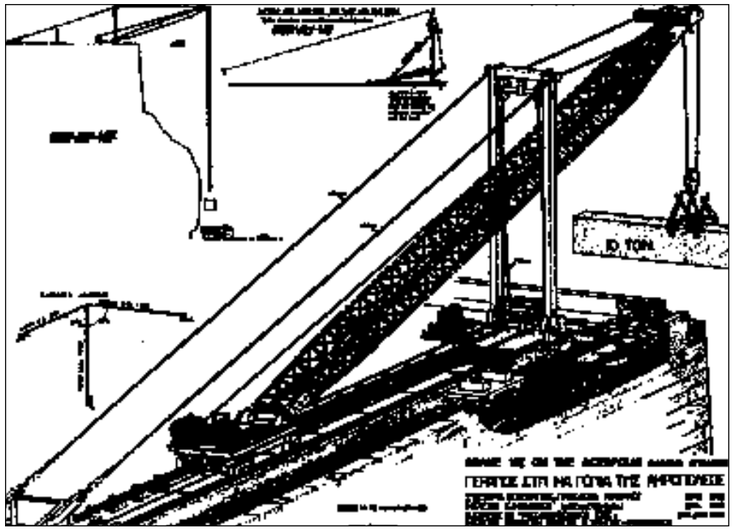

The crane on the SE corner of the Acropolis circuit Wall. Preliminary study and drawing by M. Korres, 1983

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