

A black and white photograph of the marble head of the Athena Parthenos, showing her face with a serene expression, wearing a helmet with a griffin's head on the side. The text is overlaid on the center of the image.

**INTERNATIONAL MEETING
ON THE RESTORATION
OF THE ERECHTHEION**

ATHENS 8-10/12/1977



SPONSORED BY THE MINISTRY OF CULTURE
AND SCIENCES AND THE UNESCO

INTERNATIONAL MEETING
ON THE RESTORATION
OF THE ERECHTHEION

REPORTS
PROPOSALS
CONCLUSIONS

ATHENS 8-10/12/77

INTRODUCTION

The critical condition of the Acropolis Monuments had already been noticed long ago. This statement led the Greek Government to create, on February 25, 1975, the "Working Group for the Preservation of the Acropolis Monuments", under the late G. Miliades, former Director of the Acropolis Ephory.

Initially the Group consisted of the following members:

- G. Dontas, Director of the Acropolis Ephory.
- Ch. Bouras, Full Professor at the Chair of History of Architecture, National Technical University of Athens.
- Th. Skoulikidis, Full Professor at the Chair of Physical Chemistry and Applied Electrochemistry, National Technical University of Athens.
- J. Travlos, Ph. D. Architect-Archaeologist.

Secretary: J. Chronopoulos, Ministry of Culture and Science.

G. Miliadis was succeeded, after his death in September 1975, by N. Platon, Professor Emeritus of Prehistoric Archaeology at the University of Salonica. The Working Group was completed with S. Angelidis, Full Professor at the Chair of Structural Mechanics of the N.T.U of Athens, the General Inspector of Antiquities — formerly D. Lazarides and recently N. Yialouris — and J. Demacopoulos, Director of the Restoration Service of the Ministry of Culture and Science.

The problems faced with from the beginning by the Working Group and its collaborators were:

- a. The stability of the Acropolis rock.
- b. The structural equilibrium of the monuments.
- c. Damages caused by the expansion of the iron clumps on the monuments, due to corrosion.
- d. Physical, chemical and biological deterioration of the monuments' surface.
- e. Dangers from eventual earthquakes.
- f. Dangers from vibrations caused by aircraft.
- g. Deterioration of the rock by the visitors' shoes.

Some of the above problems were already examined at the "2nd International Symposium on the Deterioration of Building Stones", organised in Athens on September 27 - October 1, 1976 by the Chair of Physical Chemistry and Applied Electrochemistry of the National Technical University, sponsored by the Ministry of Culture and Science; part of its proceedings was devoted to the Acropolis case¹.

1. See Proceedings of the International Symposium, pp. 259 - 352 as well as reprint "The Acro-

The following work has been accomplished or is being performed, in order to cope with those problems; the following people are taking or have taken part, alone or as members of subgroups, closely cooperating among themselves, directed by the Working Group:

W o r k

C o l l a b o r a t o r s

Exact scale drawings of the monuments, architectural research, constructional problems, restoration study:

Architects: B. Carcanis, M. Corres, A. Lazaridou, E. Moutopoulos, A. Papanicolaou, A. Tzacou, directed by Prof. Ch. Bouras.

Final arrangement of the Acropolis surroundings, classification of presently scattered architectural members:

Responsible of the study: J. Travlos, assisted by the architect T. Tanoulas.

Technical works, materialisation of the interventions:

Marble sculptors: G. Alibertis, J. Doucaros, M. Skaris, N. Skaris, Th. Skaris, G. Vidos, assisted by N. Vazaïos and N. Yassafacos and directed by Mr. G. Dontas and Mrs. M. Brouscari.

Statical, structural and constructional problems:

Civil engineers: M. Ioannidou, D. Monocroussos, K. Zambas, directed by Prof. S. Angelidis.

Physicochemical problems:

Chemical engineers: N. Beloyannis, D. Charalambous, E. Papaconstantinou, directed by Prof. Th. Skoulikidis.

Archaeological problems, problems of historical documentation:

Archaeologists: M. Brouscari, F. Mallouchou, directed by Mr. G. Dontas.

Geological and geotechnical problems:

Dr. Andronopoulos, Director of Technical Geology of the Instituts of Geological and Mineral Research and Dr. Geol. G. Coukis of the same Institute.

polis: Problems-Measurements-Studies-Measures to be Taken" (pp. 1 - 96, Athens 1976) containing the reports of the Working Group members on the above general subjects as well as the work accomplished by the Group up to then.

Problems of rock mechanics:	Dr. Eng. M. Arvanitakis, Erich Hackl, Johann Golser.
Analysis on special statical problems:	
a. Photoelastic simulation:	Prof. P. Theocaris, N.T.U.
b. Supersonic investigation of internal cracks in stone:	Prof. Th. P. Tassios, and Ch. Economou, N.T.U.
Gammagraphy of stone:	L. Hatziandreou, M.S. Ladopoulos, Centre of Nuclear Research "Democritos".
Study of climatisation of the Caryatids:	Mech. Engineers: A. I. Calabacas, Th. Protopapas.
Anti-pollution problems:	Prof. N. Coumoutsos, N.T.U.
Survey and architectural photogrammetric studies:	Directed by Prof. J. Bandecas, N.T.U.
Constuction of negatives and copies of the Caryatids:	Museum artists: Ch. Aletras, M. Coutsoyannis, G. Malamatidis, directed by the sculptor S. Triantis.

From 1976 to the end of 1977 the research of the Working Group and its collaborators was focused on the Erechtheion, aiming to give a report on its preservation and restoration. Thus was presented the "Study on the Restoration of the Erechtheion" in August 1977². This study, in accordance with the accepted scientific deontology and with the article 16 (publications) of the Charter of Venice, includes the analysis of the present state of conservation of the monument; detailed analysis of the southern and western sides and comprehensive analysis of the other two; it includes also a list of all kinds of deterioration observed on the monument; it proposes definite measures, in order to face the above problems. Thus, the necessity of a complete documentation of restorational and conservational interventions is satisfied. The study was published before any intervention on the Erechtheion would take place; thus, specialists were informed in time to perform instructive criticism and collaboration in an international scale.

It must be emphasised here, that more studies will be presented in the future, having as subject the rest of the Acropolis monuments, with the same degree of scientific responsibility.

2. Athens 1977, edited by the Ministry of Culture and Science. Reprints in French: "La restauration de l'Erechtheion" (résumé du texte grec en langue française pp. 373 - 476) and "La restauration de l'Erechtheion" (altérations physicochimiques - méthodes de protection du marbre p. 429 - 458 Athènes 1977).

Finally, the importance of the monument urged Greek authorities to organise the “International Meeting on the Restoration of the Erechtheion” in December 1977 in Athens, in order to have the proposals of the Working Group examined by specialists from all over the world. It must be noted that the specialists had received all the documents of the study long before the Meeting, being thus well aware of the problem.

THE INTERNATIONAL MEETING ON THE RESTORATION OF THE ERECHTHEION

The International Meeting, sponsored by the Ministry of Culture and Science and the UNESCO, took place in Athens, at the "Eugenidion Foundation" building on 8 - 10 December 1977.

Besides 90 invited congressmen, the Meeting was assisted by many more interested specialists, Greek and foreigners, as well as by press-representatives.

FIRST DAY OF THE MEETING, THURSDAY 8-12-77

Hall A. President: Prof. N. Platon

The programme of the first day was the same for all specialists (archaeologists, architects, civil engineers, chemical engineers) and included the reports of the Greek "Working Group for the Preservation of the Acropolis Monuments" and its collaborators, concerning the solutions of the various Erechtheion problems.

Welcome address of the Minister of Culture and Science G. Plytas

Ladies and Gentlemen,

It is a great pleasure and satisfaction for me to greet you upon your arrival to Athens, the birth-place of Democracy and Civilisation. I do not exaggerate, if I say, that the whole Greek people participate to this pleasure and satisfaction. This people as a descendant of glorious ancestors and an heir of these immortal monuments are well aware of the hard task of their safeguarding and preservation; this people are persuaded, that these valuable treasures, which constitute a great expression of beauty and moderation and the superb and undoubtable proof of the power and supremacy of human thought and sensibility, do not belong only to itself, but to the whole world. It is also well aware, that everything that is to be done, must be accomplished the soonest possible, correctly and efficiently and without any delay.

Continuous and persistent attack by nature as well as attack and intervention by man himself, either violent or contemptuous, together with the monster of pollution, which grows continuously and devours everything, all these together menace

with destruction this gem of all eras and generations, this monument, that had already become antique right by the end of its construction, as Plutarch refers.

What has not happened during 24 centuries, may well happen, as you know better than me, in a few years. The Parthenon, the Propylaea, the Erechtheion, with the magnificent Korae, are altogether like a sick, old man. According to a former expression of the President of your Symposium, this old man, unless supported and protected, has very weak strength and resistance. The disappearance of many surface details from the famous Korae, the Caryatids, is quite obvious, although their elegance and grace still remain; the danger emerging from sulfation has also become obvious; it might affect badly the statue of Cecrops, if it was not transferred to the Museum. In a word, fire, bombs, various uses during centuries, all those alterations upon these masterpieces, alterations from million footsteps on the floor and the Acropolis rock, not only have changed the composition of its monuments but menace with complete disappearance of important, archaeological information.

Ladies and Gentlemen,

The Greek State has done, does and will always do everything possible in order to cure this Great Sick. As you know, since 1975, i.e. soon after the restoration of Democracy, several coordinated measures were taken to achieve a radical and total remedy for this situation.

A Committee composed of specialists and archaeologists began to work using every new achievement of scientific research and experience; always obeying faithfully the Charter of Venice, it presented the first reports and conclusions concerning the safeguard of the monuments, to begin with the Erechtheion and its famous Korae. You are also aware about the possibility of a rapid and efficient purification of the atmosphere around the Acropolis, as well as of the establishing of a new Museum not far away, where sculptural parts in need of protection will be carried. Of course the Greek State will never cease to struggle with all its forces and all accessible measures; it needs, however, everybody's support as the task to be performed is tremendous. This is why we are happy to have the valuable support of the UNESCO in this effort, as was expressed by the General Director Mr. M' Bow in his address in this city, last January, and as is expressed in this Symposium.

It would be a serious mistake of my part, if I omitted to express once more my cordial thanks to this international organization, the UNESCO. However this support, as well as any other will not be worthwhile and efficient without your support, without your advice and your reports.

Ladies and Gentlemen,

You are well aware that the "2nd International Symposium on the Deterioration of Building Stone" in September 1976 devoted two special sessions to this enormous problem. The "Working Group for the Preservation of the Acropolis Monuments" gave by then very interesting reports. After two years of research, it arrived to definite conclusions and proposals concerning the Erechtheion and its Korae,

which constitute the subject examined by your Symposium. As you will see, many of the best scientists of our country have cooperated in this study. You will be asked to judge this work of theirs.

I do know, that aspects and postulates on such subjects always bring critics, criticism and many times perhaps disagreements; this is quite reasonable, I should say, because of the enormous importance of such a work. I am however sure that your Knowledge and your deep interest will help you to arrive to definitive and successful conclusions, so that our Services will be able to start the soonest possible with this great operation. I give myself the permission to remind you of the fact, that it is everybody's duty, not only of the Greeks but of the whole world, to safeguard and preserve very soon these great monuments. It is an obligation towards the people, whom we inherited, and towards the generations that will follow.

I wish also to remind you, that our Symposium takes place in a glorious moment of Archaeology. I mean the moment of discovery of the royal tomb in Vergina, with its most precious contents. The preservation of the immortal masterpieces of the Acropolis and their presence together with the findings at Vergina and those discovered some years ago in Santorini extend greatly, as you understand, our knowledge on history and development of mankind throughout the centuries; they also influence greatly the life of mankind in the years to come. The past has always been, to a certain extent, a support for the present and a guide for the future. It is with these thoughts, that I declare the beginning of your work, with the hope for the greatest efficiency and with the promise, that we will do everything possible, in order to achieve the best and fastest realization of your conclusions.

Thank you for your attention.

After the address of the Minister, another greeting by the former Minister Prof. K. Trypanis was addressed to the participants. Prof. Trypanis, who had greatly contributed to the efforts on the safeguarding of the Acropolis Monuments, excused himself for his being abroad, thus unable to assist to the Meeting.

Then the following **General Introduction** was given by Prof. N. Platon, President of the Working Group:

Eminent colleagues, dear friends,

As President of the "Working Group for the Preservation of the Acropolis Monuments" I would like to address a cordial greeting from us all and to express my warm thanks for the willing acceptance of the invitation of the Minister of Culture and Science for scientific cooperation on the serious problem of the necessary and absolutely pressing measures for the conservation and restoration of the Erechtheion.

This meeting was considered as absolutely expedient both by UNESCO and by the Minister in charge and by our Working Group, in order to take steps for the application of radical measures, concerning one of the most important monuments of the Acropolis. However, these measures should be discussed and examined by the competent specialists with greater profundity. The realization of the present

meeting is based on the spirit of universal cooperation, which was established by the Greek Government and UNESCO. The latter assisted, from the very beginning, the effort to make everything possible for the preservation of the Acropolis monuments, which constitute the peak of human creation. UNESCO proceeded, through an appeal made by its President from the Sacred Rock towards all nations, to invite them for scientific, moral and material assistance.

The Greek Government established two and a half years ago the Working Group, for the systematic organization and the detailed study of the task, and took a number of measures, upon suggestion from Prof. Trypanis, former Minister of Culture, disposing special monetary resources to the Working Group. The Prime Minister himself attended closely the effort and came to its aid. The Working Group proceeded with the systematic study of the special problems involved and organized its work through a technical office consisting of specialized scientists, archaeologists, architects, engineers and other specialized personnel.

The Minister Prof. Trypanis contributed in a great degree to the coordination of the work and secured the necessary structure, both managerial and technological. The central office and the special offices of the subgroups were established and housed through his aid. A great number of scientists gave their aid, either individually or as members of various institutions. The National Technical University of Athens obtained the cooperation of a large number of its professors and the use of its laboratories: of chemistry, mechanics, strength of materials, X-raying, photogrammetry etc; along with the assistance of other specialists, the "Democritos" Centre for Nuclear Research came to help in the task. The National Archaeological Museum placed at the disposal of the Working Group its specialized laboratories and the precious services of the Museum's artist Mr. St. Triantis. A large number of archaeological institutes and the foreign archaeological schools came to our help, notably the German Archaeological Institute. The British Museum helped in construction of the mould of the sculptures and of their copies. The technical equipment was completed with the appropriate means and with the purchasing of a strong cobalt source apparatus for the gammagraphy. The systematic attendance of the particular works was realized, through the cooperation of specialized scientists both in the Working Group and in the subgroups; scientists possessing particular experience or exceptional abilities necessary for the administering of the works. The first President of the Working Group, the late John Miliadis — Director of the Acropolis for a long period — contributed decisively to the systematization and the proper development of the work.

The Greek Government, in full cognizance of its responsibility for the preservation of the incalculable treasures of the Acropolis monuments, undertook to finance adequately the project, although, after the appeal of the President of UNESCO, abundant assistance came from all over the world with enthusiastic eagerness. At the same time a number of nations forwarded proposals for scientific and technical cooperation. As might be expected, the Greek Government accepted this world — wide assistance with gratefulness, believing, that the international, scientific and technical cooperation is quite indispensable for ensuring the application of measures

taken from the latest results of world science and technology. This is the motive underlying this first Meeting for the examination of measures proposed for the preservation of the Erechtheion. After hearing the opinions of the specialized scientists, the Working Group will proceed with a final introduction to the Archaeological Council; and this latter will undertake the responsibility for the measures to be decided, committing their realization to the Direction of Restorations, which will organize a special executive body to this end, functioning under the general control of the Working Group.

It is self-evident, that the main work of the group was of a research nature up to now, since the necessary documentation studies, special preliminary work, laboratory tests etc. in relation with the particular problems had not yet been completed. We must not forget neither the thorny course of the science of archaeology in our country, nor the almost insurmountable difficulties encountered by the Department of Antiquities, with its barely sufficient personnel and its limited technical and financial possibilities. The work, which was accomplished during all these difficult years by the Ephors and Directors of the Acropolis, the Directors of Restoration and the other special restorators, and indeed the work of the late N. Balanos, have to be considered as great feats. A stringent, subsequent criticism on the measures, that had been applied as urgent solutions, with the technical and material means of the time and lacking almost any assistance from without, is neither reasonable nor just. As a whole, the measures were of a preservatory character, and this in spite of the fact, that we can now discern — through the aid of modern techniques, the scientific progress and the incomparably greater possibilities — many of their short comings. One might deduce a mistaken conclusion from us all if, led astray from some exaggerated characterizations, that were included in the exposition of the research work for the Erechtheion, for other reasons, came to criticize works like those accomplished by the present Director of Acropolis in the Erechtheion, as well as in other monuments, in an attempt to limit the rapidly progressing wear, until more complete measures could be taken.

The Working Group considered as expedient to give in a summary form the work accomplished to this moment, before proceeding with the introductions and the proposals relative to the subject of the present Meeting; and this for the disclosure of the general course of the programming of the project and the inclusion of the project within these limits. After a general agreement the project received absolute priority. Thus, the course of a future international cooperation will be determined in the best manner.

The systematic documentation — under the supervision and guidance of Prof. Ch. Bouras — had been one of the major concerns of the Working Group. A complete bibliography of the Acropolis monuments was accumulated and classified, and information and bibliography on the consolidation and restoration works realized was gathered; a codification and classification system for the Acropolis archaeological material was evolved, as well as a register of the architectural members and fragments scattered all over the rock. Also, an archive of photographs and drawings of the monuments and of all restorations realized is being compiled with the generous

help of the Archaeological Society and the German Archaeological Institute. At the same time, a documentation system consisting of photographs and drawings of the present state of the monuments was compiled. A detailed survey of the natural rock of Acropolis in drawings of 1:100 scale (Prof. G. Bandekas) — which was also based on air photography — was carried out, as well as the detailed drawings of the present state of the Propylaea floors, the detailed drawings of the parts of the western Parthenon pediment including the sculptures and — the main work — detailed drawings of the Erechtheion, which was also the foundation of the work forming the only subject of the present Meeting.

Considerable progress has been also achieved in the research work: with the aid of the Institute of Geological and Mining Research (Prof. B. Andronopoulos) a detailed soil, hydrological and seismological study of the Acropolis rock was carried out; also a study for the formation of route system, which will give new content to the ancient one (architect-archaeologist John Irvavlos, with the cooperation of the soil scientists Kotzias and Stamatopoulos); a special study for the stabilization of all Acropolis rocks and slopes apt to detachment was achieved (M. Arvanitakis in cooperation with Austrian specialists); a study for the restoration of the ancient Peripatos, the road around Acropolis, was achieved (architect Zervas); detailed drawings indicating the alterations of the Parthenon frieze were executed and the state of the sculptures of the western Parthenon pediment was studied (group led by Th. Skoulikidis); a complete laboratory tracing and localisation of the physicochemical alternations of the stones and especially of the marble and an investigation of its causes, as well as a survey of the measures to be taken (National Technical University laboratories, under the guidance of Prof. Th. Skoulikidis); a study for two kinds of elevators, which could be installed at the S.E. side of Acropolis was carried out etc. It is only too natural, that the main work was the architectural, archaeological, static, chemical and technical study of the Erechtheion and this was carried out with the cooperation of all members of the Working Group, as well as with the groups of architects, archaeologists, engineers, chemists and technicians. A preliminary study of a probable in situ air-conditioning of the Caryatids' Porch was carried out by the scientists Th. Protopapas and A. Calabakas. The fruit of these studies is the information, which constitutes the main assistance to the specialists in this Meeting and to any other concerned. This also contains the names of all those, who worked or contributed to the project in one way or another.

A large number of experimentations was carried out, in order to improve methods for the tracing of all covered metallic elements and fractures — as with the method of surface ultrasonic measurements (Prof. Tassios) or with gammagraphy (Hatzian-dreou and Ladopoulos of the "Democritos" Nuclear Research Centre). The main body of the experimentations was applied upon the Erechtheion. Experimentations were also carried out for the determination of protective measures for the rock surfaces and the monuments consisted of tuffstone or sandstone. A natural size model was constructed for the investigation of the static problems relative to the new arrangement of the Caryatids' Porch; this will serve for the study of the deflections of the metallic reinforcements (Group of Prof. Angelidis). An interesting study on the

stability of the Parthenon was presented by Prof. P. Theocharis (in collaboration with Prof. E. Koroneos). This study uses a complete plastic model in such a way as to make possible the measurement of photoelastic forces.

A large number of the works carried out were of a temporary character, as they were designed for the provisional prevention of parts of the monuments, until radical and more efficacious methods could be applied. Thus, the three remaining sculptures of the west tympanon — the Cecrops-Pandrossos group and Callirroë — were removed into the museum, to be kept in an air-conditioned atmosphere; plastic copies of the sculptures above, constructed with the kind assistance of the British Museum are to be placed in the position of the originals. A temporary shelter of wood, metal and plastic materials was constructed, aiming at the protection of a part of the frieze at the west wing of the Parthenon. The central passage of the Propylaea was protected by a wooden framework, furnished with steps for easy access, while a series of administrative measures were taken for the protection of the marble floors of the Parthenon, forbidding access to the numerous visitors. The porch of the Caryatids was temporarily protected by a wooden shelter, facilitating the technical work realized *in situ*. Casts of the Caryatids were constructed, taking into account the eventuality of the replacement of the original sculptures with copies; this was effected through testing a large number of materials and after many experimentations (Mr. Triantis, sculptor working at the National Archaeological Museum). A new cast for the British Museum Caryatid is ordered at the same museum. A series of static controls on critical points of the structures were realized for the Parthenon, the Propylaea and the Erechtheion. The fastening of rocks apt to detachment has already begun, priority given to the supporting and fixing of the rock on the N.E. corner, being the one which needs it most immediately. And finally, the study for the construction of a system of passages and crossings on the Acropolis rock has begun to materialize, under the supervision of the architect-archaeologist John Travlos; at a first stage, the passages were freed of the heavy overlying architectural members, which were subsequently arranged at nearby places. The ancient Peripatos, the road around the Acropolis rock, is being restored. The legislative regulation for the protection of the city and its monuments through the partial amelioration of the atmospheric environment has been of great significance; the use of mazout in central heating systems was prohibited (Minister Prof. Konofagos); the enactment and application of new measures was decided, after several meetings of the Working Group with representatives from the Ministries of Industry and Social Welfare. Prof. Koumoutsos prepared a study for the replacement of the mazout central heating systems with diesel ones and electrothermal accumulators. Mr. Dontas, the Director of the Acropolis, achieved, through a series of administrative measures, to prohibit the access to Acropolis of automobiles and tourist buses; he also facilitated the ascent of pedestrians, through the construction of appropriate side-walks. The construction of the load elevator of the Acropolis S.W. corner has already begun.

This is in brevity the work, that has been realized to this day, with the cooperation of the Minister of Culture and Sciences, the Working Group, the Archae-

ological Service, the Direction of Restorations, as well as numerous other groups.

But it is necessary to turn our attention to the main task of the present Meeting; to the introduction, the proposals, the exchange of opinions and the discussion about the measures, that must inevitably be put into effect for the preservation of the Erechtheion.

Dr. Dontas, in his capacity as Director of the Acropolis, will start with a general introduction, disclosing his own views on the problem of the preservation of the Acropolis monuments. More specialized introductions are to follow; of the chemical problems by Prof. Skoulikidis, of the architectural-archaeological problems by Dr. Dontas, acting as representative of Prof. Bouras, which presently is in the USA; and finally of the static problems, by Prof. Angelidis. The exchange of opinions and the relevant discussion will follow in other sessions, after an autopsy on the Acropolis and especially on the Erechtheion area. Of the specialists, only those invited to this Meeting will participate in these special sessions.

After the report of Prof. N. Platon, Dr. G. Dontas, Director of the Acropolis Ephory, spoke about **an archaeological opinion on some of the problems caused by the present condition of the Erechtheion**

Ladies and gentlemen,

When the Group, responsible for the introduction of the necessary measures for the conservation of the Acropolis monuments, comes to talk about the disassembling even of a part of the Erechtheion, so that the massive metallic clamps, which had been introduced during past reconstructions and which have been oxidized, and, more than that, to remove the Caryatids from their original position, so that they can be rescued from the destructive alteration, being caused by the sulphur dioxide, everyone can see, why this Department felt the need to speak, before introducing the task to the competent Authorities of the Ministry, to explain to specialists, which do not belong to the Group, the imperative reasons, which prompted it to propose these measures, to listen to their opinions and objections.

Other speakers, members of the Group and more specialized than me, will provide you with an analytic account of the reasons, which imposed the disassembling of a part of the monument and the removal of the Caryatids from their original position, the particular technical problems, which will result from such an undertaking, the solutions they propose, and the methods, which they recommend that should be followed.

I would like to set forth, even with using only a few words, my personal views on the crucial theoretical question, namely, if the disassembling of the monument is qualified and under which presuppositions, and moreover, in case that the reply is in the affirmative and the proposal is finally accepted by the competent Government Authority, which is, speaking as the Director of the Acropolis, the appropriate solution for the sheltering of the Caryatids, which are to be removed.

I think, that everyone can realize the dramatical tone of the first question. One can feel the awe in his soul even by pronouncing it. Is it in reality, that we propose

today to dismantle one of the masterpieces of ancient art, which had been erected on the Sacred Rock 2500 years ago, and one of its most important parts, the well-known Caryatids, to be replaced with copies? It can be instantly perceived, that the monument's condition must be very serious, if such a bold proposal is to be formulated.

As it happens, specialists are assuring us that if we do not take instant and drastic measures, then the monument will suffer a short death, caused by various reasons. The ruinous influence of sulfur dioxide may perhaps be the primary reason. This can be combined with moisture of the air, producing sulfuric acid, which transforms marble into gypsum, which is carried out by the first raindrops. Another reason is the oxidation of the metallic clamps used in past restorations. Corroded iron has not only lost its static capacity, for which it was being used in the monument, but threatens also important parts of the monument by its swelling.

I am informed that some people are roused up, when hearing that the monument is to be "operated" upon, and making the remark, that it would be better to leave it as it existed, 2500 years ago. This is one of the opinions but firstly I would like to remind them, that this is not the first time, that a substantial operation is to be carried in the Erechtheion or the other monuments of Acropolis. Balanos, for example, in order to effect the restoration of the monument, disassembled and again assembled some of its major parts, and indeed he dug up inside most of the marbles to place the metallic clamps, which, according to his opinion, would secure the stability of those parts of the monument. Hence, the opinion stated above must, if it wants to be in good faith, be restricted to the refusal of the Caryatids' replacement. And this is, how the question should be formulated: should we leave the caryatids in their present position or replace them with copies?

To those, who hold the first view, I would propose to compare photographs of their present condition with photographs taken at the beginning of our century, just in order to conceive the magnitude of their disfiguration, and indeed during the last years, when Athens was "industrialized" and satiated with petroleum burners. It is easy to consider, what there is to happen in a few years, on the basis of this melancholic experience, and assuming that the same conditions will hold at least, if no means of fixing the marble mass is to be found. And because such an adhesive substance has not been discovered to the moment — it may be discovered, but nobody knows when — the only proposals possible for the rescue of the Caryatids (excluding of course the purification of the atmosphere, the importance of which has been well conceived by the Government, which has already taken the first steps towards this direction) are either their in situ protection (through an air-conditioning system) or their transportation in a protected and air-conditioned enclosure. I can hear these people saying: "No, we prefer the Caryatids to remain in their original place, even unprotected; and if their death has come, well, let them die". In face of such a tragic and striking confession, which abolishes the sentiment of responsibility resembling a decision for suicide, what has one to say? To remind them of the obligation of the state, according to the international conventions, to take all necessary measures for the protection of his cultural heritage? Or rather

the ardent duty of the Greek citizen to keep his most sacred cultural heritage as something very close to his heart? But all these reduce to commonplace. And if I cite them now, it is for the purpose of underlining the existence of such unhealthy and even dangerous notions-ghosts of the past, which must be coped with resolutely by the responsible state, taking all necessary measures, however drastic they may be, and the soonest possible, for the rescue of the threatened monuments.

I, during the years before the formation of the Acropolis Working Group, and in face of the danger in the Caryatids and other parts of Erechtheion of tragic losses, such as the loss of the face of a horseman, belonging to the western Parthenon frieze, which was clipped off and lost at some unknown time before 1930, made, with the precious help of the archaeologist Mrs. Brouscari, fastening interventions using the best methods of the time, employing materials tested by protracted application, such as the MEYER stone cement and bronze, aided by the country's most experienced personnel. The outcome of the above activities was, that the up to then usual marble clips and scalings came to an end and the monument acquired for once more a structural coherence. As the specialists might say, this first aid treatment does not consist a permanent remedy; more and drastic measures are needed, mainly because of the disintegration of the marble's surface.

In situ air-conditioning was one of the solutions, which was studied in detail. But this has, amongst the technical difficulties for its realization, the disadvantage, that it would give a bad aesthetic effect, due to the large size of the enclosure; and this for an unknown period of time, i.e. till the discovery of a coagulating material.

Thus, the replacement of the Caryatids with copies and their removal to a museum was the preferred solution. This measure is of a provisional character and its duration will depend upon the ability of technology to cope with the anxious appeal for the discovery of a coagulating material, appeal addressed not only by our cultural heritage, but by any other cultural heritage being under similar conditions,

From this point on wards other problems take the lead, problems which are not so distressing to our conscience, but not easier for that reason. I am firstly referring to the technical preparations, which is a fundamental presupposition for an "operation" with as little bloodshed as possible, as required by the completely exceptional quality of the monument. For almost two years the qualified colleagues of the Acropolis Working Group have prepared, aided by their collaborators, the "operation", which has been included in the work, that has been put forward; and they are ready to talk with you for every detail and every question, that you may have.

The copying of the statues was one of the most serious concerns of the Working Group. Negatives of the Caryatids were taken, last year, by highly experienced personnel, which is also constructing their copies from a mixture of cement, sand, gravel and marble dust, in order to actualize the best possible aesthetic effect.

The Direction of the Acropolis was also preoccupied with the problem of the proper surroundings where the Caryatids were to be exhibited in public, after removal from their original position. Of course nobody thinks that they should be exhibited somewhere outside Acropolis. But even the Acropolis Museum offers limited space; and this became more pressing, when the sculptures of the west

pediment of the Parthenon were carried into it, last year. Extension towards any direction is impossible for the Acropolis Museum, since it would produce serious aesthetic defects, and probable destruction of antiquities or of the Acropolis rock. Thus, the alternative is to arrange for one of the Acropolis Museum's rooms to be kept for the Caryatids, as soon as the sculptures exhibited there are withdrawn to another place. This proposal is a bit startling at first, since it is very difficult for anyone to judge, which of the exhibits of the Acropolis Museum is of a smaller value than the others. Furthermore, the selection is made difficult from the need of finding a room, that must possess the proper perspective and be in the right chronological order, but, most of all, to possess the dimensions needed, since aesthetics demand the Caryatids to be exhibited not as isolated statues, but according to their arrangement in the monument and their architectural structure. Only one of the rooms could answer some of these demands, the Museum's last room, or the room of Prokne, as it is been called. The exhibition of the Caryatids was judged to be possible in this room; a provisional solution, to which we resorted from lack of anything better and in full knowledge of its defects. Both rooms, i.e. the room described above and that, where the sculptures of the western pediment of the Parthenon have already been exhibited, are to be shortly excluded from the public (they are to be viewed only) and to be climatized with nitrogen instead of oxygen.

However, the accumulation of problems as regards the Acropolis Museum, as well as the counter-array solutions, which are not always ideal, formed, step by step, the opinion, that the Museum can not respond to these new conditions, and that a new Museum, somewhere near, having the desirable dimensions, the proper conditioning and other necessary equipment could meet the newly formed conditions. The place was found near the south side of the Acropolis, and an architectural competition was carried out during the summer, aiming at the reward of the better rough plan. My opinion for the failure of this competition is, that the space exhibits serious defects, although it is the most suitable in the whole area. I presume, that it is to be repeated in a short time, perhaps with better terms.

I do not conceal from you, that I personally find difficult to accept a Museum outside Acropolis, a building containing its antiquities, which are apart from their monuments. I think, that the deep sentimental band, binding together the people with the monuments and sculptures is broken in a way. And I underline that. I personally wish the technological progress to be moving rapidly, so that the day, when the monuments will be saved from the decomposing damage comes speedily, altogether permitting the fearless return of the antiquities back to their proper position, of all antiquities, in respect of the museums, where they happen to be at the moment. Sweet is the day of return.

Three more general reports followed, containing the most important points of the Analysis and the Proposals of the "Study on the Restoration of the Erechtheion" and made (in the same order as were presented) by the Profs. Th. Skoulikidis, S. Angelidis, Ch. Bouras. The third report was read by Dr. G. Dontas, because of the reporter's absence abroad.

Report on physicochemical problems; solutions proposed

By Prof. Th. Skoulikidis and the group of chemical engineers N. Beloyannis, D. Charalambous and E. Papakonstantinou.

I am going to present you in brief the physicochemical problems of the Erechtheion, which we are obliged to face.

The first problem is the expansion, due to the corrosion of the clamps and framework, which have been used during the restoration of Balanos in 1900. It is also remarkable that after this restoration, which was finished in 1933, there were used steel as well as brass clamps.

The corrosion of these metals was accelerated during the last decades, because of atmospheric pollution: in many cases, the stress, due to corrosion, has grown bigger than the strength of the marble, resulting in its cracking. This cracking is going on and new cracks appear frequently.

My collaborators Mrs E. Papakonstantinou, Mr. D. Charalambous and Mr. N. Beloyannis, together with the group of Architects and Civil Engineers, have identified and recorded in pictures and drawings the surface cracks on the Erechtheion and the Caryatids. On the other hand, our colleagues Mr. L. Chatziandreu and Mr. G. Ladopoulos ("Democritos" Centre of Nuclear Research) have identified practically all the internal cracks, using first a source of γ -rays of 8 Curie and later another of 250 Curies. These internal cracks start usually from the surface of the marble, which is in contact with the steel elements. By the method of gammagraphy a great number of clamps was identified, the presence of which was not known.

To our opinion, the only solution to stop the growing of cracks is the replacement of steel bars, clamps and the framework of steel and brass by a metal with better performance than steel, especially in a marine environment, concerning corrosion and stress corrosion. For this reason we have proposed the use of titanium alloys. This problem will be discussed tomorrow morning.

The removal of steel clamps imposes the problem of the method, which must be applied, because there is a great adhesion between the corroded metal and the marble. This problem will be discussed tomorrow among specialists. I would also like to announce, that we have already tested in the laboratory ammonified solutions of thioglycolic acid, which is a well-known solvent of ferrous oxide. This solution becomes red, when acting upon ferrous oxides, and after oxidation of the latter by atmospheric oxygen and ultraviolet solar rays it becomes yellow. That yellowish colour disappears after a treatment with phosphates. Another alternative would be the use of thermal lasers, which make the oxides sublime or the use of mechanical methods.

Another problem is the deterioration of marble, due to atmospheric attack. This attack is an acid one caused by SO_2 , SO_3 , CO_2 and water and occurs in the places, where marble is exposed to the rain water. Such an attack results to selective dissolution of the active centres (pitting) and the active paths of the marble. A primary dissolution of the marble to calcium bicarbonate occurs, followed by a secondary

one through an intermediary stage, the formation of gypsum and the dissolution of the latter.

The second kind of attack is the formation of a layer of gypsum on the surface of the marble not coming into contact with rain water. This layer imitates the details of the surface on the walls of the Erechtheion and especially on the Caryatids; we have recorded in pictures and drawings the results of acid attack and approximately the thickness of gypsum layer.

We have compared the original statues of Cecrops and Callirroe with their copies, made in the British Museum from moulds taken sixty years ago. We have also compared the originals with pictures of the same statues, the Caryatids and the frieze of the Parthenon, taken at several time intervals. The comparison shows an acceleration of corrosion in the last years, due to increase in the atmospheric pollution. Therefore two problems emerge i.e. the stabilization of the gypsum layer containing the details, which have already disappeared in the interface marble-gypsum, and the protection from both kinds of attack.

In our laboratory we work on the first problem. We study the transformation of gypsum to calcium carbonate by two methods. The first one by action of carbon dioxide under high pressure and temperature and the second one through transformation of gypsum to calcium hydroxide in an alkaline solution saturated with calcium hydroxide and gypsum, this reaction being followed by a transformation of calcium hydroxide to calcium carbonate by action of carbon dioxide under natural conditions. This subject will be discussed tomorrow morning.

Concerning the protection from all kinds of atmospheric attack, we cannot recommend any of the known methods, namely the application of resins, plastic mortars, inorganic substances or hydrophobic compounds for the following reasons:

1. Such an application is not always reversible.
2. All these materials are applied after the removal of gypsum layer.
3. Marble porosity should be higher than 1%, while the marbles of the Acropolis monuments present a mean porosity of 0.3%.
4. Resins are attacked by u.v. light and discolour or crack or exfoliate.
5. The aging properties of resins are not known yet enough, since they have not been used for more than 20 years.
6. On the surface of some of these products we found gypsum after accelerated attack tests.
7. The properties of the composite material, formed after the application, are very difficult to foresee.

For all the above mentioned reasons, we propose either the climatization of the Caryatids in situ with a circulation of nitrogen or their transportation in a museum climatized in the same way.

Meanwhile we fight atmospheric pollution. It has been already prohibited through out Athens to use fuel oil, which contains 3,5% of sulfur, in industry and central heating; only diesel oil is allowed, containing 1% sulfur. We also propose that in an area around Acropolis, as well as in newbuilt houses, only electric

or solar central heating shall be allowed. A few days ago the transportation of the town gas plant was announced.

The circulation of cars on the Acropolis hill has already been forbidden and we propose the replacement in this area of all vehicles with internal combustion by electric vehicles like those used in airports.

All these measures will give time to scientists to find a proper method for the protection of the marble. Then the original statues will return to their original places. The same will take place, if a considerable reduction of the atmospheric pollution takes place.

Another problem is the attack of bacterian on marble. Italian specialists have taken samples from the statues of Cercops, Callirroe and from the columns of the Parthenon. Here are presented some of the results.

The statues have been attacked by a total number of 50.000 - 80.000 colonies per gram., while on the columns 2.000.000 - 7.000.000 per gram. can be found. The bacteria species are sulfur — oxidizing bacteria, mycetic microflora and zymotic microflora. The specialists propose tests with the biocide isothiazolinone chloride, which performed best of all antibiotics ever tested. This biocide presents the advantage of being soluble in acetone. That means, that it will prove harmless to the gypsum layers mentioned above. A discussion will take place tomorrow morning and evening concerning all these problems.

Static Analysis — Conclusions

By Prof. S. Angelidis and the group of Civil Engineers M. Ioannidou, D. Monokroussos and K. Zambas.

The analysis of the static function of the Erechtheion and the static investigation of the proposed solutions were realized by a group of civil engineers comprising, except the undersigned, the civil engineers M. Ioannidou, D. Monokroussos and K. Zambas.

From the facts at our disposal (the book of G. Stevens on the Erechtheion, his drawings and observations on the spot) we concluded, that the static function of the monument in antiquity was simple. The loads, being mainly the weights of the structural elements themselves, were carried to the ground through the bearing elements. The bearing structures were always isostatic and their cross-sections, being quite large in relation to the loads, assure a high safety factor.

In our days, the static function of the monument has become different, after the destructions and the various interventions. The loads are reduced and the cross-sections are significantly attenuated in a large number of cases. The bearings, originally effected simply by placing a member on top of another, have been transformed (through the destruction of the bearing surfaces) to almost non existent surfaces; the joints have been filled up with mortar or with iron reinforcements. A large number of isostatic beams have been transformed into hyperstatic bearing

structures, with the result, that their fatigue is different from the original one.

The greatest restoration works on the Erechtheion were carried out by N. Balanos during the years 1902 - 1908. The static problems, by which we are confronted at the present time, due to the restoration above, are:

1. The oxidation of the iron reinforcements, that were being used. It is known, that the ancients covered with lead the iron clamps before using them, in order to avoid oxidation. But the reinforcements of the Balanos restoration were not safeguarded from oxidation; and this resulted into their increase in volume and the subsequent creation of cracks in the marble members.

Thus, the reinforcements used caused imminent danger to extensive parts of the monument instead of increasing its strength.

2. The adequacy of reinforcements. For the facts at our disposal on the Balanos restoration (his personal reports, various photographs and archives) we come to the conclusion, that no static calculations were done during the placing of the steel reinforcements.

Our static calculations took into consideration the alterations, into which they must have been subjected during those last 75 years.

As referred above, the loads are the weights themselves of the structural elements. The horizontal chargings, due to earthquake and wind, as well as the load from snow have found their place in the static calculations. The calculations were based on the formulae for the deflection of linear supports, as the marble supports remain linear, although they are tall enough.

The results of the static controls were qualitatively assessed in relation to in situ observations; and it was ascertained, that the dangers confronting the monument from the static point of view originate from:

a. The oxidation of the iron supports. The oxidation has reached an advanced stage and presents a rapid evolution. The iron clamps and all other iron reinforcements situated at the monument's interior have been expanded in such a degree (because of the oxidation,) that the marble shows intense signs of rupture; the bearing surfaces of the structural elements have been elevated, whole marble parts have been separated or fell to the ground. Furthermore, the expansion of clamps created horizontal cracks in the mortar covering the joints. The moisture entering the mortar and marble cracks contributes to the acceleration of the oxidation process.

b. From the decrease of the beams' safety factor, because of the present static function of the monument's members and of the displacements effected to this day.

It is only too evident, that the above stated problems call for an immediate solution.

South Wall

The original static function of the south wall was different from the present one. Its great thickness, the transverse wall, the ceiling, the southeast anta and the floors secured a high static stability for the wall against horizontal loads.

In our days, the form of the wall and its supports have been changed. A sizeable part of the inner side of the blocks of wall has been destroyed to the effect, that the bearing surfaces of the courses are become incomplete. The largest part of the wall's clamps and dowels are missing, while the existing ones are oxidized and therefore have expanded. The ceiling, the original cross-wall and the east wall of the cella do not exist. Furthermore, measurements have shown, that the south wall presents an inclination (amounting to 6 cm) towards the monument's interior.

For the static calculations, the south wall was considered to function as a vertical cantilever, fixed to the ground, without cooperating with the rest of the monument except for the porch of the Maidens. Uniform dimensions for the blocks of wall were admitted; dimensions being sufficiently close to reality. The stability of the wall against horizontal loads (earthquake and wind) was examined for two different cases: when the mortar in the joints of the blocks of wall is under tensile stress and when it is not. It has been shown, that for both cases the safety factor against possible overturning was significantly reduced from the fifth course and downwards. Also, the present condition of the south wall from the fifth course and downwards is uncertain against allowable working stress.

It can therefore be concluded, that the south wall is under the danger of overturning, due to horizontal charges, that are localized to the higher courses.

The confrontation with this problem required the investigation of a number of alternative solutions. The recommended solution has been worked out taking into consideration the following criteria: the security of the wall against horizontal loads, the aesthetic appearance of the wall, and the minimisation of interventions as regards the original building material. The completion of the orthostate with new marble is recommended, so that the secure bearing of the courses is assured.

The following have been anticipated, with respect to the consolidation of the stability of the courses No 5 to 11:

- a. To increase the thickness of a large number of blocks of stone, through their completion with new marble, resulting in the remaking of the original bearing surface.
- b. Elimination of the wall's vertical deflection.
- c. Replacement of all iron elements (clamps, dowels, joint bars) with a rustless metal (titanium).

The number of courses under completion is determined, through archaeological and architectural criteria. Anyway, the static stability of the wall will be checked for every alternative solution. It is also anticipated, that a part of the original cross-wall will be completed; this will increase the wall's rigidity against horizontal loads.

West Wall

The lower part of the west wall, under the base of the half columns, has not suffered significant wear and therefore acts as a podium for the upper part, which

presents particular problems. The upper part of the wall — restored by N. Balanos — is extensively reinforced with iron. A large number of blocks of wall are composed from many pieces of marble joined the one with the other, while a good number of horizontal reinforcements have been placed in the joints of the courses, aiming to increase the wall's rigidity against horizontal loads. Due to oxidation, cracks appeared at many places of the mortar and at most marble members of the wall.

It is evident from all above, that the precise determination of the wall's static function is not an easy task. The static examinations realized to this day were based on the presumption, that the wall is fixed to the ground at the N.W. corner, since it is strongly attached to the north wall. It has also been accepted, that the lower part of the wall functions as a restraining, due to its great thickness. The degree of oxidation of the joints could not be included in the calculations. Furthermore, the mortar of the joints presents intense cracks with the result, that they cannot receive tensile stresses.

We can therefore conclude that, although the calculations did not bring unfavourable results, the condition of the west wall is uncertain enough with regard to horizontal loads.

In order to assure the stability of the wall, it is recommended, that the wall should be disassembled to the height of the base of the halfcolumns.

During the restoration of the wall we recommend to:

a. Replace all iron elements (clamps, dowels, joint bars of the Balanos restoration) with new ones made of a rustless metal (titanium).

b. To re-establish the original thickness of the blocks of wall, through their completion with new marble.

c. To re-establish the static functioning of the four half columns by joining the pieces together, so as to increase the wall's stability against horizontal charges.

Beam A receives a large part of the wall's charges and presents a particular problem for the west wall. Through its two extremities it is supported to courses of the west wall and through its middle point, under a repective crack, to an ironcast column. The stress measured for beam A is small enough and its stability is sufficient.

Porch of the Maidens

During antiquity, the static function of the porch was the following one: the four ceiling cassette slabs were supported by the south wall and the epistyles of the porch. The epistyles bore the load of the roof and transferred it to the Maidens. Finally, the loads were transferred to the podium through the Maidens, and from there to the foundations and the bedrock.

The static function of the porch changed after the Balanos' restoration. The loads of the ceiling cassette slabs were borne by iron beams, having an arrangement of an horizontal Π , and placed in a recess carved by Balanos, at the upper surface of the epistyles. This iron cornice is formed by a double series of NPI 160 iron-

beams at the south side and a single series of NPI 160 ironbeams at the east and west side. The cornice, from which the epistyles are suspended, is supported in three iron columns at its south side, which in their turn carry the loads to the podium. This was the way, with which Balanos tried to materialize his intention i.e. that the statues should bear no loads.

The static controls effected for the iron cornice showed, that over the Caryatid statues i.e. on its sides there ought to be a significant slump of the cornice. It is concluded that, since such a slump cannot be observed, being impeded by the statues, according to calculations the statues must bear weights of the 1000 Kp class. Furthermore, from the iron columns of the south side, the columns of both sides must be charged in a significantly greater degree than the one at the middle. It is in such a way, that we can provide a justification for the serious fracturing of the podium underlying the two side columns.

For the consolidation of the porch of the Maidens, we propose the replacement of the iron bearing structure of the epistyles and the exemption of the statues from heavily concentrated loads.

The iron bearing structure will be replaced by another one with a Π cross-section, made of a rustless metal (titanium) The external dimensions will be appropriate for the recess created by Balanos, so as to avoid further carrying of the epistyles. The closed orthogonal cross-section is chosen for the form of the bearing structure, in order to possess the ability of bearing loads and twisting moments. The cornice will be supported by the south wall and not by the original statues of the Caryatids. For this reason four alternative solutions were studied from the static point of view. We have tried, and this holds for all alternative solutions worked out, not to load the Caryatids; load that would result from the deflection of the iron cornice. Thus, the form of the cornice axis was proposed to be the diametrically different one from the one obtained by it due to the loads, so as to be perfectly horizontal after its deflection. A model of the porch is constructed (from concrete and at 42 steel) in an 1:1 scale, in order to investigate the deflection of the iron cornice. The deflections have been evaluated through computerized calculations and are to corroborated through the model. The conditions determining the four alternative solutions are:

FIRST ALTERNATIVE: the bearing structure of the ceiling is an horizontal Π formed frame. It will be supported on two of the south wall and on the British Museum copy of the Caryatid. In this case the maximum deflection is ca. 12 cm, which is considerable. It must be explained, that this solution provides for a built-in metallic column in the statue, modelled as a broad flange at its lower extremity, so as the load might not be concentrated on a small surface of the podium.

SECOND ALTERNATIVE The bearing structure consists of a metallic cornice borne by the south wall and by all statues. This solution is significantly advantageous from the deflection point of view (maximum deflection 8.5mm) but reversibility is not secured.

THIRD ALTERNATIVE: The metallic Π form bearing structure is borne by the south wall and by two statues i.e. by the British Museum copy and the east

side inner statue. This solution is more advantageous than the first one, since the loads are distributed to two statues and the deflections are considerably small (max. deflection 4.11cm).

Fourth Alternative: The horizontal Π formed supporting structure is borne by the south wall and by three metallic columns (which exist already) at the front view of the porch. This form of the structure does not possess any advantage in relation to the forms proposed by the other alternatives. Calculations for the elastic design showed, that, while its south side presents small deflections, its east and west side present considerable deflections.

A disadvantage of this solution is the fatigue of the podium, through the concentrated loads of the columns, which holds at the present for the two side columns, resulting into the fracture of the podium

East Porch

The east porch originally included the columns, the epistyles, the entablature and bore a part of the ceiling loads. It was strongly fastened to the north and south walls. This is not the case today, since all the N.E. corner has been destroyed and has become incomplete.

The system columns — entablature was considered to rest simply on the ground for calculation purposes. From the investigation of the wind pressure it resulted, that the safety factor against possible overturning is considerably small and therefore the present condition of the east porch (the east porch is not secure for horizontal loads) is unsafe for horizontal loads. The danger of overturning will be faced with the completion of the N.E. corner.

Archaeological — Architectural part of the Study *

By Prof. Ch. Bouras and the group of architects and archaeologists: A. Lazaridou, F. Mallouchou, E. Moutopoulos, A. Papanicolaou, and A. Tzacou.

Before this report, was read this part of the “Study on the Restoration of the Erechtheion” relative to the general principles, to be applied in the scheduled intervention³.

EXPOSITION OF THE GENERAL PRINCIPLES TO BE OBSERVED DURING THE PROGRAMMED RESTORATION OPERATION IN ERECHTHEION

That every intervention on historic monuments is questionable constitutes a commonplace, which is met up by public opinion with a critical disposition and, not so rarely, with distrust. The reactive is felt with more rigour, when — as is

* with the collaboration of M. Korres in part of the architectural analysis.

3. “Study on the Restoration of the Erechtheion”, Athens 1977 p. 3-5.

the case with Erechtheion — the monument is well-known and is of a great archaeological and historical significance. In order that the solutions proposed in the study, and, by extension, the programmed drastic intervention be widely acceptable, having in mind the modern ideology for the conservation of monuments, as well as the scientific methodology for the classical monuments, there arises the necessity for a copious preliminary research work and for the objectification of the decision process of the partial decisions, which results in the subjection to commonly accepted principles.

Thus, the particular entity and significance for the Erechtheion imposes a quite particular preliminary way of thinking for the solution of its problems; although, the blind and absolute observance of principles both in the restoration and in the treatment of the monuments is absolute, certain liberties being accepted in our time.

This first introductory text contains the general principles, which were observed during the study and which predominate in the proposals. Most of them are also the principles of the internationally accredited Charter of Venice, which were the outcome of a common agreement thirteen years ago.

Before everything else, it must be elucidated, that the intervention in the Erechtheion is inevitable. As it can be perceived from the following analysis, the gravest danger for the good condition and the stability of the monument is in the rapid deterioration of the metallic elements, that were embodied in the original members of the temple during the Balanos restoration, the removal of which is by all means unavoidable, even if we may solve the second major problem, (that of the corrosion of the marble by sulfur and carbon dioxide) cleaning effectively the atmosphere surrounding Athens.

The alternative solutions, which could be proposed by the researchers, are much restricted by the fact, that the intervention is forced and calls for immediate action. And although the nature of the monument's structure (wholly built of marble, without using mortar, and with a perfect fitting of its individual parts) facilitates its dismantling and re-assembly, there remain the disadvantages resulting from the fatigue of every surface and every carrying, due to the drastic intervention, which do not cease from existing.

The second article of the Venice Charter imposes "The cooperation of every art and science capable of contributing to the study and preservation of the monuments being part of the cultural heritage". This claim is satisfied by the diversity of the scientists, which are members of the Working Group and those of the technical office for the restoration of the Acropolis monuments and their collaborators.

The Eighth article of the Charter refers to one of the most difficult problems of the Erechtheion; notably that: "The sculptured, painted or decorative elements, that are inseparably linked to the monument may be separated only when this measure is the only alternative for the securing of their preservation". The removal of the Caryatids, included in these proposals was judged as the only solution for their preservation under existing conditions. It is certainly believed, that the principle is not violated, and this because of the measure's provisional character. Indeed,

the removal of the Caryatids to the Acropolis Museum is proposed until the atmospheric pollution, due to sulfur dioxide, will be reduced to a satisfactory degree; on the other hand, the possibility of returning the original statues to their authentic position without a large scale intervention to the monument is assured.

However, the subject is open to question; it has and will continue to cause indeterminable discussions. The adherents of the view of the “glorious decay”, believing that the removal of the sculptures destroys the monument’s historical, architectural and archaeological unity, talk about a scenery of copies, about the justification of past plunders of the Acropolis temples etc. It must not be forgotten that:

a) the proposal is only limited to the removal of the Caryatid statues; hence the intervention is minimized.

b) solutions of such a kind are facilitated by the nature of the monument, with its absolute independence of forms and structural elements, and

c) the proposed solution can be easily reversed, since it is adapted to the request of its provisional application.

According to article No 9 of the Charter, the original form and the authentic elements of the monument have to be respected. It is anticipated, in the proposed solutions of the monument’s re-assembly after the removal of the existing oxidized metallic elements, that the original members of the monument will undergo no new cuttings; the old ones of the Balanos restoration will be used as far as possible. The incorporation of a number of presently scattered architectural members in the monument is also anticipated; also, provision is made for the protection of every trace and cutting, that constitutes historical evidence and contributes towards the authenticity of the temple. The same article prohibits all restoration work not based on evidence; the restoration is to be based on absolute certitude as to the facts and not on conjectures. This is not the case for Erechtheion, for which all problems related to the construction of the building have been already solved in the Stevens’ study and have been re-examined, where necessary, in the present study.

Article 10 of the Charter recommends, that restorations should take advantage of modern techniques. This is effected by the proposals for the use of titanium during the temple’s consolidation works. The negative aspects concerning the usage of modern materials for the protection of the marble’s surface, which are contained in the study, are based on an extensive and detailed research on the subject.

Article 11 of the Charter, according to which “The important additions of all subsequent ages to the present form of the building must be taken into consideration” is duly satisfied by the study, without any difficulty. It is evident, that the oxidized metallic supports of the Balanos restoration or the bricks used by Pittakis as filling material cannot be considered as “important additions” and therefore cannot be regarded with deference. The architectural members of the temple belonging to its Early Christian period are to be preserved in their present condition.

The principle enunciated by the 12th article of the Charter is duly observed in the study. The members, that are to replace destroyed parts of the monument, must be harmoniously incorporated in the whole, but they must also be discernible from the original parts, so that the artistic and historical features of the monument

should not be falsified. Indeed, the new architectural members are very few in relation to the original ones; and they are made from pentelic marble, the coarse surface of which is easily differentiated from that of the original members. The casts, that are to be incorporated in the monument, do not present differences from the originals (this being due to uniform wear), but differ only in the material, from which they were constructed. The exceptional sensitiveness of the form of the classical temple imposes very discreet differentiations for the new members, which are to be perceived only through careful observation. The same holds in respect to article 15, allowing restoration for the monuments not in use presently i.e. it permits the reconstruction of the original members; this article too is carefully observed.

And finally, referring to article 16 of the Charter, imposing documentation before and during the intervention, we must note, that it has been observed down to the minute details; it is hoped, that the same will hold for the future. Never before in the history of monuments' restoration in Greece such a methodical and precise documentation has been carried to the end.

Three more principles are observed in the proposals of this study:

a. Reversibility, i.e. the possibility of rendering the monument back to its previous form (i.e. its form at the beginning of the restoration works). This principle, resulting almost at once from the provisions of the Venice Charter, is observed in the Erechtheion study firstly through the systematic minimization of interventions on the original architectural members (for this the reader is referred to the special techniques contained in the following chapters) and secondly, through the detailed documentation and measurements.

The failure of the Balanos restoration, who did not hesitate to take away a considerable portion of the ancient material and to destroy surfaces resulting from fractures, made the present researchers very cautious on the observance of this principle.

b. The minimum possible alteration of the general appearance of the ancient temple. A large number of people working on the Erechtheion are accustomed to the monument and possess a very good knowledge of it; this has produced a collective sensibility, that cannot be disputed.

The general appearance of the Erechtheion will not change, if we only exclude the completion of the eastern colonnade and a part of its north wall.

c. The amplification of the instructive value of the ruin.

The study has strived to meet the widespread request of the "functions" of historical buildings, under its most general meaning. The visitors to the Erechtheion must be in the position to "understand" the building in the most complete and convenient way. The minor changes proposed in the "Study" (courses of the northern and southern wall, the eastern colonnade) aim to its realization to the extent sanctioned by the aforesaid principles.

The problems with which Erechtheion is faced, problems of conservation and restoration, mainly belong into two basic systems; those of physicochemical and those of geometrical problems. The latter ones are furthermore specialized into morphological, constructional and static problems; categories having a correlation with the system of physicochemical problems.

This introduction is focused on the part of those geometric problems. That constitutes a part of the work of the architect-restorator.

The major proposals relative to the intervention on the building are presented, not in their order of priority or in the order of their application, but along with the systematic examination of the building i. e. by parts and advancing from the lowest to the upper parts of the structure.

South Wall

A sizeable part of the south wall has been restored during the first decade of our century. For practical reasons a number of blocks belonging to the north wall was used in its restoration, while other blocks were placed in an inverted position. Mortar was used for the joints of the restored part of the walls, since the good contact of the blocks between them after the restoration could not be achieved. The oxidation of the ancient but mostly of the modern metallic clamps, as well as the uneven bearing surfaces of the blocks between them, are factors, that caused a great part of the cracks on the wall. The removal of the eastern transverse wall during the Early Christian years and the destruction of the eastern wall almost deprived the south wall of its stability. The inner face of the wall was mostly destroyed after the great fire during antiquity, above the level corresponding to the third inner step of the crepis. Thus, only half of the original thickness of the wall has been preserved. The bearings of the "anathyrosis" were lost together with the inner face of the wall, and consequently the height of all courses of the inner part of the building was reduced. This last alteration together with other unfavourable conditions allowed for the deformation of the wall; deformation that is presently demonstrated, through the irregular way, with which the wall is inclined inwards and carries along the porch of the Maidens with it; in this way, the porch bears horizontal loads. Thus, there is a grave danger of collapse for the wall, due to its instability.

Proposals

The extent, as well as the nature of wear, in conjunction with the need for disassembling of a portion of the porch of the Maidens, dictate the disassembling of the south wall as a presupposition for the preservation of the monument. The disassemblage will be even extended to parts of the wall, that remained intact to this day.

A study of the nonformal characteristics of the blocks, which are the insignificant

variations of the positions of the metallic clamps, as well as the traces of a second usage and wear, can determine the exact position of each block in the wall. All blocks originating from the north wall will be replaced to their original position.

The resulting gaps after the removal of all blocks not belonging to the south wall are to be replaced by new blocks.

The blocks of wall belonging to the lower part of the deformed wall shall be completed with new pieces of marble, so as to obtain both a complete form and the proper dimensions. The blocks of wall, that shall be used for completing, are to be chosen on the basis of their static effectivity and the synthetic, aesthetic wholeness of the intervention, which will be visible from the interior of the monument.

Rust-proof metals and stone coagulating material will be used during the completion works. The metallic clamps and the mortar will be removed during the disassembling of the monument. Rust-proof metals will be used during the reassemblage in the joints and the reinforcements.

The removal of the inner brickwork, serving as an reinforcement for the interior part of the building, the considerable restoration of the inner face of the wall with marble, the restoration of a small part of the eastern cross-wall on its meeting with the south wall for static stability reasons and, finally, the completion of a number of missing blocks on the outer face of the wall shall contribute in a significant degree to the aesthetic restoration and the presentation of the distinctive features of the wall.

S.W. Corner — West Wall

The S.W. corner of the building comprises a large number of particular structures related to the limitations set by the grave of Cecrops and extends well below the corner, in accordance to the special functional and constructional requirements. The almost acrobatic, original solution consists in the omission of the corner foundation and in the transportation of its whole weight to the solid walls at the north and south sides of the grave. This beam, which, due to its dimensions and form, constitutes the continuation of the west wall, presents a gap near its middle and at the same time reveals a displacement and a turn towards two directions: both downwards and westwards.

The west and the south walls along with a part of the porch of the Maidens follow, consequently, the displacement of this beam.

The west wall essentially exhibits the same signs as the south wall; and furthermore its inner side restoration presents two serious disadvantages:

1. An almost total absence of its morphological structure (absence of pillars and mouldings).

2. A inelegant and incongruous presence of small separate completions with pieces of new marble.

Proposals

Replacement of the cast iron support of the S.W. corner.

Disassembling of the west wall at least until the level at which the stone blocks remain undisturbed.

Removal of mortar and of all metallic elements.

Completion of blocks with new material.

Re-assemblage.

Special care will be reserved for the restoration of the inner face of the west wall, aiming at the complete "combination" of old and weared surfaces with new marbles.

Furthermore, an extensive restoration of two antae and partial restoration of the remaining ones, as well as a part of the moulding of the podium and the anta capital.

In such a way the interior of the monument will gain in instructive value, in the clarity of its forms and in aesthetic equilibrium; the vague and restless, qualities pertaining to the west wall, will be significantly reduced. In its place, the classic equilibrium of forms and the tranquility of the plane surface of the marble will be felt, even in a fragmentary way.

Porch of the Maidens

The material of the porch of the Maidens presents problems similar to those of other parts of the building.

The foundations of the podium's crepis exhibit a number of differences; it is formed from hard Carra limestone and, along the south side, from soft tuffstone.

The Maidens (also acting as supports) exhibit extended scaling off of the marble and wear as well, due to the hardships they have undergone during the many centuries and also due to the large loads (both horizontal and vertical) of the architrave and the ceiling, which they bear.

The Balanos restoration attempted to relieve the load, through a suitably shaped metallic frame, that would bear, in reality, the loads of the ceiling cassette slabs and the cornice, as well as the load of the architrave, through the aid of hangers. This metallic beam is installed in the interior of a large groove, carved in the upper surface of the epistyles of all three sides of the porch. It has been calculated and constructed, so as to be based on restrainings and on three cylindrical metallic supports placed between the statues of the south side.

The present function of this beam has emaciated; in reality the great part of the loads continues to be borne by the Caryatids. The whole of the metallic structure presently appears intensely oxidized in such a degree, that the epistyle is under the very probable danger of breaking, at least in some of its points.

The four large slabs (which also form both the ceiling and the cornice of the porch) are destroyed to a considerable extent. One of them needs instant conservation.

The particular significance of the Caryatids-supports as masderpieces of the 5th century art poses a basic problem for the porch. Their treatment must not be

other than a special one: they must be looked at not only as part of the building but also as museum pieces. Hence the necessity of their placing or removal without influencing the construction and the static function of the ceiling of the porch.

Proposals

De-assemblage of the porch combined with the necessary de-assemblage of part of the south wall.

Cleaning of all stone parts from mortar and metallic elements.

De-assemblage of the base and removal of metallic objects.

Replacement of the tuffstone of the foundation with hard tuffstone or limestone.

Re-assemblage of the podium, completion of the orthostates and of cornice with new marbles, and replacement of small-size members with new ones, if necessary.

Completion of the podium's crepidoma in the inner part of the porch.

The Balanos solution is adopted for the consolidation of the ceiling, i.e. the replacement of the iron elements by a rustproof material, e.g. titanium.

The three metallic supports remain as an alternative under examination. The north extremities of the frame for each of the four alternative solutions are supported by the south wall cuttings for beams: while three more alternative solutions do away with the visible supports of the existing restoration and support the metallic construction, either on shores inserted into two or into one of the Caryatids, either into copies of all Caryatids.

East Porch.

A number of phenomena similar to the other parts of the building are pointed out as: dilation of clamps, widening of joints, deflection from the vertical, reduced stability and, furthermore, a small precipitation on the N.E. corner, due to the destruction of part of the foundation.

An important problem of form arises, because of the absence of the north corner column and of the architrave corner at the same position.

The mutilation of the monument at this particular position is accompanied by serious static problems created by the discontinuity; therefore, the deficiency of cooperation in terms of statics in the north wall.

The north column (the better preserved column of the east porch) has been removed from the monument along with some other overlying members and transported to England by Lord Elgin, during the last years of the Turkish occupation of Greece.

If we consider the missing column back in its original position, we may find out, that its morphological significance as a unit and as part of the whole increases considerably. Thus, and this is the main point, in such a way the total impression and the aesthetic wholeness of the porch is heightened beyond bounds.

The restoration of the original column is proposed as a solution, that has realized both the aesthetic completeness and the morphological intention. We must empha-

size, that the proposed solution is also the most consistent in relation to articles 8 and 15 of the Venice Charter.

It must be mentioned, that these, who have visited both Acropolis and the British Museum, will certainly derive an aesthetic pleasure, which is of course more intense than those two above mentioned visits.

Noth Wall—Noth Porch

Presenting a few problems similar to those of the south wall, as well as the critical problems, created by the metallic beams embodied in the construction over the large doorway.

The north porch presents much simpler problems in spite of its larger dimensions. Some iron beams are installed on the ceiling; these carry the load of the three of five beams, through hangers. All the above metallic elements are oxidized.

Proposals

Replacement of the metallic elements of the north porch and the north wall.

Furthermore it is proposed, that a part of the north wall should be completed with material derived from the disassembling of the south wall, as well as with new marble pieces, if necessary.

The Immediate Vicinity

The ground surrounding the building has almost the same form, as in the excavations of the last century.

A good part of the building's foundation is exposed to a great depth. A part of the foundation material consists of soft-yellow tuffstone, which is quickly destroyed from natural agents but also from visitors.

We propose that the immediate vicinity of the monument should be filled up with earth, up to the height of the euthyteria.

In such a way, a more detailed picture of the Erechtheion will be obtained and emphasis will be given on the exterior of the monument, that was inseparably linked with the temple during antiquity, i.e. with the Pandrossos Temple and the courtyard, between the north porch, the north wall and the Acropolis walls (which has a theatre like form).

SECOND DAY OF THE MEETING - FRIDAY 9.12.77

The second day of the Meeting was devoted to the discussion on the most important restorational problems of the Erechtheion. The length and the special character of the subject, as well as the dependence of the problems with each other, imposed an order accordingly to the importance of each problem.

The participants formed two groups, which discussed in depth the various problems, based upon the General Reports of the first day.

In Hall A archaeologists, architects and structural engineers discussed the form and the “geometry” of the monument, as well as the methodology and deontology of the proposed intervention.

In Hall B physicists, chemical engineers, geologists, biologists and mechanical engineers occupied themselves with the deterioration and its remedies.

Hall A. President: N. Yalouris

List of participants:	Piazza del Popolo 18
Agalopoulou P.	Rome, Italy
Ephory of Acropolis Athens	Brouscari M. Ephory of Acropolis Athens
Angelidis S. National Technical University Athens	De Angelis D'Ossat G. University of Rome Lungotevere Sanzio 9 Rome
Akurgal E. University of Ankara Ankara, Turkey	Demacopoulos J. Ministry of Culture and Science 14, Aristidou Str. Athens
Badekas J. National Technical University Athens	Dinsmoor W. B. American School of Classical Studies 54, Souidias Str. Athens
Bakalakis G. 38, Gymn. Mystakidi Thessaloniki, Greece	Di Vita A. Italian Archaeological School 14, Parthenonos Str. Athens
Berquist B. Switzerland Kungsgärdesplan 4 - 5 5-752 38 Uppsala Sweden	Dontas G. Ephory of Acropolis Athens
Blomé B. Gandviksvägen 13 S-18262 Djusshholm Sweden	Doumas Chr. Ministry of Culture and Science 14, Aristidou Str. Athens
Borreli-Vlad Ministry of Culture	

Gruben G.
Technische Hochschule München
Am Muhlbergschloß 6
D-8130 Starnberg
Munich-W. Germany

Hagg R.
Swedish Archaeological School
9, Mitsaion Str.
Athens

Hoepfner W.
Podbielskiallee 65/71
Berlin 33-W. Germany

Ioannidou M.
Ephory of Acropolis
Athens

Karouzou S.
15, Dinocratous Str.
Athens

Kienast H.
German Archaeological
Institute
1, Phidiou Str.
Athens

Korres M.
Ephory of Acropolis
Athens

Kyrieleis H.
German Archaeological Institute
1, Phidiou Str.
Athens

Kranidioti L.
Ministry of Culture and Science
14, Aristidou Str.
Athens

Lavvas G.
University of Thessaloniki
Thessaloniki, Greece

Lemaire R. M.
University of Louvain
Groot Begijnhot 95
3000 Louvain, Belgium

Leon-Mitsopoulou V.
Austrian Archaeological Institute
26, Alexandras Ave.
Athens

Mallouchou F.
Ephory of Acropolis
Athens

Mallwitz A.
German Archaeological Institute
1, Phidiou Str.
Athens

Martin R. M.
L'Ermitage-Fixin
21220 Gevrey
Chambertin, France

Monocroussos D.
Ephory of Acropolis
Athens

Mylonas P.
National Technical University
Athens

Oeconomou G.
National Technical University
Athens

Papanicolaou A.
Ephory of Acropolis
Athens

Petronotis A.
8, G. Iatrou Str.
Athens

Platon N.
126, Alexandras Ave.
Athens

Schmid M.
French Archaeological School
6, Didotou Str.
Athens

Stikas E.
Anapirou Polemou Str.
Athens

Tanoulas A.
Ephory of Acropolis
Athens

Tassios Th.
National Technical University
Athens

Theocaris P.
National Technical University
Athens

Tzacou A.
Ephory of Acropolis
Athens

Travlos John
146, Alexandras Ave.
Athens

Williams C.K.
American School of Classical Studies
54, Souidias Str.
Athens

Winter F.
American School of Classical Studies
54, Souidias Str.
Athens

Yalouris N.
Ministry of Culture and Science
14, Aristidou Str.
Athens

Zambas K.
Ephory of Acropolis
Athens

The following problems were discussed:

1. General principles. Necessity, reasons (importance of the monument, expansion, limits of resistance) and limits of conservative intervention.
2. South wall, west wall, in particular the S.W. corner: steel reinforcements of N. Balanos, removal of mortars and metallic elements, dismantling and resetting of the parts of the monument.
3. The Caryatids porch: Consideration from aesthetic and structural points of view of the alternative solutions proposed for the preservation of the porch. Model.
4. East porch: restoration, anastylosis of the N.E. corner. Structural joining of the east and north sides of the monument.
5. Other subjects: North wall (completion), north porch (conservation works), improving the area of the Pandrosseion and the area north of the Erechteion.

Hall B. President: Prof. Th. Skoulikidis

List of participants:	University of Louisville
Anagnostidis K.	Louisville, Kentucky
University of Athens	U.S.A.
Athens	
Andronopoulos B.	Hyvert G.
I.G.M.R.	Centre d'Études pour la
70, Messogion Str.	Conservation du Patrimoine
Athens	Urbain et Architectural
	Collège d'Europe
	Dyver 10 - 11
	Bruges, Belgium
Assimenos K.	
National Archaeological Museum	Ladopoulos G.
Athens	Nuclear Research Centre
	"Democritos"
	Athens
Beloyannis N.	
National Technical University	Lazzarini L.
Athens	S. Gregorio Restoration Laboratory
	Dorsoduro 170
	30123 Venice,
	Italy
Charalambous D.	
National Technical University	Lewin S. Z.
Athens	New York University
	4, Washington Place
	New York 10003
	U.S.A.
Chatziandreou L.	
Nuclear Research Centre "Democritos"	Mamillan M.
Athens	C.E.B.T.P.
	Domaine de St. Paul
	18470 St. Remy les Chevreuses
	France
De Henau P.	
1, Parc du Cinquantenaire	Marchesini L.
1040 Bruxelles,	Institute of Industrial
Belgium	Chemistry
	9, Marzolo Str.
	35100 Padova
	Italy
Furlan V.F.	
Laboratoire des Matériaux Pierreux	
Ecole Polytechnique Fédérale de	
Lausanne	
Chemin de Bellerive 32	
Lausanne 1007,	
Switzerland	
Gauri K. L.	
Department of Geology	

Markantonatos G.
Ministry of Social Welfare
Athens

Paleni A.
Società Italiana per Ricerche
Agricoli Industriali
P.O. Box 104
45015 Correggio
Italy

Papakonstantinou E.
National Technical University
Athens

Protopapas Th.
Ministry of Culture and Science
14, Aristidou Str.
Athens

Ragot J. P.
B.R.G.M.
B. P. 6009 4518 Orléans-Cedex
France

Romanovski V.
C.R.E.O.
73 - 77, Rue de Sevres
92100 Boulogne
France

Schwab G.
Sofienstrasse 11
Munich
W. Germany

Skoulikidis Th.
National Technical University
Athens

Taron J.
Laboratoire de Recherche des
Monuments Historiques
3, Rue de Valois
Paris 1er, France

The following problems were discussed:

1. Removal of the steel clamps: purpose, methods of intervention.
Proposal: Thioglycolic acid, thermal laser, mechanical methods.
2. Replacement material for the steel clamps.
Proposal: Titanium alloys.
3. Consolidation of the gypsum films.
Proposal: Transformation into calcium carbonate.
4. Protection of the marble from atmospheric attack.
Proposal: Defensive measures against the atmospheric pollution, conditioning in situ, removal of the statuary to the museum.
5. Protection from biological deterioration of the marble.
Proposal: Use of Isothiazolinone Chloride.

During the discussion general positions were formulated, so that at the end of the sessions the two groups had separately expressed their conclusions:

Conclusions of the group of archaeologists, architects and structural engineers

The participants in the Meeting congratulate their Greek colleagues for the scientific strictness and the profoundness of the study realized, having as its subject the historical approach and the description of the actual state of a part of the Erechtheion. This study should be, as they hope, set apart as an example for future restorations. With its scientific strictness, its methodology and its careful observance to the principles of the Charter of Venice it assures the immediacy and the quality of the interventions necessary for the preservation of the monument.

The damage of the Caryatids and the imminent danger regarding their preservation, which could be caused by them remaining in situ, have persuaded the participants in the Meeting of the necessity and immediacy of setting the Caryatids in a protected enclosure inside a museum and subject them in a satisfactory conservation treatment and in a study of the various possible treatments.

The replacement of the Caryatids by casting models or by copies and the disassembling and re-assembling of the entablature and the coffered ceiling according to a method of construction, which will be as close as can be to the original conception, as well as a probable replacement of the Caryatids in their original position are well worthy of recommendation.

The withdrawal of the metallic clamps, which were introduced during the successive restorations of the Erechtheion, the oxidation of which constitutes a constant and growing to the monument danger, is considered as an unavoidable measure for the good preservation of the monument's blocks.

However, it is desirable, that the necessary disassembling, which will be realized to this end be restricted to certain areas and be carried out in line with the strict scientific method, which has been proposed by the Working Group.

The disassembling of the northern wall and the stabilization of the eastern porch are considered as necessary, although not of the same immediate character as with the withdrawal of the Caryatids.

We propose, that the problem should be examined continuously and with a greater profundity, so that everyone authorized should take the necessary decisions at the proper time; decisions, which will be based on the acknowledgement of an absolute need, which by its existence will justify an intervention so serious for the monument's future.

Conclusions of the group of chemical engineers, physicists, geologists, biologists and mechanical engineers

Thanks are expressed to the participants for their cooperation, attention and competence.

The first subject discussed by the Group was the question, whether any of the known methods could be applied to slow down or stop completely the corrosion of the metallic clamps, bars and the whole metallic framework in situ.

All participants were unanimous to the statement, that no such possibility exists and that the only solution is the replacement of steel with a material more resisting to corrosion and stress corrosion cracking in a marine environment, such as that of Athens. A question was asked, concerning the possible ways of extracting the steel elements, taking into consideration their adhesion on marble, because of expansion due to corrosion. The use of purely mechanical methods was adopted in principle, but, according to the case, thermal lasers or chemical methods may be applied, provided they are harmless to the marble.

The next question concerned the material, that will substitute for steel. All were unanimous on the use of titanium alloys. We are all persuaded that stainless steel presents much poorer performance against corrosion, because of chloride ions contained in the atmosphere; dangers of stress corrosion cracking exist for the same reason.

There followed the discussion upon the problem of consolidation of the gypsum layer, where its preservation is considered necessary, as this layer often contains important details, that disappear from the interface marble-gypsum. We concluded, that such an operation upon the Caryatids is unnecessary, as they will be transported into the museum and climatized there. On the contrary, if the Caryatids remain in situ without any climatization a consolidating operation will be necessary.

There is a possibility of choice among four methods of consolidation of the gypsum layer. The first two are being studied in the laboratory of Physical Chemistry on the N.T.U.

a. Immediate transformation of gypsum into calcium carbonate by reaction with carbon dioxide in an autoclave under high pressure and temperature conditions.

b. Reaction of gypsum with an alkalic hydroxide solution, saturated with gypsum and calcium hydroxide, achieving to transform gypsum into calcium hydroxide, and then reaction of the latter with carbon dioxide under atmospheric conditions of pressure and temperature, yielding calcium carbonate.

c. Method proposed by Professor Schwab. Transformation of gypsum into calcium oxalate by reaction with ammonium oxalate, followed by oxidation with a chlorate, yielding calcium carbonate.

d. Method proposed by Professor Lewin. Transformation of gypsum into barium sulfate, by reaction with barium hydroxide.

However, before applying any of these methods, many tests are necessary, in order to choose the best among them. We cannot, therefore, at that moment suggest any of these methods. Thus, the Caryatids will keep on deteriorating in the atmosphere for some time, unless they are transported into the Museum or climatized in situ.

Afterwards, we considered the problem of the protection of marble against acid attack and sulfation. Concerning the Caryatids, we cannot suggest any of the current methods of protection. The best solution would be the temporary, reversible transportation of the Caryatids in a climatized museum with circulation of purified air or nitrogen. If, however, this solution does not satisfy the demands of archaeologists and architects, the Caryatids may be climatized in situ by nitrogen circulation.

Concerning the walls and the columns, no known method can be recommended, before the contribution of microclimate and petrographic microstructure to corrosion is studied; before also laboratory and in situ tests are accomplished with the methods proposed by Prof. Lewin and Profs. Marchesini and Gauri, provided that the first method will precede the others.

In the meanwhile measures against pollution must be taken; fuel with a sulfur content lower than 1% must be used in the whole Athens district; only electric and solar energy in an area around the Acropolis shall be used and all industrial plants existing in the Acropolis area today shall be transported.

The biological factor in the attack of marble must not be ignored. Research on the Erechtheion must go on, in order to identify all microorganisms and find the way of fighting them.

According to a proposal by Prof. Marchesini, it has been suggested that, apart from the material used for the Caryatid copies, two more copies will be worked out of marble and placed under atmospheric conditions, in order to follow atmospheric attack and study methods of protection.

It has also been decided, after a proposal by Prof. Romanovsky, that the research group of the Laboratory of Physical Chemistry of the N.T.U. will formulate a research programme containing the goals, the methodology and the applicable methods on the subject mentioned above. This programme will be distributed to all the participants of meeting Hall B, in order to agree upon a final programme. There will also be formulated a programme of collaboration of Profs. Palleni, Curri and Anagnostidis on the problem of biological attack.

THIRD DAY OF THE MEETING. SATURDAY 10.12.77

Hall A. President: C. A. Trypanis

The third and last day of the Meeting had a common session for the two groups.

First were announced the particular results of the two groups. A general discussion followed, in which final results were formulated. Finally the participants S. Angelidis, G. Dontas, R. Lemaire, and Th. Tassios from Group A and G. Schwab and Th. Skoulikidis from Group B expressed definitively the final results, composed of 13 paragraphs.

Final Conclusions of the Meeting

The Athens Meeting, organised by the Greek Government in collaboration with UNESCO took place on 8,9 and 10 December 1977. This Meeting was in accordance to the spirit of the Charter of the United Nations within the framework of world collaboration, established by the international campaign for the preservation of the Acropolis. In this Meeting, devoted to the study of the protection measures

for the Acropolis Monuments proposed by the Greek Commission, the following were adopted:

1. The participants in the Meeting congratulate their Greek colleagues on the profound scientific approach of their study on the history and the present conservational state of the Erechtheion. They believe, that this study can be adopted as an example for the future restorations. It ensures the immediate and the high quality of the conservation operations, necessary for the preservation of the monument, with its purely scientific approach, its deontology and fidelity to the principles of the Charter of Venice.

2. The deterioration of the Caryatids and the immense danger for their preservation deriving from their being kept in situ, as they are now, was a subject of profound examination. From this was apparent, that their protection in situ by construction of the necessary climatised case, results in architectural and esthetic problems and some technical difficulties, so that this solution cannot be adopted but only as a temporary measure; in that case this solution should be applied without damaging the ancient material of the monument. A chemical treatment for the protection of the statues cannot be proposed for the time being, since there is no doubt, that it might lead to a greater danger. The participants believe, that there is urgent need for the protection of the Caryatids in an appropriate climatised museum.

3. The corrosion of the metallic elements, used for joining the ancient marble in old and recent restorations of the Erechtheion, results to severe damages on the marbles of the monument and endangers some of its structural elements. Considering, that there is no possibility of applying in situ an effective method for the protection of the metallic elements, their removal is necessary and urgent.

The deterioration of the Caryatids and the corrosion of the supporting metallic elements persuaded the participants about the inevitable and urgent character of the statues' removal and the demolition and reconstruction of the entablature and the coffered ceiling slabs in the porch of the Maidens.

4. In the removal of the metallic elements such methods and means should be applied, so that no alteration results in the texture, appearance and cohesion of the ancient material.

The participants studied a great number of methods and recommended the use of mainly mechanical methods and, in some cases, thermal lasers or chemical methods. It is, however, highly desirable, that the necessary demolition be limited to certain areas and that it be performed with the strictly scientific method, proposed by the Greek Working Group.

5. The replacement of the Caryatids by casts or other copies is highly recommended to be performed, by a material easily adopted to the texture, colour and esthetic equilibrium of the monument at the same time avoiding the confusion with the authentic elements. As for the reconstruction of the entablature and the coffered ceiling slabs, it is wished, that a structural state should be adopted, which respects, as far as possible, the authentic, architectural concept, but which also would mainly provide for the return of the Caryatids into their original places.

6. According to a proposal by Prof. Skoulikidis it is recommended, that the

metallic elements, whose replacement in the construction of the framework is considered necessary, be worked out of titanium alloys.

7. The existence of stability problems at the southern and western walls and eastern portico has been evidenced. Very probably the works of stabilization will necessitate the demolition of parts restored by Balanos. However, these works are not of such urgency as those for the Caryatids. It is therefore proposed to go on with considering the problem through the scope of many specialists, in order to allow the responsible services to take the necessary decisions in due time; those decision will be based on absolute necessity justifying such a critical intervention, which will seriously influence the future of the monument.

8. The participants have testified, to their regret, that among all known methods for the protection of marbles, there exists none efficient and harmless, that they could recommend. They have expressed the wish, that research upon the following methods should be continued:

a. Method of Prof. Lewin, aiming at the formation of barium carbonate on the marble surface.

b. Impregnation with polymer resins:

i. Phenyl-ethyl-polysiloxane (Prof. Marchesini).

ii. Polyfluorinated hydrocarbons etc. (Prof. Gauri).

9. Concerning the consolidation of gypsum layers containing original, morphic elements, which have already disappeared from the marble-gypsum interface, the participants wish, that research goes on upon the following methods:

a. Method of Prof. Skoulikidis, aiming at the immediate transformation of gypsum to calcium carbonate by reaction with carbon dioxide under high temperature and pressure conditions.

b. Method of Prof. Skoulikidis, aiming at the transformation of gypsum into calcium hydroxide by reaction with a strong alkaline solution saturated in gypsum and calcium hydroxide, followed by transformation of calcium hydroxide into the carbonate under normal temperature and pressure conditions.

c. Method of Prof. Schwab, aiming at the transformation of gypsum into calcium oxalate by reaction with an ammonium oxalate solution, followed by oxidation of the oxalate to carbonate.

d. Method of Prof. Lewin, aiming at the transformation of gypsum into barium sulfate.

It is also desirable, that according to a proposal by Prof. Marchesini and apart from the material used for the Caryatid copies, two more Caryatids should be worked out of marble and placed under atmospheric conditions in the Acropolis area, in order to study the progress of their deterioration and the efficiency of the applicable methods of protection, and to deduce useful conclusion for the preservation of the original statues.

11. According to a proposal by Profs. Paleni and Curri, research on biological attack phenomena should go on, in order to achieve a better understanding of their mechanism, their effects and to find methods against that attack.

12. Coordination of research in an international scale should certainly prove

useful. To achieve this, a detailed programme will be elaborated by the group of chemical engineers of the laboratory of Physical Chemistry at the N.T.U. of Athens, under the instructions of Prof. Skoulikidis. The programme will then be submitted to approval.

13. Atmospheric attack constitutes one of the two main reasons of deterioration of the Acropolis monuments, as well as of other ones in the Athens region (it is reminded that the other reason is the corrosion of metallic clamps). Any attempt to preservation will prove useless, if the present disastrous pollution conditions go on. Therefore, the participants address a solemn appeal to the Greek Government, in order to have the necessary legislative and technical status studied and applied, that will put an end to a situation endangering the health of the inhabitants of the city, as well as the preservation of a cultural heritage of tremendous importance.



Printed in Greece by
K. MIHALAS S.A.
Vlahaki 44 N. Psychico - Athens
Tel. 67 24 512 - 67 12 700

