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UNESCO MISSION TO ISTANBUL
NOVEMBER 1993

TO REPORT ON THE PRESENT STATE OF THE HAGIA SOPHIA MONUMENT
AND MAKE RECOMMENDATIONS FOR ITS PRESERVATION AND RESTORATION

MISSION REPORT

prepared by R J Mainstone
on behalf of the members of the mission

18 April 1994
revised 9 December 1994

FOREWORD

This report has as its origin a query addressed to the Director-General in 1993 about the state of what is now the museum of Aya Sofya in Istanbul. Originally Hagia Sophia, the principal church of the Byzantine Empire and subsequently the Ottoman mosque of Aya Sofya, this historic building is also known as Saint Sophia.

At the invitation of the Turkish authorities a mission comprising high-level experts from Belgium, Greece and the United Kingdom visited Istanbul in November 1993. It had as its terms of reference to assess the present state of the building and to make recommendations to the Turkish authorities on ways to ensure its continued safeguarding.

In view of the limited time available, it was decided to draft the report of the mission after the departure from Istanbul of its members, one of whom, Dr. Rowland Mainstone, whose involvement with Saint Sophia began in 1958, kindly agreed to undertake the task. Further consultations with Turkish colleagues proved necessary before the report could be finalized.

The excellent collaboration of the Turkish experts and officials throughout this process should be emphasized.

1 THE MISSION

The mission took place between 14 and 21 November 1993 for the purpose of assessing the present state of the Hagia Sophia (Aya Sofya) monument in Istanbul and making recommendations for its preservation and restoration.

The members were:

Professor Dr R Lemaire (University of Leuven, also Honorary President of ICOMOS)

Dr R J Mainstone (formerly UK Building Research Establishment and Professor, University of Leeds and University College, London)

Professor Dr C Mango (University of Oxford and formerly Kings College, London and Dumbarton Oaks, Harvard University)

Professor Dr T P Tassios (National Technical University, Athens)

accompanied by Said Zulficar (Division of Cultural Heritage, UNESCO)

We were received on 15 November by Ms Ülkü Izmiriligil, Dipl. Architect and Archaeologist (Director of the Central Laboratory for Restoration and Conservation) who with Nevzat Özinaç, Dipl Engineer (controller of restoration works on Hagia Sophia) outlined present responsibilities for historic monuments in Turkey as these affected Hagia Sophia and assisted us greatly by arranging meetings with the following:

Representatives of the Net Construction Company (Net Yapi) currently working in Hagia Sophia under contract to the Ministry of Culture

Professor Müfit Yorulmaz (Technical University of Istanbul, joint director with Assistant Professor Kenichiro Hidaka of the University of Tsukuba, Japan, of a structural research project on Hagia Sophia and consultant to the Ministry of Culture on Hagia Sophia restoration)

Professor Dr Mustafa Erdik (Department of Earthquake Engineering, Bogazici University, joint director with Professor Dr Ahmet Çakmak of Princeton University, USA, of another structural research project on Hagia Sophia and consultant to the Ministry of Culture on Hagia Sophia restoration)

Peter Berzobohaty and Tom Organ (mosaic conservators currently working in Hagia Sophia under contract to the Ministry of Culture with the support of UNESCO World Heritage Fund and in association with Turkish experts headed by Revza Ozil, Dipl. Conservation and Archaeologist, from the Central Laboratory for Restoration and Conservation)

Professor Nevzat Ilhan (Yildiz Technical University, also member of the Turkish National ICOMOS Committee)

Professor Dr Engin Özgen (Director General of Monuments and Museums, Ministry of Culture)

and broken windows, and (in the early summer) of condensation. There are also conspicuous deformations and less conspicuous scars testifying to a somewhat fraught initial construction followed by a long history of earthquakes and intervening periods of neglect. The last known major structural intervention was in 1926.

It is therefore timely to consider, in the light of present knowledge and understanding and present ideas about conservation objectives and practice, what should now be done to safeguard the structure from the effects of future earthquakes, to conserve what has survived of the marble and mosaic of the interior and to give back some of the lost splendour.

3 PRESENT ARRANGEMENTS FOR OVERSIGHT, CONSERVATION AND RESTORATION

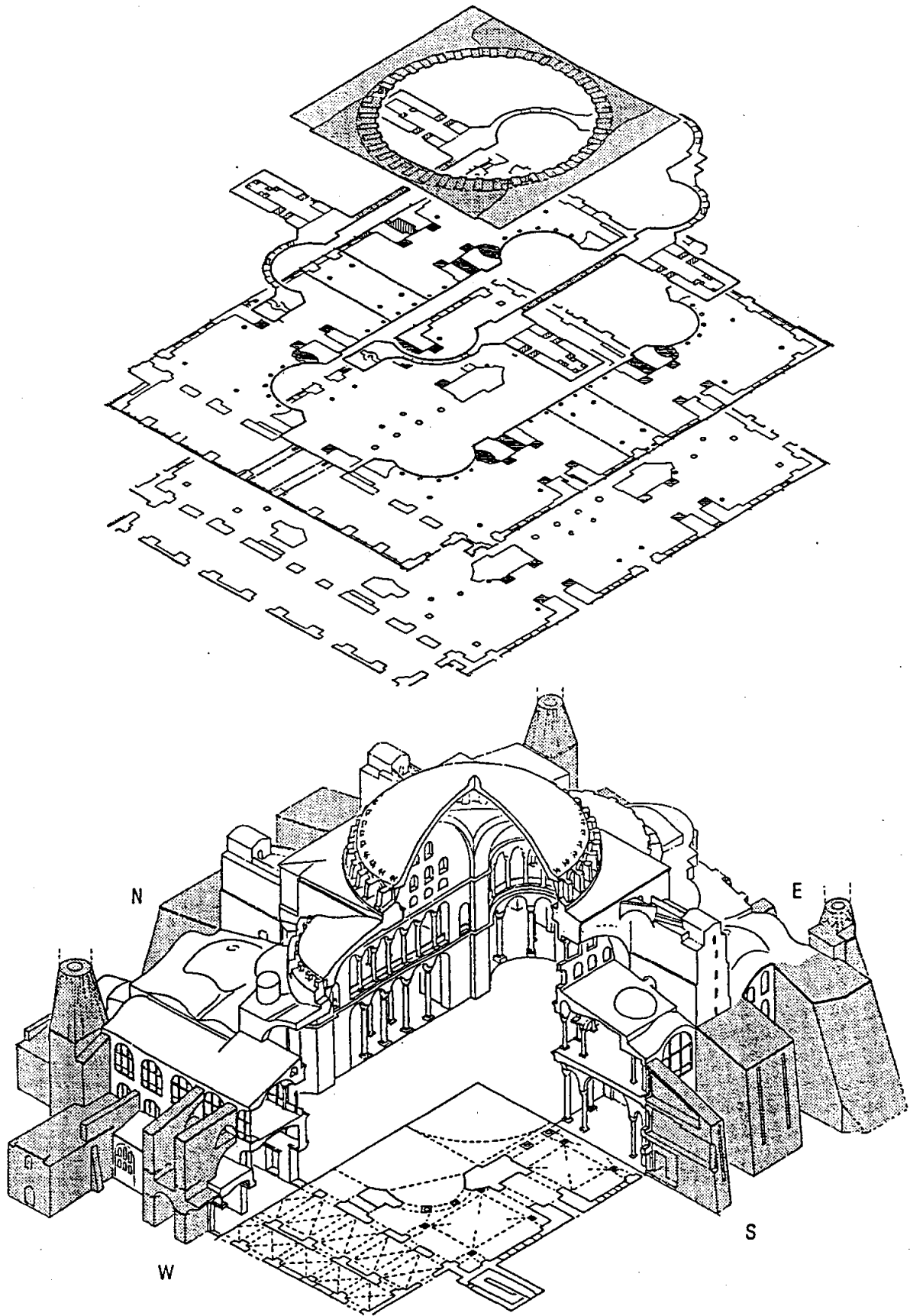
Within the General Directorate of Monuments and Museums in the Ministry of Culture, responsibility for the care of the monument is currently shared between the following three groups:

- 1) The Central Laboratory for Restoration and Conservation (Director Ms Ulku Izmiriligil) is responsible for conservation of the mosaics.
- 2) The Directorate of Surveying and Monuments (Director Mr Muharrem Oral) is responsible for the supervision and coordination of works and for payments, with Nevzat Ozinanç as controller for Hagia Sophia.
- 3) The Directorate for Culture in Istanbul (within which Erdem Yucel is Director of the Aya Sofya Museum) is responsible for the operation of the monument as a museum but not for the monument itself.

Mindful, however, of the needs outlined above and with additional funds allocated by the Ministry, the General Directorate of Monuments and Museums has recently taken a number of further steps to meet them:

- 1) An outside contractor (Net Yapi) has been appointed with a wide brief to undertake necessary restoration works.
- 2) A Consultants' Committee (consisting of Professors Ahunbay, Erdik and Yorulmaz and subsequently joined by Professor Zerrin Yilmaz Aygün to advise on humidity and condensation problems) was established in 1992 to advise on desirable works and, where appropriate, to suggest actions for urgent repairs.
- 3) A larger Advisers' Committee was also established. On this committee, members of the Consultants' Committee are joined by representatives of the contractor and of all the responsible groups within the Ministry (Museum Directorate, Directorate of Surveying and Monuments, and Central Laboratory for Restoration and Conservation) to discuss problems that call for attention and to decide on the actions to be taken by the contractor under the supervision of Mr Özinanç.

What we see as a desirable simplification of this present pattern of responsibilities is referred to in section 10 after a discussion of the main conservation needs.



Figs 1 and 2 The structure today with partial reconstructions and main additions shown by hatching and stippling (Mainstone copyright)

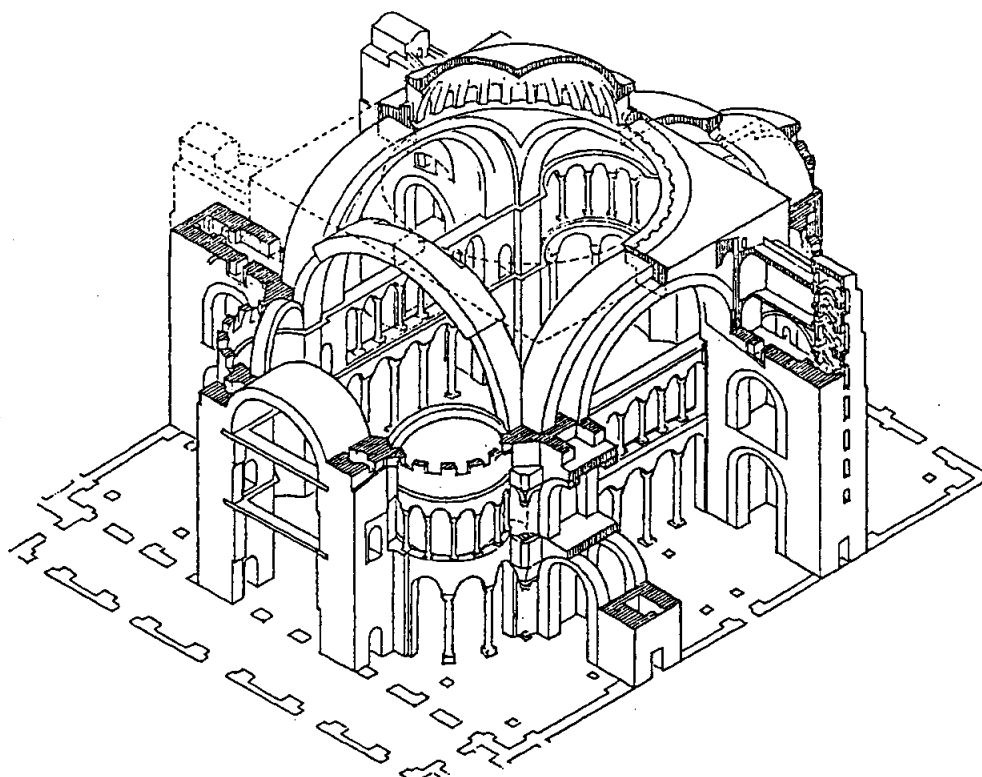


Fig.3 The original primary structure (Mainstone copyright)

As a basis for this modelling, the first need is for a distillation and critical appraisal of all that is now known about the structure, followed by the filling of significant gaps in knowledge so identified. Characteristics of the masonry (including probable zones of reduced strength), the bond or absence of bond between elements, hidden voids, and the extent and nature of cracking (including crack widths and other relative displacements) are all relevant. The modelling should also be guided by recorded patterns of response to actual earthquake shocks and, as an independent check on safety, there should be continuous monitoring of potentially dangerous long-term movements, both before, during and after any intervention. A second objective of the appraisal of current knowledge should be the precise specification of the most desirable monitoring.

Both the appraisal and the monitoring requirements are considered further in the following sections.

Distillation and appraisal of present knowledge of the structure

Fortunately there is an unprecedentedly complete and accurate record of all that it was possible to observe and measure during the period 1937-69. This takes the form partly of a vast archive at Dumbarton Oaks of field notes and unpublished drawings and partly of a published series of meticulously accurate plans, elevations and sections (Van Nice 1965 and 1986). These are the fruits of at least 50 man-years of skilled work. This record is supplemented and brought up to date by the observations of Mainstone from 1965 onwards, by photogrammetric surveys of the interiors of the dome and main semidomes (Gurkan et al.1992 and

for the large cross sections of the main elements and they are mostly less important (bearing in mind average stress levels and the likely character of seismic responses) than existing cracking. In addition to these explorations and tests, some attempt should be made to assess by suitable non-destructive means (perhaps including gamma-radiography) the continuity and likely effectiveness of the principal existing iron ties and the reinforced concrete one placed around the dome base in the most recent major structural intervention.

Below ground, the most likely need is for a continuation of the recent non-destructive tests supplemented by geotechnical boreholes around the building and limited excavation or core drilling alongside some of the piers to confirm the foundation depths, dimensions and character.

Monitoring of long-term movements

Studies of past behaviour (Mainstone 1988, 1992) show that the critical movements have been the progressive separations of the springings of the main east and west arches resulting from progressive tilting of the supporting piers. Future separations and inclinations should be monitored directly. Also desirable is monitoring of the openings of some of the cracks and joins that have contributed to the inclinations. These will include several of those over which glass tell-tales (now useless) were fixed in 1910-11.

The precise locations for all this monitoring and for that of seismic response should be specified as part of the appraisal of present knowledge as noted above.

Monitoring of seismic responses

We welcome the installation of digital strong-motion accelerometers in time to record responses to the March 1992 earthquake. The responses have shown the expected significant reduction in frequency with increase in amplitude (Mainstone 1992) as well as confirming the greater movements at the SW that were to be expected from prior evidence of greater cracking of the masonry of the SW pier.

This instrumentation should remain and should be supplemented by the installation of further transducers to clarify the modes of response. These should include a) further accelerometers at gallery level and at the corners of the dome base and b) suitable transducers to record opening and closing and/or relative slips at selected cracks and open joints (possibly proximity gauges or Hall-effect gauges).

Monitoring of the external and internal environment and other studies relevant to damage by excess moisture

Decay of materials also has a bearing on structural safety as well as on the durability of the decorative finishes discussed below. Some materials (notably those used for surface finishes) have, for instance, suffered from the crystallisation of soluble salts as a result of excess moisture movements (Massari 1992). There have been three principal sources of this moisture: rain penetration through broken windows and unsuitable or ill-maintained roof and wall coverings, rising damp from foundation level, and condensation. Some remedial

of soffit slabs, cornices and capitals, and the ample lighting gave the whole interior a sumptuous luminosity. Figural mosaics were later substituted in prominent positions on the main high vaults and many of the gallery vaults and in a few places on the flat surfaces of the walls - notably in the south gallery and on the great north and south tympana - without detracting from this overall effect.

Present condition and current work: non-figural mosaics

Much of the original non-figural mosaic remains in situ on the vaults of the inner narthex and the aisles, on the soffits of the exedrae arcades at gallery level and on the 6th century sectors of the dome. On the soffits of the lateral arcades and tunnel vaults of the gallery, on the tympana and elsewhere on the dome and other high vaults, there are extensive further survivals of later date, though there has been proportionately more loss in some of these positions.

Until recently very little attention has been paid to these mosaics - either to their precise dating or to their cleaning and conservation. But a detailed study of the dome mosaics was commenced in 1992 from a substantial scaffold under the NE quadrant.

We were impressed by the high professional quality of what has already been achieved here. The exact boundaries of the 6th, 10th and 14th century mosaics and of the 19th century and later interventions have been established and much more has been learnt about the techniques adopted and the present condition. Were it not for obstructions occasioned by working practices in the museum and by one shortcoming in the scaffold, even more could have been achieved.³ Apart from making good this shortcoming (which has precluded direct access at and slightly above the level of the window heads) we suggest that in future the team of experts is enlarged from 4 to 6 and that they are allowed to continue work after the museum is closed to the public. That should call for no more than keeping one guard on duty, entailing only a very minor expense in relation to the other costs.

Close inspection has shown the precarious state of some of the mosaic and the very different characters of the work of different periods which had been far less noticeable from the floor below. Work of high quality in the 6th century contrasts with much poorer work in the 14th and there is a marked contrast even between the Fossati interventions and later ones modelled on them. Some cleaning and the removal of rusting nails are clearly desirable. Once this is done, difficult decisions are called for about how best to conserve, or partly replace, what now exists. Ideally these decisions should be taken only in the context of the wider consideration of the whole internal aspect of the building referred to below.

The similar mosaics at ground level are now much obscured by Fossati over-painting, though partly visible through it in good light. Present indications are that they will present fewer problems. There is not the juxtaposition of work of many different periods that is seen in the dome, and the main need may be simply for careful cleaning and limited consolidation. The reward would, on the other hand, be greater. The effect could be dramatic.

may be unobtrusive in one light yet disturbing in another light. Changing reflections from surface to surface also affect appearance.

In these circumstances judgements should be made only on the basis of long familiarity under all conditions of light. And since, even with that experience, no two experts are likely to come to identical conclusions, wide consultation seems especially desirable - perhaps on the pattern of the consultations that have been taking place to guide the current exemplary work on the Acropolis in Athens. Despite the desirability of an overall strategy it may also be helpful, as in Athens, to approach it in stages. Lacunae present a much greater problem on the tympana, for instance, than on the dome and in most other places, so that experience here could help to guide later work elsewhere.

7 EXTERNAL COVERINGS AND FINISHES

Reference has already been made to the large variations in thickness of lead etc. disclosed by recent exploratory stripping of the roof coverings. Some further investigation is desirable, followed by a detailed scheme for systematic repair or replacement. This scheme should embrace substratum, timbers (where necessary) and underfelt, as well as thickness, size, cutting and jointing of the lead. A 3mm thickness is recommended, preferably of recast old lead whose impurities have usually been found to confer greater durability.⁴ Other recommendations were made by Mainstone last year at the request of the Consultants' Committee including size of sheet, underfelt, and the prime importance of detailed pre-planning of cutting and working sequences and of adequate protection from rain of all uncovered areas. In this last connection we noted with alarm during our inspections that, after recent stripping, brickwork had been left unprotected in several places at a time of heavy rainfall. This must not be allowed to continue or to happen again.

Most wall faces and exposed arch soffits have stucco rendering. Much of it was renewed at the upper levels almost 40 years ago and there was a more extensive redecoration in pink wash some 5 years ago. This choice of colour was a mistake. It is understood that further re-rendering is now intended, calling for further redecoration. The mix should be sufficiently permeable to avoid trapping water in the brickwork and should be chosen only after taking appropriate expert advice. Also the importance of taking steps to minimise exposure to rain during the work is again emphasised. Past experience shows that it is easier to achieve a reasonable uniformity with a yellow-buff colour and that this is less noticeably discoloured by subsequent weathering.

The original marble revetment remaining on the west front and the marble panels at the feet of the windows should be carefully conserved.

8 RECORDING

Uncovering of the working masonry as other work proceeds should clarify some details of the construction and structural history of the building

9 ARCHAEOLOGICAL INVESTIGATION

Much less is known of the earlier churches on the site than about the present building. The only significant excavation ever undertaken, that of A M Schneider in the NE segment of the Justinianic atrium (1935), resulted in the spectacular discovery of a Theodosian facade (probably that of the Theodosian atrium rather than of the church itself). Eventually an extension of Schneider's excavation to reveal the other half of the facade while leaving sufficient access to visitors is highly desirable, plus some selective soundings underneath the present floor.

It should also be remembered that Hagia Sophia was not an isolated building. As the cathedral church it had important dependencies abutting on it: the patriarchal palace, library, two baptisteries, treasury, school, outlying chapels, etc. There have been some minor findings south of the surviving Baptistery and behind the Director's office (1939), and outside the central north door of the church where a marble Byzantine pavement was revealed then allowed to become covered with earth (summary report Koyunlu 1990). One may also mention the emptying out of the circular Treasury which used to be filled with earth to a depth of 6m. (summary report Türkoğlu 1983).

In a comprehensive project it would be a great pity to neglect further external archaeological investigation of these dependencies within the perimeter wall of the Museum before it becomes too late as a result of the erection of new structures, the re-arrangement of the lapidary exhibits or the ultimately desirable partial repaving and landscaping. A more serious investigation of the Treasury with exterior soundings is highly desirable. It is also desirable to conduct scientific excavation on the site of the destroyed medresse, within the northwest angle of the perimeter wall and along as much of the north side of the church as may be practicable (fig.4).

10 RECOMMENDED FUTURE ARRANGEMENTS FOR OVERSIGHT, CONSERVATION AND RESTORATION

The establishing of the Consultants' and Advisers' Committees are welcome steps towards the better safeguarding of the monument. The Consultants' Committee brings to bear a wider range of expertise and the pooling of ideas and joint discussion of proposals in the Advisers' Committee reduces the risks of a piecemeal approach, with actions taken in pursuit of one objective being unnecessarily inimical to another. But we doubt whether they go far enough.

In discussions both with officials of the Ministry and with others such as Professor Ilhan it was repeatedly suggested that, to overcome fully the difficulties arising from divided responsibilities, there was a need for a "Hagia Sophia Institute" to exercise full responsibility for the monument.

We strongly support this suggestion, questioning only the name which might be misunderstood as denoting a primarily academic role.

We see such a body as the counterpart of the permanent organisations

in relation to investigations and works of conservation or restoration:

- 5) that no action should be taken on the works tentatively suggested by Net Yapi and others until they have been more fully considered (section 4).
- 6) that there is no evidence of immediate risk to the structure but that there should be a full appraisal of what is now known about it followed by further investigations and monitoring to serve as a basis for considering possible strengthening measures and realistically analysing their effects on the response to possible future earthquakes (section 4).
- 7) that there is an urgent need for the repair/renewal of the lead covering of the vaults and for its future maintenance (section 7).
- 8) that there is a need for the cleaning and consolidation of much of the internal mosaic decoration and marble revetment and some making good of losses, and for the formulation, with advice from recognised experts, of an overall policy to guide this work (section 6).
- 9) that, in relation to both 7) and 8) there is a need for further study of moisture movements and condensation and their effects with the objective of reducing damage to materials and finishes (section 6).
- 10) that, before other developments make it too difficult, some further excavations should be undertaken to add to our knowledge of the history of the monument, of its ancillary structures, and of its predecessors on the site (section 9).
- 11) that the findings, both of these excavations and of all other investigations, should be fully and centrally recorded, preferably on a data base of all previous observations and measurements (section 8).

12 FUNDING

We consider that the international importance of the monument justifies an international contribution to the costs of caring for it and preserving it for the future. Until some of the studies recommended above have been completed and desirable works specified no estimate of the eventual total cost is possible, though structural monitoring alone could cost up to several hundred thousand US dollars. We suggest looking into the possibility of a UNESCO initiative to seek voluntary contributions, particularly from states of the European Union. To this end, UNESCO funding of the recommended preliminary studies would be desirable to provide a firmer outline of needs and a costing basis.

REFERENCES

- Erdik, M, 1993, oral presentation to the mission.
- Gurkan, O et al., 1992, "Photogrammetric studies of the dome of Hagia Sophia" in Mark and Cakmak (editors), Hagia Sophia from the age of Justinian to the present, Cambridge, 78-82.