M. Zádor

Ancient Civilisation - New Technologies

In the international practice of monuments preservation there are two fundamental insights justifying the increased attention paid by this typically interdisciplinar /or more precisely said multidisciplinar/ activity to recent achievements of natural and technical sciences.

One insight is that the older, the more ancient the culture of which the monument is a material document, the newer, the higher developed technical achievements it requires to be conserved, to be preserved for the future.

The other insight, increasingly manifest, is that new technique is at the same time a factor endangering the monuments. This is related partly to the known problems of environmental pollution concomitant to industrial development, in particular, acid rain /my views on the relevant new research results see later/, and partly to damages due to recent techniques applied without the necessary, careful diagnostic tests, or upon wrong decisions. Damaging effect is understood here not only as unskilled or inconsiderate application of new processes but also as the moral damage caused by the failure to deter competent authorities from the justified, often exclusively efficient application of the new methods. All in all, both a daring irresponsibility, and a "conservative corservator" may finally destruct our oldest, most valuable cultural remnants.

These considerations are underlying the work done at the research basis of Hungarian monuments preservation at the Technical University of Budapest, some new achievements of which I deem to be worth to call the attention of this Symposium.

1. Methodology of preliminary diagnostic tests

Against destructive agents, otherwise objective and partly necessary factors in the development process of modern civilization - in spite of international and national specifications, restrictions for the emission - monuments preservation requires effective "defensive arms". Obviously, among them, primarily the diagnostic test methods determining causes of the monuments destruction process and the rate of damaging, as well as their practical implementation have to be internationally considered.

According to observations in Hungary, there has been an important development in diagnostic tests on timber and metallic materials, and recently, on stones. In this respect let me point out the activity of this RILEM - ICOMOS Working Group. Nevetheless it cannot be stated - in spite of my long-time efforts in this field - that a clear-cut cooperation system has developed in diagnostic tests previous to building conservation hence, not of that of museum exhibits. In this scope let me stress the following problems:

- building monuments have to be investigated as architectural integrities where the building materials to be consolidated share structural, functional and aesthetical unity of the given building;

- accordingly, the architect responsible for the project /or in certain cases the stone carver restaurator/ is not able, in addition to his managing-coordinating function, to cope with diagnostic tests at an up-to-date technological level himself. But the same is true for chemists, physicists, biologists, petrographers, etc., indispensable co-workers in this work. Unfortunately, laboratory achievements on single stones do not enable them either to act as experts in themselves of the complex problem of a monument. A more efficient teamwork where no representant of a given profession would think of himself to be able to make an expertize in himself decisive for the consolidation of e.g. a stone fasade, or if the architect managing the project possessed only professional skill enough to collaborate with professionals of marginal sciences - would preserve several monuments from perishing. Such an inter-disciplinarity of our civilization would enable itself to protect remnants of ancient cultures to a degree as the destruction created by itself.

Specialized teams of our research basis have had new achievements:

- as reported earlier on previous conferences, in-situ measurement of wall moisture, as well as a simple and rapid method and tool for building survey feasible by a single person /WEZA telemetry/;
- development of complex instrumental methods and of simple, generalizable manual means for in-situ tests of stone masonry weathering;
- consolidation of adobe-walled folk architecture monuments, taking care of an "optimum moisture" percentage still permitting the building to be used but preventing pulverization of the adobe, and most favourable for the wall consolidation process;
- getting aware of the adverse effect of some substances applied to repair joint mortars and stones as well as for stone replacement, elaboration of novel-type materials and formulae;
- elaboration of methods for exact dating of mortar and brick materials of historical buildings.

2. Analysis of destructive agents

A new feature of this age, also of importance for monuments preservation, is that, being aware of environmental pollution effects of industrial and urban development, UNESCO, just as governmental, professional and social organizations all around the world, endeavour to solve fundamental environmental problems. Although these endeavours are still far from being effective

/for instance, realization of the agreement concluded within ECE/UNO to reduce the emission by 30 % to 1990, is generally felt to be far from being promising/. I am afraid monuments preservation even dispenses with available possibilities, such as to bring an action at monuments authorities against those responsible for atmospheric pollution damaging to monuments: contacts between environmentalists and monuments preservators, etc.

All these are preconditioned, in addition to knowledge of general international and local features, by the exact knowledge of quality and rate of aggressive agents acting on a given monument or complex. It is hard to understand why precisely determined, mapped atmospheric pollution data are unknown to those concerned with monuments preservation. In spite of space shortage, let me refer to an example somewhat in details.

No doubt, the much discussed acid rain is one of the worst enemies of limestone fassades and of lime painted surfaces. The destructive effect of acid rain passing through borders, sometimes as strong as 4 to 5 pH, seems a somewhat excessive simplification according to our investigations.

In this country, the fifth in Europe as concerns the sulfur dioxide per sq.km, exact analysis of acid rains /below 5 or 6 pH/ is of special importance. Emission of nitrogen oxides has increased by 40 % from 1970 to 1980.

In the scope of multidisciplinary cooperation between marginal sciences, data delivered by the Institute of Meteorology are not irrelevant either, such as freezing-thawing cycles, yearly hours of sunshine on a fassade temperature, driving rain, and of course, atmospheric pollution. In this country /medium in this respect in Europe/ rain pH values range from 3 to 9 pH, hence, it may deviate from 7 /natural/ even toward basicity. Now, what is the cause of damaging clearly visible on monuments surfaces, transformation of calcium carbonate to calcium sulfate hence gypsum?

According to measurements in the Buda Castle district, <u>dry deposit</u> of sulfur dioxide + sulfur trioxide on 1 sq.m /126 g/ exceeds rain-borne acid pollution and it is responsible, together with the atmospheric moisture /<u>not only</u> rain/, for the transformation of 200 to 300 g of lime in 4-5 years.

Thus, rather than to speak of the effect of acid rains in general, such <u>exact</u> measurements permit a realistic prognosis of the destruction process, calling for a differentiated surface protection.

These investigations also here pointed out a hitherto little known, serious effect of carbon dioxide, with important consequences for the consolidation.

All these are meant to stress the multidisciplinary cooperation for determining actual origins and rates of destructive agents threatening even the most valuable monuments.

Let me make an organizatory-type comment. Cooperation between marginal sciences is rather difficult if staff members of different institutions have to be addressed to still before beginning the work proper, before availability of technical

implements /e.g. scaffolding/ and of funds. For the Hungarian monuments preservation it is favourable to be in the position to rely on the personal and material basis of the some 100 departments at seven faculties of the Technical University of Budapest so that the management is done by architects rather able to survey the project.

3. Recent achievements in the consolidation of monuments threatened by civilization concomitants

In Hungary, the most threatened monuments are made of either of two fast deteriorating building materials: adobe and a low-grade, porous coarse limestone.

The great majority of folk architectural monuments, rural houses have been made of adobe, using different skills. Actually, with the revival of adobe as building material for modern architecture, it's especially proficient to possess means to consolidate adobe walls - at the cost of multiannual research work and experience obtained in practical applications.

This times the starting point has been the quoted principle of "optimum moisture content". Experience of some 15 years made with the patented Silicophob-Anhydro chemical wall dampproofing method and the observed consolidating effect of one component, in addition to its effect to protect the adobe against humidity /at about 90-95% vapour diffusion/ has been of great help for us. This effect is manifest at the location of maximum weathering: at the footings.

Those among our coarse limestone monuments /i.e. some 80% of the total/ still exempt from weathering, thus, in no need of consolidation /a primordial diagnostic problem!/ raise no specially difficult problem. As I already outlined at international meetings of the last two decades, a properly selected field of application, adequately prepared surface /strong, clean, smooth/, proper water repellent and technology, as well as systematic maintenence treatment every 10 or 15 years keeps them safe. These are, however, only cases of a preventive treatment relevant to a minor exclusive part.

The other, more serious case is that for weathered surfaces in need of consolidation, a world-wide much discussed problem. For sandstone and tuff, imported agents were quite effective. As concerns, however, weathered coarse limestone, the most frequent in Hungary, adequate consolidation results could not be reported before 1986, at the international stone consolidation congress in Lausanne. Since then, stone consolidating agent called ZKF, - employe's patent of the Technical University of Budapest - has been purchased by firms abroad, and its practical application is booming. Recent tests support its consolidating effect from 60 to 300 %, and 10 to 15 cm penetration at a vapour diffusion of about 85 to 90 %, inachieved to now by any compound.

It is of special importance for us now, in this period of restauring extensive stone public offices, that the same material serves as basic material for the reconstructed stone applied for

replacing and repairing, and even for the joint mortar, providing for unified physical and chemical properties of all the stone surface.

So much of the civilization harms to our monuments, and of our principles and recent methods of protecting them.

References

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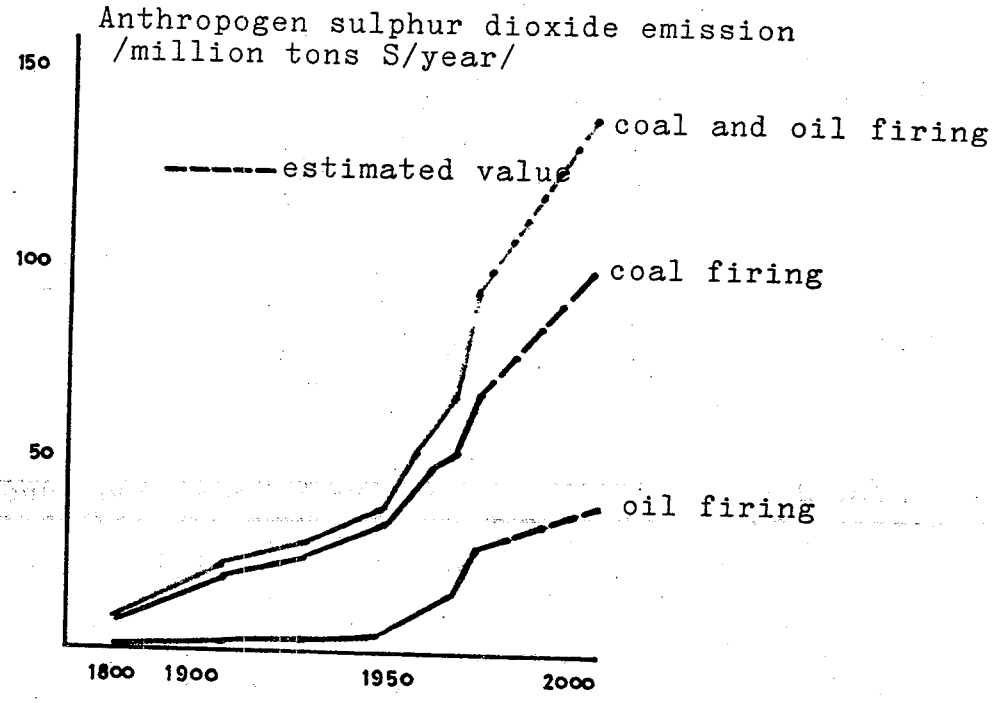

Diagram 42.
The increasing tendency of the sulphur dioxide emission o of world in course of the 100 years past. Since the turn of our century the emission has been increasing approximately tenfold. Up to 2000 even higher emissions have to be anticipated. /According to the scientific investigations of G. Várhelyi./.

M. Zádor

Ancient civilization - new technologies

Summary

The first part of this lecture intends to deal with the destroying factours causing the increasingly rapid impairmnet of our built environment and especially of our most valuable buildings, the architectural monumentts, based on most recent international information.

These threatening factors are-to a certain extent - necessarily and irreversibly associated with technical development, so they have to be counted with as real factors - even if hard efforts are made to reduce their devastating effect.

On the hand it's just technical development that provides us with much more effective weapons for the protection of our cultural treasures, our historical monuments of irreplaceable value.

The more comprehensive part of this lecture wants to give an outline of those most up-to-date mrthods used for diagnostic tests and for the long-lasting conservation of monuments which have been developed and elaborated recently in Hungary and primarily at the Techical University of Budapest, the technical-scientific basis /centre/ of research work for the protection of monuments in Hungary.

Such a new result is, for example, the system of the complex diagnostic tests, which have to be performed under the leadership of an architect specialized for the preservation of monuments and having a special knowledge of this field - with a comprehensive multidisciplinar cooperation.

About 100 Institutes and Departments as well as cooperating Institutes of the 6 Faculties of the Technical University of Budapest - existing for more than 200 years - have dispose of personal and objective possibilities which render the solucion of these problems possible. A number of new technologies were developed and several patents granted as a result of the scientific work in the field of the diagnostification methods of buildigs, their protection against humidity /their damp-proofing/ their cleaning technologies as well as the conservation of stone fasade.

We managed to solve the problem of hardening the weathering and wearing away of soft limestone surfaces of which the majority of our monuments were built, furthermore that of the conservation of the Hungarian vernacular monuments and adobe building materials.

It's not my intention to discuss these technologies in detail; the coming congress will offer a possibility to discuss all special fields of interest. My lecture rather attaches an importance to the fact that - if we consider the increasing environmental damages as an inevitable reality - a country with an appropriate financing and science organising system is in position to carry out a succesful fight againts this ese destroying factors, presuming a well-coordinated, multidisciplinar collaboration of all fields of research and of all professional lines concerned.

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Civilisation ancienne - technologie nouvelle

Premièrement les agents destructifs seront considérés, en possession des dernieres données internationales, qui sont responsibles pour la déstruction accélérée de l'environnement bâti, comprenant celle des plus appréciés: les monuments architecturaux.

En part, ces agents déstructifs résultent inévitablement et irréversiblement du développement technique, dont - à part des efforts de mitigation - il faut compter de leur existence en facteurs réels. En même temps c'est exactement ce développement technique qui permet d'appliquer des armes beaucoup plus effectives qu'auparavant en défense des monuments culturels d'une valeur irréplaceable.

Après cela, celles des méthodes récentes pour la préservation permanente, issues récemment à l'Université Technique de Budapest, base des recherches techniques - scientifiques de la préservation des monuments en Hongrie, seront présentées.

Ces résultats nouveaux comprennent p. ex. le système des essais complexes diagnostiques appliqués sous la direction d'un architecte compétent en restauration des monuments, possédant des connaissances spéciales dans ce domaine, avec une coopération extensive multidisciplinaire.

Cette université a six facultés comprenant une centaine d'instituts ou de chaires, collaborant aves les instituts de recherches, qui possèdent des dispositions personnelles et matérielles pour solver ce problème. Plusieurs procédés et patents en sont nés concernant le métrage des bâtiments, leur protection contre l'humidité, le nettoyage et la consolidation des façades en pierre. C'est comme nous avons réussi à consolider des surfaces en pierre calcaire tendre effritée, constituant la plupart de nos monuments, ainsi que la conservation des briques en torchis et du pisé. De même, un patent d'employeur de l'Université fut développé pour le nettoyage des façades en pierre.

Au lieu d'entrer en détails, nous accentuons la possibilité - considérant le danger des nuisances environnementales comme des réalités - pour un pays en possession d'un système adéquat d'organisation et de financement de recherches, aves la collaboration coordonnée multidisciplinaire des spécialités intéressées, de surmonter effectivement ces agents déstructifs.