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Group Report: How Can We Ensure the Responsible and Effective Use of Treatments (Cleaning, Consolidation, Protection)?

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GENERAL INTRODUCTION

Our group examined issues related to the responsible and effective use of conservation treatments. It is important to state from the beginning that (as defined in our brief) we considered only "surface" or "surface applied" treatments and did not discuss structural interventions. Clearly, buildings are systems and structural concerns must be addressed prior to surface treatment; but we had to limit our scope in order to focus the discussion and to arrive at some reasonable conclusions. The composition of the group was heavily weighted toward science and technology. However, invaluable input was received (especially as regards ethical and management issues) from members of other groups.

Saving Our Architectural Heritage: The Conservation of Historic Stone Structures
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The following report outlines areas chosen for discussion. The topics are broad-ranging and somewhat disparate but were chosen as those most likely to reveal gaps in knowledge and future research needs. Questions were formulated in response to the background papers and from a consideration of the comments submitted by conference participants. Each section of the report contains a summary of the group discussion on the established topic and some indications of areas requiring future study. The paper concludes with a series of summary recommendations.

DEFINITIONS

The responsible and effective use of treatments demands adherence to sound theoretical and technical principles. The group felt that it was necessary to clarify certain terms and to redefine some criteria before discussing particular issues.

Reversibility

Along with minimum intervention, the concept of reversibility has been considered to be one of the principal requirements of conservation treatments. However, in the case of the treatments under discussion, reversibility is often not achievable and in some instances (as in the case of cleaning treatments) is not applicable. Prompted by the suggestion made by Sasse and Snethlage (Chapter 12) as well as discussions which have long taken place in the field, it was proposed that the requirement of reversibility be replaced by the demand for compatibility and retreatability.

Compatibility

A treated material should have mechanical, physical, and chemical compatibility with the untreated historic materials under consideration. Simply stated, compatibility means that introduced treatment materials will not have negative consequences.

Chemical compatibility can be understood to mean that there should be no undesirable chemical reactions between treatment materials and the historic substrate and that no harmful by-products will be formed. In addition, a treatment material should not provide a nutrient source for encouraging biological growth.

It is argued that materials which are extremely different from natural masonry materials (e.g., acrylics, epoxies) should not be used for conservation; that is, repairs should reflect a philosophy of "like for like." Clearly, it is always preferable to intervene minimally and with materials that are as similar as possible to the historic materials. And other values like color, texture, and esthetic presentation must be considered. However, as long as there are no negative consequences which can be predicted, even "dissimilar" materials should not be ruled out.

Though not considered at length in this paper, environmental and human safety issues (as established by relevant legislation) must also be considered in determining the compatibility of a given treatment.

Tolerance Limits

Theoretically, it may be desirable to "improve" some characteristics of a material as long as there will be no harmful consequences. For example, Sasse and Snethlage (Chapter 12) propose that mechanical properties may be improved through consolidation as long as "strengthening" does not exceed the mechanical properties of the original material. In actual fact, terms like "stone strengthener" are misleading. The objective of treatment is an increase in durability rather than strength.

It is obvious from the above discussion that acceptable compatibility tolerance limits need to be established for various properties and materials. The tables proposed by Sasse and Snethlage (12.2–12.6) might be considered a starting point for various treatments of sandstones based on present experience, but we need systematic research to confirm suggested tolerance limits and to develop parameters/values for other treatment materials and substrates.

Retreatability

Retreatability can be defined as the possibility of applying a new treatment without negative results. Simply stated, a retreatable material (or its aging) would not preclude further treatment. Since it is difficult to predict the aging characteristics of new materials, the safest course is always to wait until materials have a reasonable track record before utilizing them on historic buildings.

However, even if a material is judged to permit retreatment, the results of retreatment are largely unknown. In the case of water repellents, for example, the uneven distribution of the material both before and after reapplication could create both physical and aesthetic problems.

There are currently a few research projects which are examining the issue of retreatment. One EC-funded project[1] is examining mostly hydrophobic materials and ethyl silicates used twenty years ago. Samples are being subjected to artificial aging and are then retreated with consolidant materials in use today.

The issue of repointing a surface treated with a water repellent has been studied by the Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek (TNO Building and Construction, The Netherlands). Results indicate that even on freshly treated water repellent surfaces, it is possible to repoint utilizing proper techniques (Polder and Korf 1991). And since, in the majority of cases, repointing will

[1] EC project EV5V–CT94–0518: Re-treatment of Consolidated Stone Faces. Collaborators are:

- Gifford and Partners Ltd., Carlton House, Ringwood Road, Woodlands, GB–Southampton SO40 7HT
- Institut für Bauforschung der Rheinisch-Westfälischen Technischen Hochschule Aachen, Schinkelstr. 3, D–52062 Aachen
- Hoechst Portuguesa A.S., Apartado 6, P–2726 Mem Martins Codex
- The University of Surrey, Guildford, GB–Surrey GU2 5XH

occur some years after treatment, there will usually have been a decrease in the effect of the water repellent in the contact zone. However, it is still critical to have adequate documentation to ascertain the type and location of previous treatments, and this is often not available.

Despite these preliminary efforts, it is clear that more research is needed in the general area of retreatment. Such work should be expanded to include a variety of substrates and treatment materials.

Effectiveness

Treatment should be considered effective when it slows the rate of decay and increases durability. Effectiveness is usually measured against goals set prior to treatment.

Cleaning

In this regard, the case of cleaning is somewhat special (see also Sasse and Snethlage, Chapter 12). Cleaning should really only be carried out when necessary to remove deleterious substances from the surface. However, cleaning may also be desired to restore the esthetic integrity of the object. In cases where surface deposits are judged to be harmful, it is best to remove them as soon as is reasonably possible. The objective should be to remove accumulated material without harming the surface.

That said, not enough is known about the tolerance parameters for cleaning. Research is needed to establish what properties are critical and the limits within which they can be altered. It would also be extremely useful to develop methods for the field evaluation of the effects/effectiveness of cleaning.

Measurement of Effectiveness

Indicative properties must be established for various treatment types. For example, in the case of consolidation, depth of penetration might be considered a measure of effectiveness. Alternatively, it might be better to say that at least the decayed zone has to be penetrated rather than citing a specific depth.

Again, the effectiveness table proposed by Sasse and Snethlage (Table 12.8) might be considered a starting point. However, these data are specific to a certain treatment in certain types of stone. Some useful models might be developed by adopting the parameters/format established in the table, without the accompanying values, and then elaborating this model for other substrates and conservation materials.

It is also clear that we need a data base of treated buildings in order to better understand the long-term effects and effectiveness of treatments. Some attempts have been made to gather such information (Lazzarini 1979 and current efforts by the Stone Working Group of the Federation of European Chemical Societies), but data are incomplete and have not been systematically organized. Obviously, there are considerable administrative, political and technical obstacles to creating an inventory of treated sites.[2] However, the collection of such data to an agreed format would be of exceptional value and should be promoted.

TEST CATEGORIES/QUALITY CONTROL

Sasse and Snethlage (Chapter 12) and Charola et al. (Chapter 13) make a strong case for the quality control of conservation materials. However, before conducting a series of quality control tests, it is essential to identify precisely the aim and objectives of this important and potentially costly activity.

Six categories of quality control tests were proposed (based on proposals by Sasse and Snethlage, Chapter 12) addressing different aims, types of laboratories, and regulatory authorities. The group evaluated each category, elaborated certain aspects and made recommendations for research where gaps in the knowledge were identified.

Category A: Preliminary Screening Tests to Determine the Effects of the Product

To avoid the introduction of potentially harmful (or ineffective) treatment materials, a comprehensive set of laboratory tests (including natural and artificial aging) should be performed before a new product enters the marketplace. Of course, these tests are costly and sometimes require lengthy test periods (e.g., durability tests). However, this category of test would only need to be performed once for a product, and the costs are negligible compared to the possible negative consequences of a product which is not suitable for its intended use and/or potentially harmful to historic fabric.

Such tests would compare treated and untreated samples of unweathered reference stones (depending on location) and perhaps (at least for consolidants) a reference aggregate which could be easily reproduced.

The investigation should include mechanical and physical tests as well as artificial aging and field trials which will differ depending on the intended use of the product in question (e.g., hydrophobic treatments, repair mortars, cleaning products, etc.). Tests should also be included to determine the tolerance limits of the material for different parameters such as temperature, relative humidity, salt content, water content of pores, etc. at the time of application.

Finally, such preliminary screening should include tests for biological susceptibility ranking to determine whether the product can act as a food source for microbes. Koestler and Santoro (1988) provide a methodology for ranking products for their

[2] It should be noted that a proposal for a Census of Treated Monuments was part of the NATO–CCMS Stone Pilot Study Proposal published in *Conservation of Historic Stone Buildings and Monuments* (Baer 1982). Subsequently, several attempts were made to undertake such a project, including one by the U.S. National Park Service.

susceptibility to fungal attack which can be adapted for other microbes. This category of testing would be carried out by the industry or a qualified independent laboratory.

Proposed Categories of Treatment Materials

The intended use of any product should be clearly defined so as to develop a suitable battery of tests for each category. After a lengthy discussion, the group agreed on the following list of material groups:

- cleaning materials
- consolidants
- water repellents
- biocides
- mortars
- coatings (film-forming and nonfilm-forming)

Though the term "protective" is sometimes used to describe various conservation materials, the term was intentionally excluded from the list because it is rather vague and potentially misleading. Obviously, as new products (like anti-swelling agents) appear on the market, the list may have to be expanded and appropriate tests developed.

Samples for Testing

As discussed above, it is suggested that such preliminary screening tests be carried out on unweathered samples of reference stone. This can pose problems when the samples are of relatively low porosity, especially in the case of consolidants.

Though the concept of aged samples is an attractive one, it is presently difficult to age stones in a way which reflects reality and does not contaminate the samples. Salt is an effective aging agent but contaminates the samples. Freeze-thaw aging may be a possibility but it is not clear that representative and reproducible samples could be achieved. This is certainly an area where research would be of value. Viles et al. (Chapter 6) provide additional information on the subject of artificial aging.

Category B: Adjustment Tests

These are tests to determine the suitability of a treatment in a particular case. (A term other than "adjustment" test may be more indicative.) Such tests would involve a comparison of treated and untreated samples for defined properties.

If possible, treatment materials should be applied in the laboratory as they would be in the field. Application should follow the recommendations of the manufacturer, adjusted for scale and for specific types of substrates. It is also important that testing conditions (temperature, relative humidity, etc.) should reflect conditions in the field (Appolonia et al. 1995).

As a second step, following the *laboratory adjustment tests*, products should be applied to test panels and evaluated under field-exposure conditions to prove their practical suitability. This recommendation raises the problem of standard procedures.

Although national and international standards exist for various laboratory tests, there are no such standards for test walls for the evaluation of conservation products. Thus, at present, it can only be recommended that test walls reflect as closely as possible the material type, construction system, and exposure conditions of the site/location in question. However, international cooperation is needed to develop appropriate and uniform standards for test walls which provide guidelines regarding wall composition, size, and construction as well as characterization and application of products, length of exposure, exposure conditions, evaluation and measurement of decay, etc.

Level of Testing/Minimum Tests

Clearly, the level of testing must be adjusted to suit the importance and complexity of the object. However, it was suggested that some guidelines as to the minimum indispensable tests for a range of treatments would be useful to practitioners. The tests should be well defined according to standard procedures[3] and within the capabilities of most laboratories. Based on the reality of conservation practice (where funding is often lacking for large-scale testing programs), it would also be useful to restrict the number of tests to a feasible level.

The group attempted to define a list of minimum tests for the indicated treatment categories. Though this issue should be studied further, a first indication of minimum tests for each material might be as follows:

Cleaning Materials. Effectiveness can only be evaluated case by case on the monument itself, because it strongly depends on the nature of the soiling to be removed. The cleaned surface should be observed with a portable optical microscope. When the main aim of cleaning is salt extraction, the effectiveness can be evaluated by electrical conductivity measurements of the water extract.

To test the potential danger of a cleaning method, at least the following parameters should be measured, before and after the treatment:

- color
- surface roughness
- water absorption by capillarity through the treated surface.

3 The whole issue of standard procedures is a rather complex one which cannot be considered in-depth here. Many of the tests mentioned in this section are defined in national (e.g., DIN, BSI, ASTM, etc.) and, in some cases, international (e.g., RILEM, ISO, etc.) standards. However, such standards differ among themselves, making comparison of test results difficult, if not impossible. In addition, most of the standard procedures have been designed for purposes other than the evaluation of conservation products and may not be entirely appropriate (or useful) for this purpose. This issue has been of concern in the architectural conservation community for some time. There is clearly a need for international cooperation both to harmonize existing standards and to recommend appropriate testing procedures for the evaluation of historic building materials and conservation products.

The observation of the treated surface and of polished cross sections under optical microscopy is also advisable.

In the case of chemicals for cleaning, at least pH and specific electrical conductivity must be measured.

Consolidants. The absolute minimum tests which should be carried out when it is impossible to take samples from the monument are:

- visual inspection of cleaning trials (if any)
- amount of penetrated consolidant per unit area (over time)
- visual (or instrumental) inspection of color and gloss changes
- water uptake (before and after treatment)
- resistance to drilling (if some invasive measures are permissible).

If possible, it is desirable to take some representative samples from the monument for the following laboratory tests which should be performed before and after treatment:

- pore-size distribution over depth (microscopical and Hg-porosimetry)
- water vapor permeability
- penetration depth
- strength and modulus of elasticity (if information over depth is necessary, tests could be performed on thin sections from 50 mm cores using biaxial bending)
- shrinkage and swelling.

From these tests, it would be possible to optimize the application procedure and to calibrate computer simulations of water distribution due to climatic influences.

Water Repellents. Minimum tests would include:

- color change
- drying rate
- water absorption under low pressure (Karsten tube)
- water vapor permeability
- capillary water absorption.

In clay-bearing stones, shrinkage and swelling tests are required.

Biocides. Tests should be run for at least the following:

- interactivity with other treatments
- visual changes to the surface (color, gloss, texture)
- effectiveness in removing target organisms, general organisms, and biopolymers.

Mortars. To a certain extent, tests will depend upon the function that the mortar will perform in the building (e.g., mortar repair, pointing mortar, etc.). In general, the visual, physical and chemical properties of a conservation mortar should be similar to those of the original mortar and compatible with the brick or stone with which it is in contact. It is, thus, critical that both historic and replacement materials be tested.

In addition to the assessment of visual properties, minimum tests (especially on pre-mixed materials) would include:

- water vapor permeability
- capillary water absorption
- soluble salt content
- drying shrinkage.

In the case of mortars which are required to fulfill a more structural role and where reasonable data could not be determined from known values (e.g., standard tables for various types of binders in typical mix ratios), tests might be required to determine:

- compressive strength
- modulus of elasticity
- coefficient of thermal expansion.

Film-forming Coatings. Tests should be performed for the following:

- color change, light fastness, gloss
- adhesion to the substrate
- water vapor permeability
- capillary water absorption or water absorption under low pressure (e.g., Karsten tube)
- drying rate
- removability.

In addition, specific tests might be required for specific applications such as removability of graffiti for anti-graffiti coatings, covering power for paints, or wear resistance for floor coatings or exterior paint.

Anti-swelling Agents. This category has been added as an example of a new product group. Minimum tests would include:

- swelling and shrinkage before and after treatment
- depth of penetration as it relates to the critical zone (minimum required impregnation).

Category C: Application Tests

These tests are really just monitoring procedures which are made on the building site before, during and after application to ensure that various parameters (temperature, relative humidity, etc.) are kept within acceptable limits for the material in question.

In addition, the quality and uniformity of workmanship and the correctness of the application procedure should be controlled.

This is an area where future research should be promoted to develop nondestructive methods for both the determination of properties like moisture profiles and the verification of correct application procedures (quality control) in the field.

It would also be useful to develop better modeling based on recent work carried out in Germany (Garrecht et al. 1991; Künzel 1994; Künzel et al. 1995; Künzel and Krus 1995; and Mayer and Wittmann 1996).

Category D: Product Conformity Tests

These are tests to assure that the product to be used is identical with that tested in categories A and B. As pointed out by Charola et al. (Chapter 13), conservation products for building materials can vary widely in uniformity and quality control. Many products are reformulated from bulk materials by intermediary dealers and there is no guarantee that a bottle bought today will contain exactly the same mixture as the one bought from the previous lot.

It is obviously impractical to demand that every bottle of material which arrives at a worksite be tested. However, it is advisable to check the composition of each batch. In general terms, this should be possible with relatively inexpensive tests which would ensure that materials are basically of the same composition. However, it is difficult to identify low quantities of, for example, additives which might have dramatic consequences for durability including biological attack. Future research is needed to develop tests and tolerance limits in this and the following category.

Category E: Industrial Quality Control

This is more an issue of standardization and regulation than of testing. Manufacturers of conservation products should be required to identify product components and provide at least a minimum of technical data (as is required for the pharmaceutical industry, for example). Such regulations may take some time to achieve and undoubtedly will be strongly opposed by the manufacturers (who admittedly are often not informed when their suppliers change the composition of raw materials). Nonetheless, the issue should be pursued on the appropriate political and legislative levels.

Category F: Long-term Assessment Tests

This is an important category which has been neglected to date. Essentially, it involves the monitoring of treatments over time to assess long-term effectiveness.

In order to make such assessments in a useful way, we must determine what parameters to measure and further develop the necessary nondestructive techniques to carry out the measurements. Assessment is also dependent on the quality of the graphic and written documentation of the treatment which provides a baseline for future evaluation. In this area, too, further research is required to improve and standardize documentation and reporting systems.

ARTIFICIAL AGING

The group discussed two principal categories of artificial aging:

1. *Artificial aging of reference samples.* This relates to the discussion of preliminary screening tests for conservation and the desirability of representative and reproducible weathered samples for standard tests.
2. *Reproduction of natural weathering for the artificial aging of treated and untreated samples.* This type of aging would be extremely useful in predicting the performance of various materials if useful correlations could be made with real field conditions.

In our discussions, the view was expressed that both categories of tests required further development. In terms of artificially weathered reference samples, it would be difficult at present to produce reproducible samples in a reasonable period of time even with homogeneous stones. Similarly, though laboratory artificial aging can assist in understanding the parameters (salt crystallization, thermal and hygric stress, etc.) which lead to decay, it cannot be correlated with what occurs on an exposure site. There is also concern that attempts to accelerate aging in chamber experiments may actually alter the mechanisms which cause decay in natural conditions.

Clearly, more research is needed both to understand complex decay mechanisms and to correlate the results of artificial aging tests with those of field-exposure trials. Existing literature (e.g., Price 1978; Fitzner and Kalde 1991; Feller 1994; Price 1996) should be reviewed as a starting point for such research which should also examine methods of artificially aging samples to produce various types of damage.

BIOFILMS

Questions were raised about ways in which the problem of biofilm interaction with conservation treatments could be further investigated.

It is postulated that biofilms may create an "interference" layer between any cleaning or treatment applied to a stone surface. A biofilm is defined as layers of microorganisms (including dead organisms), their secretory products, and any adventitious material entrapped therein. Biofilms have been found up to ten centimetres into the stone. The interference may manifest itself in a variety of ways that could alter the apparent effect of a treatment. For example, a cleaning "biocide," intended to remove a target organism may not reach that organism depending upon the layer of biomolecules present (Koestler and Salvadori 1996). Another type of interference occurs if the biofilms restrict the flow of surface treatments — e.g., a consolidant or waterproofing agent — from reaching the surface. This could result in a spotty treatment and a reduction in depth of penetration of the product.

In testing for biointerference, the following must be considered:

1. Is a biofilm present?
2. What is the extent and depth of it?
3. What do we need to know about it?
4. What organisms do we need to test for (if any)?
5. What biomolecules do we need to test for (if any)?

6. How do we test for points 4 and 5?
7. How can we test for potential effects of biofilms rapidly, and preferably without having to identify the components of the system?

Research and development is required in several areas including:

- the amount and characteristics of biofilm interference with treatments (e.g., effect on penetration of treatments, by-product formation) through empirical tests with naturally aged stone,
- whether it is necessary to identify all, some or none of the components of a biofilm in order to treat or assess the effect of interference on the treatment. If the identification of biofilm components is necessary, research will be required to develop methods and rapid field test procedures or kits,
- the effect and effectiveness of newer, more environmentally friendly biocides on stones (and biofilms?).

EVALUATION OF TREATMENTS

How can we evaluate the long-term benefit to a building of a particular treatment? What is the benefit of maintenance in increasing the life expectancy of a treatment and in reducing the need for treatment in general?

Figure 16.1 is an extremely simplified model of the decision-making process and available options in the care of any historic building or monument. Various factors influence the decision to treat, to maintain or to simply monitor, including the condition of the building, its perceived value in terms of significance and use, existing technological solutions, and available funds.

Most conservation professionals would claim that the most desirable option for any building is regular maintenance which would preclude the need for "extraordinary interventions" or at least minimize their occurrence. Unfortunately, most building owners do not share this conviction regarding maintenance, and structures seem to lurch from one major repair program to the next.

The group felt that some type of economic analysis might be useful in arriving at objective conclusions and, hopefully, in proving that assumptions regarding regular maintenance are true. We thus requested the assistance of the conference economists in trying to develop an economic model which would attach real figures to abstract concepts of cost and benefit.

The ensuing session was one of the most interesting in which the group participated. Though we could not arrive at any conclusions in so short a period, the interaction challenged old assumptions and forced all participants to think in new and different ways. The conservation professionals were challenged to articulate often unspoken values and to question the way in which decisions are usually made about the care and conservation of the built heritage; the economists were asked to tackle a problem with complex variables and to convey concepts of economic modeling to those with little or no background in their discipline.

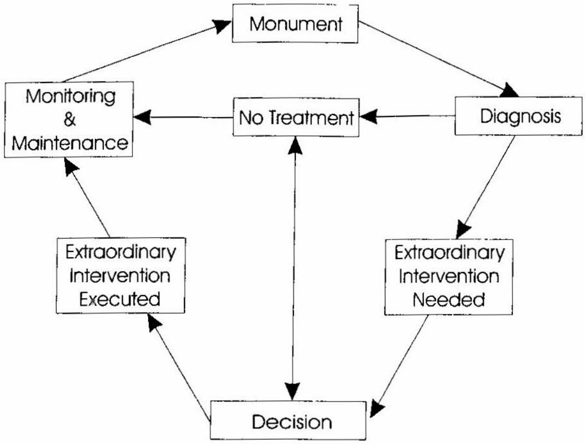

Figure 16.1 Simplified model of the decision-making process and available options in the care of historic buildings and monuments.

Much of the model explored and developed during the course of the discussion is described by Brimblecombe et al. (Chapter 21). Therefore, here we will only highlight particular aspects of the discussion that led to new insights or that indicated areas for future research.

The Model

In economic terms, the questions posed at the beginning of the session could be considered a maximization problem with the aim of developing the best strategy for prolonging the life of any historic building or monument. In this respect, the problem is similar to standard operational research problems encountered in industry.

To understand the problem, it is first necessary to establish relevant parameters. On the most basic conceptual level, the model sets the "quality" of the building (defined by its physical attributes as well as the values derived from its significance, its authenticity, etc.) against its deterioration over time (decay function) and the cost of its maintenance. The problem also has certain boundaries or constraints such as the flow of investment and, perhaps, minimum acceptable levels of quality.

In theory, if all of these parameters can be defined, it would be possible to calculate the net benefit at certain moments in time depending on different scenarios of decay and intervention.

Several things became clear when the model was applied in general terms to the case of a museum: first, the need to more clearly articulate the values which define quality, and second, the need to develop better methods to measure rates of decay with and without intervention. Without some ability to describe the decay function, it is extremely difficult to utilize this type of model. The situation is further complicated by the fact that neither the decay functions nor the valuation functions are linear. Thus, there may be several optimal solutions or one or more local optimal solutions.

Other Factors Influencing the Model

The group raised other questions regarding factors that might influence the model. Marketing the building, for example, would be considered another control and might imply constraints if investment was fixed (i.e., funds could be spent on marketing or on intervention).

Of course, monuments cannot be considered in strict monetary terms. If we lose part of a historic building, we have lost something that cannot be replaced.[4] It was suggested that the model could be made to account for this but that it would complicate the function. A similar discussion ensued about treatments that are a "disbenefit" (i.e., harmful) to the monument. Again, it is theoretically possible to account for such "disbenefits" in the model but only if they can be anticipated, which is not always the case.

Measurement of Decay/Risk Assessment

As stated above, the ability to measure rate of decay is critical to use of the model. Questions were raised about techniques which might be used to establish decay functions without the need for actual measurement. With enough data, it might be possible to create a probability function based on previous failure rates. Alternately, one could attempt to define the parameters that lead to collapse and then use various computer programs to work out probabilities.

Though it might be difficult to utilize either of these methods, the discussion again highlighted the need for a data base of treated sites which could provide valuable information on performance and rates of decay. Though historic photographs and records of past treatments would probably only provide general impressions, they would establish some baseline data on which future assessments and estimates could be made.

Values

While it is possible to measure physical attributes, it is less clear how we might measure less tangible values. It was suggested that the guidelines set out in the *Burra Charter* (1988) for the assessment of cultural significance might be of use in arriving

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4 Obviously the meaning and consequences of *loss* are complex issues. For a more complete discussion of these ideas and their impact on the economic modeling of the conservation process, see Chapter 21.

at an estimate of value. This is an interesting line of thought and should be investigated further. Clearly, however, all values are subject to change due to variables (such as fashion) which are difficult to control. Somehow, the model would have to allow for such oscillations within the established estimation.

Decision-making and Public Participation

Though in welfare economics, one theoretically consults everyone who would be affected by a particular action, reality is different. For this reason, it is critical to establish the institutional framework for which the model is developed (see chapter by Schubert, Chapter 17).

This part of the discussion highlighted the point that values other than those of the professional conservation community (i.e., building owners, tourists, etc.) have to be considered in any decision regarding conservation. Furthermore, it is important to look at more than just positive values. Individuals who feel that their welfare is decreased by conservation efforts must also be considered.

Clearly then, issues of partnership and public participation are critical to the success of conservation efforts. Most historic buildings involve a host of players — owners, professionals, politicians, etc. More effective information transfer will lead to real dialogue and more satisfactory solutions for both the monument and those who are affected by it in some way. Public pressure can also be an extremely powerful force in persuading institutions to place more value on cultural heritage.

The Way Forward

Though the application of cost-benefit models to conservation is not a straightforward exercise, there is clearly much to be gained by considering the field in this way. Further collaborative work between professionals in the fields of conservation and economics should be promoted as a means to improve decision-making and to gain broader public support for conservation.

TRAINING AND PROFESSIONALISM

Training in conservation has been addressed in a number of forums (e.g., ICCROM 1991a, b, 1994; ICOMOS-CIF 1995) and is currently under discussion by recognized organizations and training institutions in various parts of the world. The aim of this session was not to review the entire subject area but to consider specific issues that were raised by the background papers and that are pertinent to other topics of discussion.

Roles of Different Participants in Any Conservation Project

Conservation is a multidisciplinary activity which always involves a number of participants with diverse backgrounds and expertise. Several writers have attempted to define the roles and interaction of these players who include (among others) craftspersons, contractors, conservators, architects, engineers, scientists, and administrators (Feller 1989; Fielden 1993; COTAC 1993, unpublished).

Training of Craftsmen

Craftsmen skilled in both traditional technologies and in conservation techniques are essential to maintaining the quality of conservation work. Though the old system of apprenticeship was very effective, it is no longer operative in many places, and other forms of training need to be explored.

In general, it was agreed that there has been a decline in craftsmanship which may be due to a variety of factors. Ironically, these might include a rise in professional training programs in conservation which have created a bias toward conservators for certain types of work. Similarly, there is a danger that a general preference for conservation rather than restoration has limited the demand for traditional craft skills.

Ideas explored included the concept of exchange schemes for craftsmen from different countries as well as required training for the use of certain conservation products. The latter has not proved commercially advantageous in the past but could help to maintain standards and provide training opportunities.

MA Courses in Conservation

To date, MA courses in architectural conservation have largely been aimed at architects and specifiers. However, such courses are becoming increasingly multidisciplinary. Some group members considered this to be a largely positive development with benefits to be gained for all concerned through the development of a common language. Such shared training has begun to manifest itself in multidisciplinary conservation firms which include architects, engineers, historians, archaeologists, and conservators. Despite such developments, other group members felt that the adaptation of specifically designed MA courses for an increasingly multidisciplinary audience has led to declining training standards, both in the sciences and in conservation.

The admission of craftspersons to such MA programs has created some difficulties in terms of university regulations regarding the academic qualifications normally required for entrance. This has been overcome at certain institutions by permitting assessment based on life experience or allowing such candidates to be admitted as nondegree students. In other cases, craftspersons cannot be admitted without the required academic qualifications and alternative training schemes need to be developed. It was suggested that many contracting firms could be persuaded to take on trainees if they had sufficiently large projects. Interesting collaborative training opportunities might be explored.

Contractors and Low Bidding

Another reason identified for a general decline in standards is the requirement in many countries to award contracts (even for conservation work) to the lowest bidder. Contracting firms which win such tenders are often ill-equipped to handle the work and more concerned with profit than quality.

In certain countries, it is possible to require pre-qualification or to designate certain firms for specific types of work. All agreed that much can be gained by rigorous specifications which will tend to eliminate firms that do not have the specialized capabilities to carry out the job.

Engineers and Conservation Scientists

It was agreed that there is a need for specialized training for both engineers and scientists who wish to work in the field of conservation even on a part-time basis. The discussion focused principally on training issues for conservation scientists, though the proposals developed could apply equally to engineers or other specialists who wish to work in the field of conservation.

For scientists, two problems were identified. The first is the need for conservation journals which will command the respect of professionals in other fields. At present, academic scientists who publish in the conservation literature are penalized when citations are counted for professional advancement.

Though this was recognized as a problem, the group concluded that a two-track publication record (one in conservation and the other in a scientist's primary discipline) may be the only solution at present.

Training

The second problem identified was that of training for conservation scientists. It was suggested that a helpful model might be that adopted by certain universities in the United States and Europe for those entering graduate programs in architectural conservation with a previous professional qualification. Such students complete only one year of study (instead of two or three) which essentially provides a basic grounding in conservation theory, architectural history, and traditional technology so as to create a common professional language.

It was suggested that this one year of additional training might be supplemented by inter-European internships or placements for scientists in specialized institutions. This would probably be best served by the creation of a network of specialized institutions to facilitate such exchange.

The importance of interdisciplinary training was again stressed in this context. Scientists should have the opportunity to learn from craftspersons and vice versa. It was suggested that a forum for such an exchange might be organized within the context of the specialized internship.

The proposal of a Ph.D. in conservation was considered. However, it was generally agreed that this would be too limiting in terms of career options and would not necessarily provide the scientist with the specialized training needed (i.e., a context for conservation rather than training in research).[5]

True Interdisciplinary Working

Though the need for interdisciplinarity has long been recognized (e.g., Torraca 1982), it is still rarely achieved in practice. It was noted that there is still a divide between conservators and scientists. This seems to result from insufficient understanding of and appreciation for the work of each group by the other.

There is a need to foster true interdisciplinary working on the level of research and to make scientific results understandable and useful to practitioners.

How Do We Improve Professionalism?

Various proposals were discussed for improving professionalism in the field of conservation. Accreditation schemes are an obvious solution, but these are often difficult to achieve in practice due to the diverse backgrounds and qualifications of conservation professionals.

Another critical problem in the field of architectural conservation is the lack of a strong professional association and of respected, peer-reviewed publications. This is at least partially due to the complexity of the field and, again, to the great diversity of individuals involved in various aspects of conservation work. Models were proposed like that of the American Geophysical Union, a multidisciplinary professional organization, and the International Council of Scientific Unions (ICSU), the world nongovernmental organization of scientists (Kendrew 1991), that are well organized and produce important international journals.

In the short term, however, the most promising proposal seems to be that of an ad hoc network of specialized institutions which could facilitate training, placement and exchange. Such a network might also form the basis for the type of multidisciplinary professional association mentioned above.

SUMMARY: CONCLUSIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

The group addressed a variety of issues related to the responsible and effective use of conservation treatments. Though the discussion could only address selected topics and

[5] It should be noted that a few Ph.D. programs in conservation already exist, such as those in conservation at the University of Delaware and the Cortauld Institute and in materials science in a joint program of the Johns Hopkins University and Smithsonian Institution.

was certainly influenced by the background and professional expertise of the group members, it did identify obvious gaps in knowledge and prioirty areas for future study.

Some of the recommendations address long-standing problems; others are new concerns which reflect changing environmental conditions, technological advances, and more recent professional experience. It is hoped that at least some of the recommendations will be explored further and that the discussions recorded here will provide a framework for action which will advance the field of conservation and help to ensure the survival of our cultural heritage. In summary, as described above, further research and study is recommended in the following areas:

Testing/Quality Control

- Acceptable tolerance limits for various treatment materials and substrates.
- Retreatability (similar to the work now underway on hydrophobic consolidants) for a variety of conservation treatments and materials (alkoxysilanes, water repellents, etc.).
- Tolerance parameters for cleaning. What properties are critical and within what limits can they be altered? Also, methods for field evaluation of effects/effectiveness of cleaning.
- Standardized methods of artificially aging samples to produce various types of damage.
- Reproducible aging of stone for the purpose of testing.
- Relationship of pore-size measurements to water uptake results.
- Test methods to determine whether treatment has been correctly applied in the field.
- Nondestructive methods for quality control in the field.
- Reliable nondestructive methods for determining properties of material like moisture profiles.
- Rapid tests to predict the potential effects of biofilms on treatment which do not necessitate identifying the components of the system.
- The effect and effectiveness of newer, more environmentally friendly biocides on stones (and biofilms?).

Treatment Evaluation

- The development of inventories of treated sites according to an agreed format.
- Nondestructive methods for monitoring and evaluating the quality and long-term performance of treatments.
- Improvements/standardization in initial documentation and reporting systems to permit long-term evaluation.
- Relationship between field-exposure results and artificial aging tests.

- Collaboration between professionals in economics and conservation to develop models for long-term evaluation of treatments and the best use of limited resources.

Training and Professionalism

- Inter-European internships or placements for scientists in specialized institutions; the creation of a NETWORK to facilitate such placements on a European and international level.
- Issues of accreditation and of multidisciplinary professional organizations.

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