Renders and Materials of Fired Clay other than Brick

Much brickwork is obscured by coatings of plaster, render, rough cast and other materials applied in plastic form and allowed to set. Rigid materials, such as tile and slate and sheeting are also applied for the same purpose. They all share the one objective of providing a wearing surface thought to be more suited to the needs of the building. Sometimes this surface is designed to shed moisture, sometimes merely to improve appearance; sometimes it has the very widespread function of making brickwork more amenable to comfort. There is something in the psychology of the user which differentiates visible brickwork from plastered surfaces — the bare brickwork being thought suitable for outside use and plaster for the interior. It may be nothing more than the contrast in the feel of the materials. Plaster can be painted and covered with decorative fabrics or paper and its smoothness makes it more agreeable to touch. This universal reaction in favour of a covering to the brickwork internally has produced high levels of skill in which plaster surfaces are moulded, modelled and contoured sometimes in echo of the shapes of the brick and sometimes in deliberate contrast. The 'Muqarnas' (sometimes called 'stalactite') vaults and pendentives so universal in historic Islamic Architecture rely on an intricate geometry derived from the interweaving of ribs and the shaping of squinches in brick vaulting. A scintillating interplay of curved groin, coved recess and pendant terminal has been developed with a geometry that can dazzle the eye. The clarity of its interweave is breathtaking. At its extreme it is covered in mirror glass with a multiplicity of images bewildering to the point of incomprehension. Ultimately these elaborate creations were created independently of the complex corbellings and squinches of genuine domes to be constructed on timber frameworks within the domes themselves but as entirely separate structures. Likewise in Europe the cornice and architrave mouldings derived from classical design and applied sometimes to make brickwork look like stone were remodelled as styles evolved to be manipulated into plaster wreaths and scrolls with frames and figures carried across the surfaces regardless of the structure beneath. Sometimes it has been the role of both plaster and rendering to simulate stone and to give to brickwork the appearance of masonry. In many areas and over long periods it has simply been the

function of render coatings to improve the weathering properties of brick and lime mortar.

Externally the materials used have generally been lime with an hydraulic additive to speed its setting and improve its strength. Historically many experimental mixes were produced, some of which have achieved remarkable hardness and strength. Notable among these is the 'Roman' cement of the 18th century. For internal use the similar rendering base has often been simply made of lime and sand given an increased coherence by the addition of fibre usually in the form of hair but occasionally of cheaper materials, such as pulverised stems — jute and hemp and, at the lowest level, of straw or even grass. The greatest attention, however, has turned to the finishing coat which is often found to contain gypsum as an additive to achieve a set and smooth the surface. A more refined type of lime will have been used as the surface coating in almost all work and until the introduction of modern industrially-manufactured plasters these techniques were virtually universal.

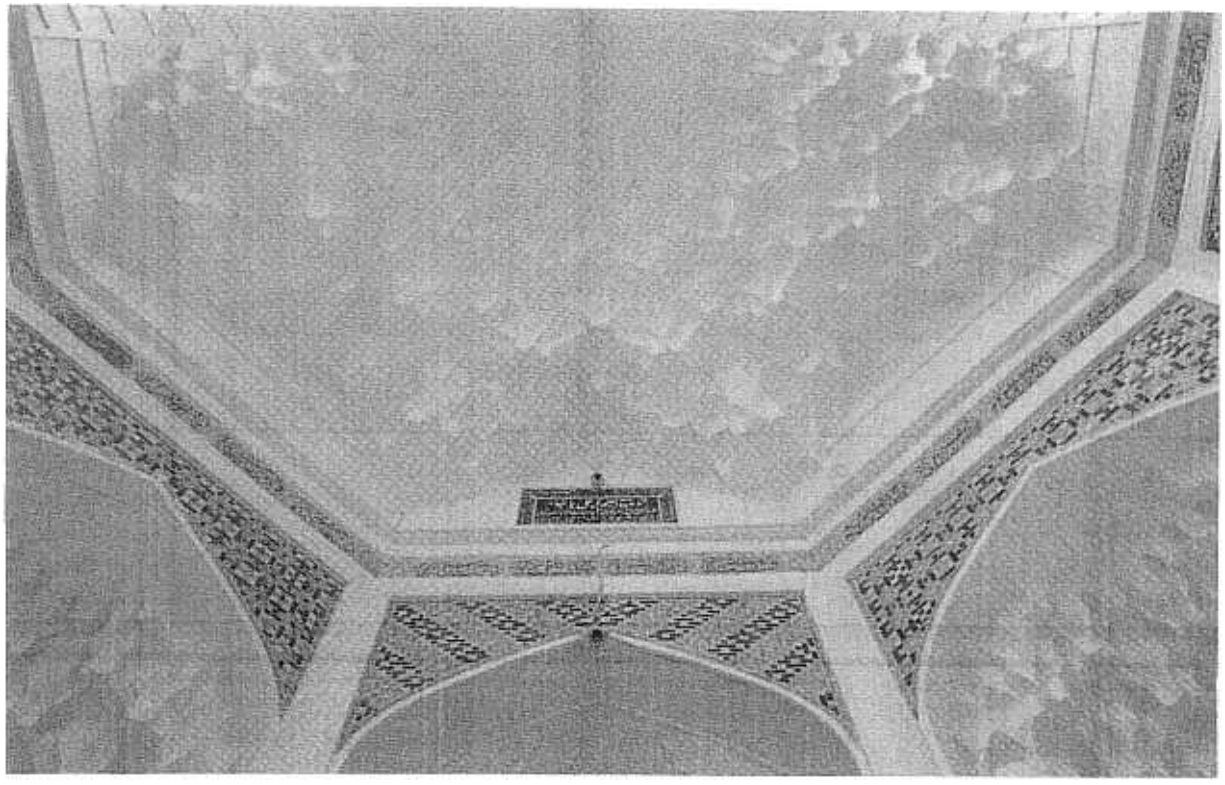
The fundamental question in the application of all these coatings is compatibility with the brickwork base. This compatibility must exist throughout the whole period of its life but particularly during the initial stages. Varying rates of shrinkage during application and setting could crack the applied coats, reduce their bond to the substrate and compromise their longevity. Initial application to a wall in too great a thickness or in the wrong consistency could cause cracking. Failure to provide sufficient moisture in the wall to avoid the suction of the brick so withdrawing water from the applied mix and failure to maintain even and consistent temperatures during the setting period could all prove damaging or disastrous. Once overstressed by excessive rates of shrinkage the applied coat of render would crack or craze with permanent loss of cohesion. Sometimes a top coat will fail to adhere to a substrate for similar reasons.

Analysis of a mix of plasters and renders is relatively straightforward and simple. Laboratory tests will supply the conservator with a clear indication of the nature of the binder and the proportionate mix and types of sand used. The introduction of other materials may be more difficult to ascertain. Oils, milk (casein), egg and other albuminous products are all known to have been employed in plaster mixes and even the proportions of lime used are sometimes confused in analysis by an addition of powdered chalk or limestone used as a form of aggregate.

Trial mixes should be made to determine the compatibility of the proposed material with the brickwork to which it is to be applied. There is no reason why bonding agents should not be used in the trials and if satisfactory in the general works of repair. Their function is to provide adhesion at the crucial stage of application and setting.

As a general principle it is better (or in some cases essential) to use a compatible but not identical mix for repair with the objective of differentiation so that future conservators will be able to identify the repair.

Plaster surfaces and renders which



Muquarnas details modelled in stucco on brick. (Mahan, Iran).

have detached themselves from their brick background are readily detected by tapping and their removal usually presents no problem. Where decay has occurred due to water entry organic material of bacterial or fungal nature is likely to be found. The brickwork must be cleaned back to a key and the application of a fungicide may be a desirable additional precaution although recoating should not take place without the elimination of the fault which allowed the previous water entry.

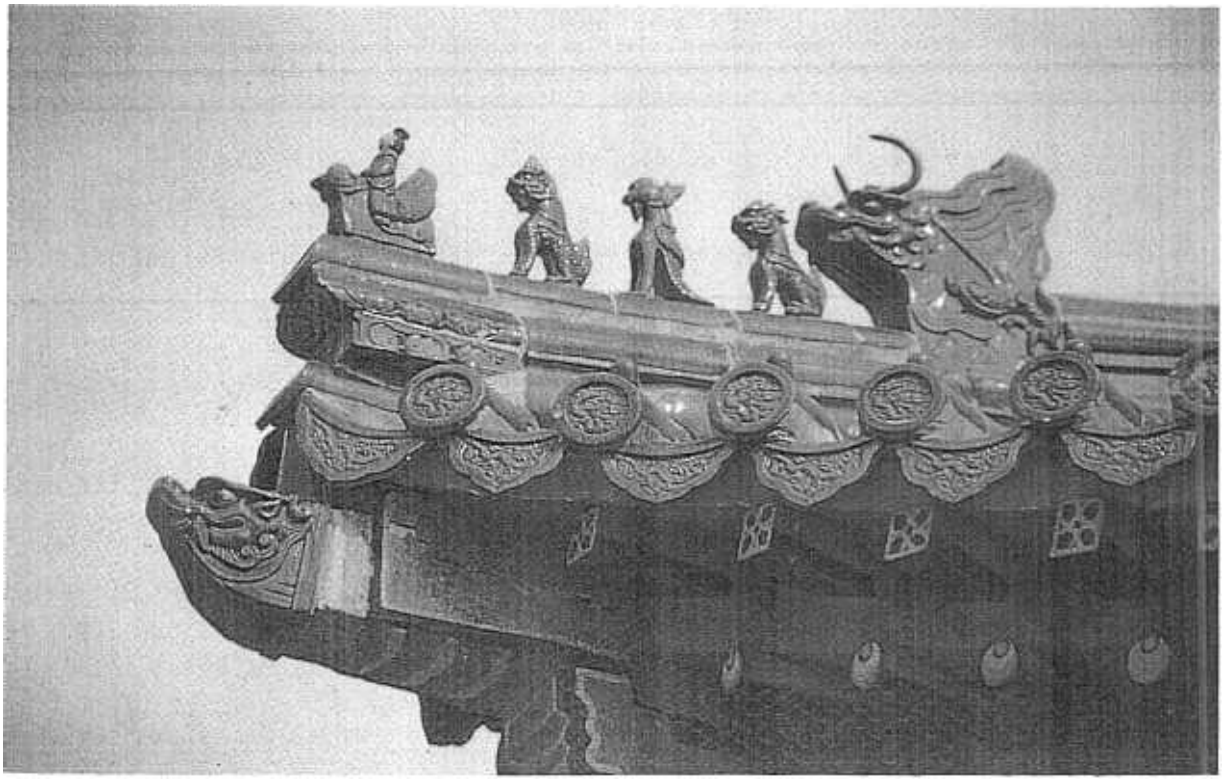
Brickwork is inherently water permeable and lime mortars likewise. Historically the exclusion of weather has been achieved by the construction of sufficiently thick walls to exclude the bulk of water falling as liquid and being absorbed. The addition of an external skin of rendering has often much improved the protection against wind driven rain and the failure of the rendering by cracking has in consequence provided points of localised water entry. Water running down the face of a wall can be trapped by transverse cracking and effectively gathered into the brickwork with damaging effects upon the internal plasters and woodwork. It is essential that

external skins of rendering are maintained. The conservator, however, faces a greater dilemma when a rendering or weather coat has been applied subsequently to achieve adequate weather protection. A decision to restore a building historically to its original form may reduce its weatherproofing below acceptable levels whereupon the conservator can perhaps use the potential of new materials in an attempt to achieve a satisfactory return to the original surfaces. Ancient brickwork may be re-exposed at the cost of applying a modern synthetic waterproofing medium. Removal of a firmly adhering render coat can result in serious damage to the brickwork if not carried out with the greatest care and skill.

Physical damage occasioned by an operation of this type is sometimes irremediable and sometimes not perceptible initially. Surface delamination of brickwork after cleaning may be a direct consequence of the methods used and the fireskin of some types of brick can be irreplaceable. Once it has been removed the brick may be subject to rapid failure.

Walls have sometimes been sheath-

Decorative glazed roof tiles. (Beijing, China).



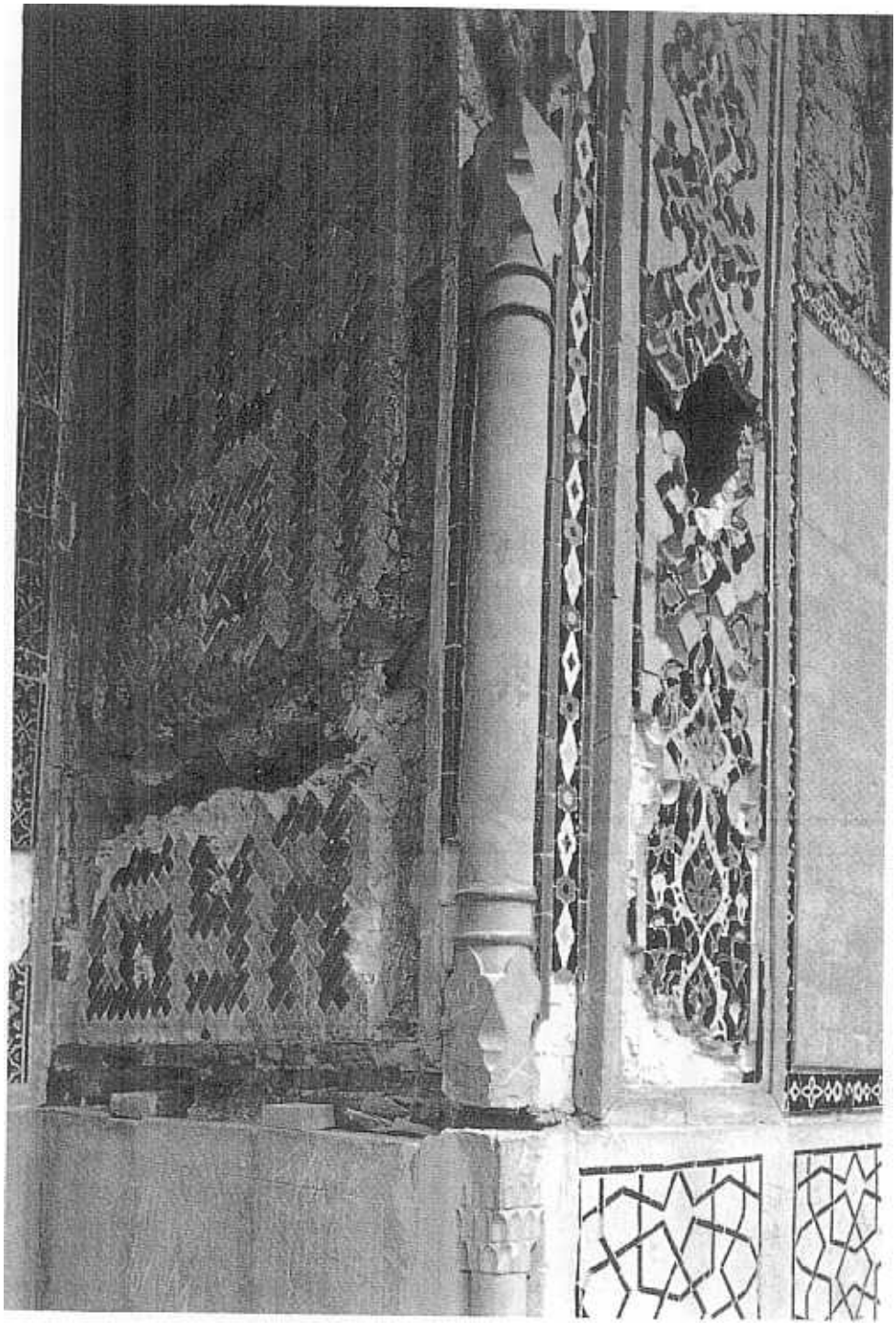
ed with earthenware or terracotta tiles as a method of combating the worst of exposure of brickwork to weather. The removal of such a covering from walls too thin to be weatherproof in themselves can have such serious consequences that it is preferable to suffer retention of the later additon. Alternatively it might be thought the later sheathing is an improvement and an historical event to be retained in its own right. Such tiles are bedded to the wall on mortar and effectively become integral with it. Other tiles can be hung from the wall as a weatherproof skin.

Roof tiles have been made in a variety of forms which can be thought of as exhibiting two different principles of weathering. The first is the simple flat slab laid on a slope, the joints between the slab permitting the penetration of water which is, therefore, arrested and deflected by the surface beneath. This entails a double thickness of tile and because even the lower surface must be carried up well beyond the point of exposure between the upper tiles the effect is to require each tile to be upwards of 2½ times its exposed length and, therefore, the effective thickness of the roof covering is three layers of tile. The economy of reducing this to a single layer has long been apparent. To achieve it the Romans developed two forms of tile used side by side in which the lower tile was dished at its edges and the upper tile curved conversely to cover the joints of the lower tiles and discharge water laterally. This allowed tiling to be a single layer with a minimal lap, albeit rather complex in shape and more difficult to fix. A compromise between these two principles was achieved by the introduction of a tile combining the convex and the concave curves in a single sinuous shape or alternatively adopting the same principle with a wide flat section and narrower capping piece formed in a single tile, known as a pantile. Tiles with angled edges were made with the same objective. Techniques of conservation relating to roof tiling are very much more straightforward than brickwork.

Tiles can delaminate, that is to say decay by dividing parallel to the surface on planes of weakness inherent in their manufacture. Such failure can be the result of the presence of particles of limestone or chalk in the initial mix which will have turned to lime during the burning and will then absorb moisture through the tile, expanding as it does so. Such failure will occur early in the life of the tile. A natural plane due to inconsistency in the preparation of the clays may develop much later and final failure may be due to the freeze-thawing cycle or to the penetration of the plane of weakness by plant growth. Defective tiles are simply replaced with the material.

If tiles which are already weathered are to hand they will be used with advantage. Otherwise a tile of similar type can be expected to weather into compatibility with the remainder of the roof. Failure will sometimes occur through failure of the fixings particularly where iron nails or pegs have been used. Expansion due to rust will burst the fixing point and fracture the tile leaving it free to fall away.

Some roof tiles have become elaborate decorative artefacts in their



Decorative wall tiling failing due to surface detachment from the substrate. (Samarkand, Uzbekistan).

own right. Tiles have been glazed and coloured to add sparkle and splendour to buildings. The addition of a glazed surface poses further problems of successful manufacture and the fate of much glazed tiling has been the loss of surface due to the different density as between the body of the tile and the glazed surface. In many cases standards of manufacture have not been the equivalent of the complementary techniques of pottery. Levels of exposure to which such tiles are subject and longevity running into centuries means that their ultimate fate is loss of surface. Although epoxy resin techniques are available for the permanent restoration of tiles in these circumstances, replacement with the equivalent manufactured item is the conservator's normal response. Glazed tilework has been particularly popular throughout the Mediterranean, the Islamic world and in China where the modelling of key pieces such as finials, ridge tiles and terminations has taken on its most elaborate and exciting forms. Dragons, birds, beasts, demons and other mythical creatures, products of the potters art, have been set as finials, ridge pieces, hip terminals and simply as modelled upstanding tiles. In the case of such elaborate pieces the proper answer is the replacement of damaged and worn originals by facsimiles made using the same techniques and materials as originally. A particularly significant original can be repaired using synthetic epoxy resins but its durability will be less than that of the original and inadequate to prolonged exposure and it is best retained as a museum piece.

Decorative glazed wall tiling and roof tiling bedded on to solid surfaces has been at the heart of the traditions of Muslim building, reaching its apogee in the late 16th century in Southern Spain, the Ottoman Empire, Iran and India. The destruction of most of the wealth of preceding Timurid buildings obscures the importance of this period in which the formative work took place. Different types of ceramics were produced in different areas and the techniques of pottery conservation are applicable to them all.

The glazes used in ceramics are notably alkaline. This renders them susceptible to acid water. Organic acids due to decaying vegetation, carbonic acid in rainwater and nitric, hydrofluoric, hydrochloric and sulphuric acids from pollution are all dangers, resulting in pitting of glazed surfaces, and the need for protection and repair.

However, as with roof tiles the synthetic resins employed in museum technology allow such repaired items to be used only in sheltered and internal situations. Where a tile has suffered frost action or crazing which has separated the glazed surface from the body the conservator has the option of minimum intervention which will probably be a policy of micro-climatic protection and the alternative of replacement of the tile with a facsimile.

Judgement as to whether large scale replacement is justifiable can only be made on the individual circumstance and assessment of the importance of the coherent view of the building. Where disfigurement or loss of visual coherence is the overriding criterion replacement

may well be justified on the grounds that the design of the building requires the completion of the original pattern. Where, alternatively, the damaged building is to be retained in a fragmentary state, damage to the tiles is simply a natural part of the scene. In either case work to prevent further decay and loss may entail measures to remove salts from the structure and to inhibit rising damp. Apparently well made and durable glazed material can fail due to the deposition of salts at the edges particularly where the glaze is incomplete and terminates on an unglazed area or where by crazing or impact the glazed surface is broken allowing evaporation to take place. In such areas the growth of a salt deposit will break apart the earthenware background causing the glazed surface to flake away.

Mosaic workers have long used tesserae of terracotta in their work. In Roman mosaics these survive mainly on floors and on walls and vaults of the Byzantine period. The technique is found also in periods of stylistic revival. Repair techniques can vary from the removal of the entire mosaic surface where its background or substrate is insecure or decaying to the replacement of individual tesserae when each new piece is cut to the shape of the missing original as shown by the imprint on the background. Tesserae are secured in place with synthetic adhesives or desirably with a mortar compatible with the original.

Fired clay has been used for flooring from the earliest times. To achieve durability in the patterns required for patterned floors clays which would fire to different colours have been used to produce the encaustic tile extensively used in Medieval Europe and revived in the industrial era. In such tiles the basic body is imprinted with the required pattern. A clay of different colour is introduced as a slip within the surface depression of the imprint, which when fired becomes integral with the earthenware. The pressing techniques adopted for this purpose were refined to produce tiles of higher density than normal and the depth of patterned material introduced was sufficient to give a long life despite continual wear. Laboratory techniques may be used to repair such tiles. Fractured specimens may be repaired satisfactorily using modern adhesives of which two-part epoxy resins are the most commonly employed. Repair of pigmented areas can be made good similarly although the repaired tile must be subject to less exposure by wear and weathering than an undamaged example.

Historically simple uncoloured tiles — quarries — and brick-paviors, have provided a surface for solid and suspended floors. Glazed ceramic tiles have also been used for this purpose despite the relatively short life to be expected of a ceramic glaze under heavy wear. Faults in such floors fall into several categories. Tiles can be fractured as the result of slight changes in the substrate. Settlement of timber or the heave of soft ground between load bearing walls can be sufficient to change the bearing conditions causing tiles to fracture under normal live loads. In many instances such cracks are benign and they may even be visually acceptable, producing a pattern of wear. The cracks of an

Terracotta in damaged Roman mosaic flooring. (Jordan).

older floor are intrinsic to its character and its history and may be seen as being sufficiently well to be left alone. Where repair work is necessary the rebonding of such tiles can be achieved using resins and they can be restored to their position on a re-estabilished surface. The fundamental work must provide a more stable background. In some instances a floor bearing all the patina of age and wear can be removed and replaced in sequence on a substrate which has been reinforced or made damp proof to avoid the spoilation that otherwise arises. The strength of earthenware varies being softer when damp than when dry and the elimination of damp from a floor may well be justifiable on grounds of wear. Maintenance must avoid the application of materials likely to seal damp into floor tiles even although appearance may seem to be improved and resistence to wear enhanced.

In pursuing a policy of minimum intervention the conservator will also have an eye to the acceptability of wear. While this applies to all circumstances it is particularly significant in flooring where the individual tiles may have the importance of rarity and there will come a point

where a judgement has to be made as to whether further wear can be tolerated on historic artefacts or whether they should be replaced by replicas at the expense of authenticity.

Replication, which is accepted without question in replacing a common brick or tile, raises doubts when the item is a decorative artefact, and the argument increases in proportion to the significance of the art-work. It is unavoidable that, as time goes on, ever more artistically important objects will be withdrawn to the sanctuary of Museums to protect them from wear, decay and the effects of atmospheric pollution. The ancient Greek bronze horses of San Marco, now in the shelter of a Museum while their replicas stand outside are the precursors of a trend which will include Islamic tilework, Renaissance majolaica, medieval encaustic floor tiles and much material of lesser calibre. The conservator will number among his tasks the assesment of the point at which such transfer should be made. To make such assesments he will need to monitor the condition of the art-object itself, the changing environmental conditions and the effects of visitation and rarity values all of which can be guides to the point at which to make a decision to remove and protect.

Cleaning is a complex subject in itself to which several simple rules apply. No cleaning should be undertaken until the method to be used has been thoroughly tested. The subject area has to be left to mature after cleaning to allow long-term after-effects to become apparent.

No abrasive method should be used unless it can be shown that the fireskin or surface of the subject will be unaffected. This will rarely be the case. Microscopic damage can occur even with hard brushing. The critical factors are the comparative hardness of materials and the energy of impact. It is essential that any brush or abrasive material is softer than the subject material and that the energy applied is the minimum needed to move the softened dirt or disfigurement. Initial (prolonged) application of a lubricant or solvent is always advisable.

Solvent based methods must be specific to the material to be removed. Hydrochloric acid will remove most cementicious material for instance but at the expense of damaging mortar. The solvent must always be used as dilute as possible and must be washed away with the greatest care to avoid staining. Successive washes are more effective than continuous washing.

Steam and torch cleaning cause thermal shock and induce microcracking. Mechanical cleaning has the same damaging effect through physical shock. All are methods of last resort. The most acceptable methods are based on washing with soap or detergent and water, followed by generous cleansing with ample water which must be disposed of effectively.