The cleaning and treatment of limestone by the 'lime method'. Part I

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Fig. 1. The Percy statue, Beverley Minster, showing typical sulphation damage and cement repairs. This is one of the few magnesian limestone subjects which has now been treated by the 'lime method'.

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In England, the west fronts of Wells and Exeter cathedrals and the ruined west front of Crowland abbey have undergone interesting transformations over the past few years. Heavily soiled, badly repaired limestone sculpture, valuable surfaces fragile with spalling sulphate skins, have been pulled back, in some cases, from the apparent brink of destruction. The dirt and all the wreckage of iron, copper and cement associated with past remedial work has gone. Some observers see a new warmth, clarity and stability in these facades; others see an unnatural uniformity, a blurring of detail and an uncertain future. These façades, and others less well known, have been cleaned, repaired and consolidated using techniques generally summarised together as the 'lime method' (*Fig. 1*).

This article, divided into two parts,[1] describes and discusses the 'lime method' and investigations carried out into some of its more controversial aspects. It is not new. In 1904 William Richard Lethaby, who was a prominent member of the Society for the Protection of Ancient Buildings founded in 1877 by William Morris as well as being the architect responsible for Westminster Abbey from 1906–27, wrote the following comment about the sculptures on the west front of Wells cathedral: 'Sooner or later the question of preserving the statues from surface decay must be considered. It would, I believe, be desirable to cover them by degrees with distemper'. He did not have his way at Wells. 'The suggestion was rejected by the dean and chapter . . . on the advice of their architect, Edmund Buckle, who foresaw a danger of blocked pores of the stone.'

In the absence of a precise specification for distemper,[2] it is difficult to say how much harm the execution of Lethaby's idea would have caused. His suggestion was not so far removed from at least one aspect of the 'lime method', that of replacing the protection once afforded by the medieval gesso and polychrome with a substitute medium; and Lethaby did carry out similar work at, for instance, Queen Anne's Walk, Barnstaple, Devon in 1913.[3] But although distemper has been removed successfully from medieval polychromed sculpture elsewhere,[4] it is not unlikely that damage would have been caused during the application and that some of the effects of 'pore blocking' feared by the architect of Wells cathedral would have exacerbated the decay of the sculptures, especially in sheltered areas. Some critics of the recent work at Wells have expressed similar doubts about application techniques and pore-clogging, and they do not find the finished work visually pleasing.

The 'lime method', also described as the 'Baker' or 'Wells' method, has been developed on a few important sites over the past two decades (*Fig. 2*). Although the generalities of the technique are by now sufficiently familiar in the conservation world, there is still much misunderstanding about what it really entails and what it sets out to achieve. It is also true to say that opinions which may have been formed about it seven or eight years ago should, perhaps, be reviewed, since the technique has 'grown up' in this time through increasing use, accumulation of experience and exposure to discussion.[5]

[1] The second part will be published in the December issue of *Monumentum*.

[2] The distemper referred to is likely to have been a mixture of whiting (crushed chalk) and water, bound with a size made from parchment chippings and coloured with burnt umber of yellow ochre.

[3] The building in question was 'The Merchant's House'.

[4] As, for instance, in 1983 from the figures of the Virgin and Gabriel flanking the Annunciation Door of Westminster Abbey Chapter House.

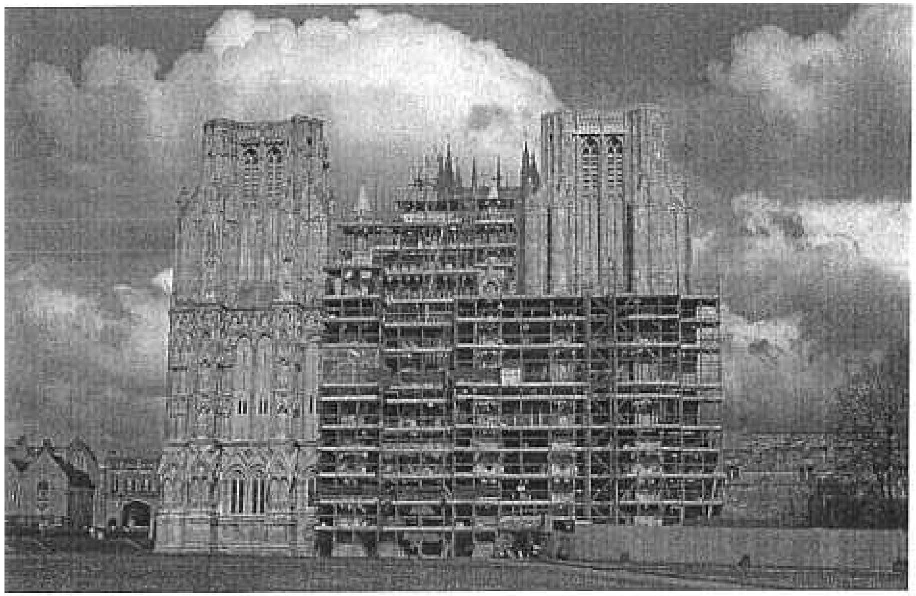


Fig. 2. The west front of Wells Cathedral during cleaning and repair. Much of the pioneering work on the 'lime method' has been carried out at Wells.

What does the 'lime method' involve? There is nothing revolutionary; nothing new, for instance, in the use of hot lime poultices to clean stains from limestone, or in the use of lime mortars for 'plastic repair', or in lime washes for external weather protection. Yet, although all these processes relate to the 'lime method', they do not actually describe it. Nor, adequately, can the description which follows, for so much is attitude and technique, learned during an apprenticeship, which cannot be covered by a specification. At the same time, there is no justification for surrounding the technique with mystery; it is based on good common sense and traditional materials. Indeed, it is partly the very lack of sophistication and the 'low technology' which has won over many with an interest in conservation who instinctively set their faces against anything they feel to be synthetic or 'untried'. But, of course, all techniques, even those based on traditional materials, must stand close scrutiny and come under review from time to time. Success at Wells or Exeter or Crowland should not stimulate unqualified commitment to the 'lime method' as a solution to all stone problems, or even all limestone problems. Such a view may be impracticable, or even dangerously optimistic.

[5] Credit for this must go to the originator of the complete 'lime method', Professor Robert Baker, the architects responsible for the west front of Wells cathedral, Alban and Martin Caroe, the Dean and Chapter of Wells cathedral and members of the 'West Front Committee', and especially the growing team of conservators who have shared their experience and made their findings available.

The 'lime method' can conveniently described in the following sequence.

Survey

In common with other proposed schemes of treatment, any activity should be preceded by a careful survey of the general and detailed environmental influences and the condition of the subject. The survey should cover the following

1. The environment—effects of the prevailing wind, exposure to direct sunlight, exposure to rain, water run and drip effects, humidity patterns, local pollution levels, proximity to heating outlets and nuisance from roosting birds.
2. The structural condition—presence of soft beds or open vents, failures due to edge or face bedding, damage from impact, diagnosis of other crack patterns, identification of position and type of fixings, especially ferrous fixings, type of any corset, stiffening or strengthening existing.
3. The surface condition—type of stone(s) and description of any original covering, such as gesso and polychrome, pattern of decay and soiling, identification of existing repairs and fillings, especially those associated with decay, identification of later treatments, such as wax or limewash, description and analysis of any visible efflorescences, description of organic growth in the form of algae or algal slimes, identification of any areas too weak or too vulnerable to be cleaned by poulticing.

If the subject is very important and the conditions complex, the conservator may call in the services of other specialists. For instance, it may be advisable for an art-historian to make an assessment of sculpture before it is touched, or a consultant to look at the conservation of fragmentary polychrome. What is of importance to the conservator is thorough familiarity with the subject before work commences; for this reason, the survey should always be part of the conservation exercise and not carried out by someone other than the conservator.

The completed survey must include adequate photographs and drawings, to record and explain all the information listed above, in addition to notes and appropriate measurements.

Structural repair

Although structural repairs are sometimes the first operation, most do not take place until the cleaning has been completed. They are not described here in detail, as they do not relate specifically to the 'lime method', but they will commonly include the removal of at least one large iron dowel (in the case of figure sculpture) and other iron pins, copper straps, bars and nails. Where pinning and support is needed, it will be provided with threaded stainless steel dowels or non-ferrous pins, such as phosphor bronze, delta metal or fibreglass, set in a grout of synthetic mortar or lime mortar. All dowel and pin heads are set well below the surface of the stone and the outer part of the drilling will be filled with the repair mortar described below. Removal of old fixings is normally carried out by careful drilling, providing temporary support as required. Staining from copper and iron is removed as much as possible during the cleaning operation.

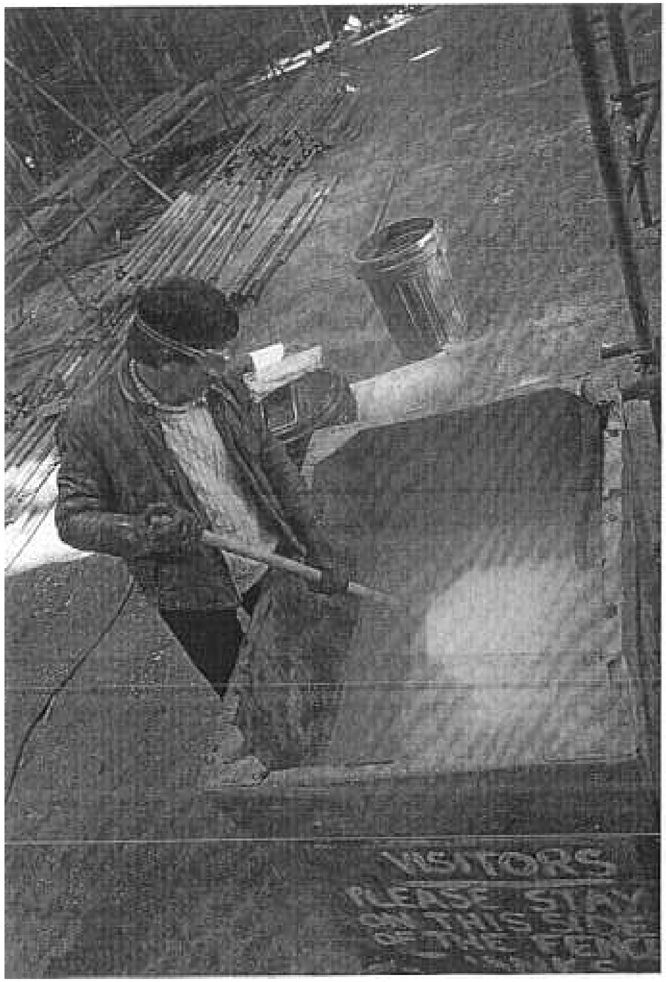
Cleaning

Large areas of limestone, including ashlar and architectural moulding, are cleaned by traditional washing. Large amounts of water are very undesirable in situations where there is polychromed sculpture and many natural traps which will hold water. Various ways to protect vulnerable areas and figure sculpture have been devised, including polythene sheeting and rigid catchments, temporary gutters and downpipes. Experiments with controlled washing were commissioned by Alban and Martin Caroe at Wells about seven years ago and some pioneering work was carried out by R. H. Bennett with sensor-controlled and clock-controlled washing. Clock-controlled systems were subsequently developed by the Wells conservators under the direction of Professor Baker and Peter Cooley and are still in use, on a four-second wetting time with 'dry' intervals of four to five minutes. It is not sensible to specify the wetting-interval time too precisely, as it can only be determined on site by trial. The principle is to achieve a progressive softening of the dirt deposits, sufficient to enable them to be removed by brushing. Experience has shown that this does not require constant sheets and cascades of water running over the face of the building, with all the attendant risks of staining, loss of friable or fragile material and other problems associated with salt migration and water penetration.

Some areas of detail will require more positive protection from water than sheets or catchments. Obvious areas of polychrome, for instance, or areas likely to have surviving colour under dirt layers, should be covered with tissue pads under a thin plastic film, taped or tied in position. Delicate areas such as fleurons may now be cleaned with dry air abrasive and protected from subsequent washing, which is limited at Wells to two scaffold lifts at a time. Once the washing of masonry has been completed, cleaning of the sculpture can begin.

The traditional method of cleaning associated with the lime method is by hot lime poultice. In the early days of experiment at Wells, the lime was slaked against the surface of the stone (*Figs 3, 4*). Hot lime is still in use, but is now applied by gloved hand and trowel, pressing the putty well

FIG. 3. The slaking tank. Lime slaked in the traditional way is the basic raw material for much of the lime method activity.



into the surface of the pre-wetted stone. When a thick plaster has been applied, it is bound with scrim and wet sacking or underfelt secured with string (*Fig. 5*). Finally, a heavy duty polythene sheet is tied loosely in position. From time to time, over a period of two to three weeks, the polythene will be lifted and the felt/sacking surface sprayed with water to ensure that the poultice remains damp and soft. It is essential that no drying out occurs which would render the lime useless as a poultice, or bind it to the surface of the stone.

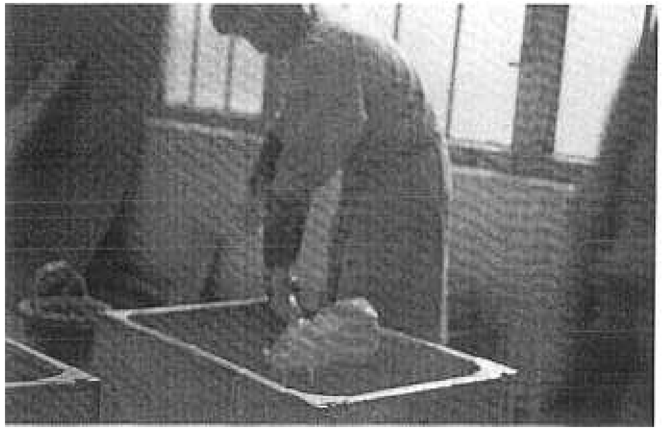
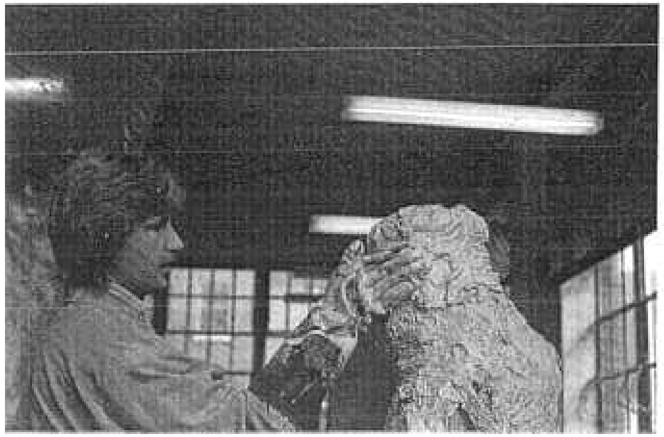


FIG. 4. Lime putty lifted while still hot from the slaking tank is screened to remove lumps and unslaked particles.

When the packaging is finally removed, the lime is carefully lifted off in small areas at a time with spatulas or small trowels, taking with it some of the dirt from the contact surface (*Fig. 6*). Water sprays are used to assist in the removal of the lime and to further soften the dirt. In common with most other poultices, not very much dirt actually detaches with the poultice material; the softened deposit must be worked at with hand sprays, dental picks and small toothbrushes or stencil brushes, to achieve a clean, or relatively clean, surface. In the past, some areas were scraped down, but this practice no longer continues. The scrubbing stage is long and laborious; added to perhaps three weeks of poulticing, the cleaning of



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after screening, is applied carefully to a piece of sculpture. Scrim bandages are included to assist adhesion and hold moisture. It is essential that the poultice does not dry out.

FIG. 6. The shrouds, wet bandages and lime poultice being removed from a figure at Wells. Some of the dirt detaches with the pack, and what remains will usually be more responsive than before to gentle scrubbing.

a life size figure might well extend to a month or six weeks before any repair work is undertaken.

A recent report by one of the Wells' conservators draws attention to the fact that the air abrasive unit preserved more of the polychromy than a lime poultice would have done, particularly in view of the risks involved with water during removal of the poultice.

Wet poulticing combined with careful mechanical cleaning (dental tools and brushes or air abrasive) seems to be the best option for safety (of

FIGS 7, 8. Before and after effect of cleaning the head of a queen at Wells with lime poultice and water. Cleaning must be followed by consolidation and protection. At this stage the detail is very vulnerable to damage.

the surfaces and operatives) and economy. Whether or not the poultice should be lime, hot or cold, or attapulgite clay, or some other medium is still open to debate. Any 'wet pack' which can remain in intimate contact with the stone without drying out, or adhering to the surface, will have a softening effect on dirt and make it more responsive to gentle washing and brushing (*Figs 7, 8*). Does the lime poultice, initially hot, have any other beneficial effect during its two or three week contact period with the stone? The claim has been made that it increases the permeability of a sulphated layer and makes the surface more receptive to the limewater applications that follow; it is also claimed that initial strengthening of friable areas is noticed after the poulticing and as the stone dries out. This phenomenon is related to the strengthening claimed to have been achieved after multiple applications of limewater, the investigation of which is described in the second part of this article.

Removal of old fillings

The cleaning processes reveal the full extent of the damage due to

FIG. 9. A Wells sculpture ready for repair. The surfaces have been cleaned and areas of cement-based mortar have been cut out. Much is still fragile.

weathering and decay and the amount of filling to spalls and cracks which has been carried out in the past. These fillings, including some crude remodelling, have often beeen carried out in 'Roman cement', a strong, brown coloured hydraulic cement much favoured in the nineteenth century for restoration repairs, or, more recently, in equally strong Portland cement-based mortar. These fillings are, of course, completely unsuitable as a visual match for the stone, but, more seriously, their dense, impervious nature encourages moisture and salt concentrations around them, extending the area of decay still further.

Removal of old fillings is essential but slow and careful work. The dental analogy is difficult to avoid when describing the forming and preparation of cavities which are later to be plugged with a carefully designed amalgam. The old fillings are drilled out, with only the minimum use of impact tools such as sharp masonry chisels and fluted plugging chisels on large areas. Small chisels and air abrasive tools are used to assist cutting out and to enlarge the cavities slightly by undercutting to improve the keying effect, but the maximum amount of surviving surface is always retained. Only where the original surface is already lost should any further dressing off take place, to avoid the retention of water traps (*Fig. 9*).

Once all old fillings have been removed and their cavities recut and new cavities formed where newer spalls and splits had developed, all loose dust and debris must be removed by flushing with clean water. If algae are present a few drops of formalin may be added to the water. This will provide a sound, clean and sterile area in which the new mortar can be placed. Flushing out is most conveniently carried out with trigger-operated hand sprays which have a simple adjustable nozzle to vary the jet as required from a fine pencil to a coarse spray pattern. At this stage much of the sculpture looks very leprous indeed but all deleterious material which can be removed has been scrupulously excised.

Once the cleaning has been completed the structural repairs referred to above will, where necessary, be carried out.

Consolidation by limewater

The cleaned surfaces with open cavities are next treated with limewater to attempt to consolidate the more friable areas. Limewater contains small quantities of calcium hydroxide (0·14 g in 100 ml of water at 15°C). Traditionally it is siphoned from the slaking tank after lime has been slaked in an excess of water and after all slaking has ceased and the water is clear, but usually, now, lime putty is stirred into a container of water and left to stand until the water is clear. It is important that the limewater is protected from the air otherwise it will carbonate and become ineffective. A number of different methods have been used to achieve this in a practical way; the most recent development is the covering of the surface

of the limewater in its container with a float of polystyrene sheet stock, pierced only by a siphon tube fitted with a filter. The limewater is drawn off when required by a hand pump into spray bottles or directly to a lance with a control valve and adjustable nozzle, checking from time to time that the water has not accidentally become clouded through disturbance of the lime in the bottom of the bin. Any cloudy water is rejected and the water allowed to stand until it is clear again. Approximately forty applications of limewater are flooded onto the surface of the limestone over a period of several days; application can continue as long as the surface will absorb, but excess limewater should not be allowed to lie on the surface of the stone and is removed by sponges which are then squeezed out in clean water.

Consolidation effects have been reported over many years as a result of multiple applications of limewater to lime plaster, Doulting, Bath, Clunch, Barnack, Beer, Salcombe and Chilmark limestones, although it has to be said that attempts to record or quantify the phenomenon have met with a disappointing lack of success.

Surface repair

The consolidation treatment is followed by the placing of mortar repairs, the stage of work in the 'lime method' where perhaps the greatest skill and the most experience are needed. Certainly the mortar repair is the core of the method and, when well executed, is the work which evokes the greatest admiration.

All mortar repairs are based on lime; no Portland cement of any kind must be used at all. If a weak hydraulic mortar is needed, then a small addition of 'HTI' powder (high temperature insulation—a pale coloured ceramic powder) is used as a pozzolana.[6] All limes are of a 'high calcium', non-hydraulic type.

Lime is brought to the site after burning and is slaked as soon as possible in a suitable tank by adding it to water, raking and hoeing it through, until all visible reaction has ceased. An excess of water is used, so that the soft mass of lime putty formed during slaking is kept well covered. Experienced lime practitioners express preferences for different limes according to the kind of work and the type of stone they are working with, although this should be an indication of very considerable practical experience and not an affectation of the 'wine-snob' variety! The lime putty must be left in its tank under water for as long as possible. The absolute minimum should be one week to ensure that all slaking is finished, but any days, weeks, months or even years that can be added to this period can be looked on as a bonus, especially if the lime putty can be mixed and stored in wet, air-tight conditions with the aggregates. Of course, it will never 'set' or harden too much if it is kept from the air and, even if it has stiffened, it can easily be 'knocked-up' again when needed

[6] At Crowland abbey, Professor Baker used finely crushed 'Cambridge White' brick dust as his pozzolanic additive is matching Barnack limestone. Brick dust is a useful alternative to 'HTI', with a slower setting effect.

without the addition of any water; with sufficient working it will soon become a soft gelatinous mass again. Pozzolanic additives must only be added just before use, and then mixed in very thoroughly indeed.

Aggregates are selected and graded for colour and function. Considerable time is spent in their selection and many sands and crushed stones will be tried in the process of finding the right combination. Stone pieces are crushed by a hammer or roller on a concrete slab, or even in a corn grinder and then carefully sieved and graded for storing in a 'bank'.

The mortars have a number of different functions to fulfil. They are all likely to be a combination of lime and the same aggregates, but the lime:aggregate proportions may vary and so will the size of aggregate; only some functions require a pozzolanic additive. Basic proportions may be summarised as follows

	Lime		*Aggregate*
Repair morter	1	:	2
Adhesive mortar (for fixing spalls)	1	:	1
Grouting mortar (for crack filling)	1	:	1½
Shelter coating	1	:	3

Ten percent pozzolanic additive ('HTI' powder) is included in the basic aggregate proportion in the adhesive and grouting mortar, but a lower percentage in the repair and shelter coat mortars. The aggregates tend to become finer towards the bottom of this list and are always very fine indeed for shelter coating. Some examples of aggregate sizes related to mortar function are given below.

		Aggregates BS sieve sizes (mm)				*Pozzolanic additive*	
Mortar function	*Lime*	1·18	600	400	300	600	300
Mortar repair	3	1½	1½	¾			
Mortar repair	3	3	2			½	
Adhesive mortar	6	—	—	—	6	1½	
Adhesive mortar	6	—	1	1	4	½	
Grouting mortar	3¼	3	—	1	1	½	—
	2	—	½	1¼	—	—	¾
Shelter coat	3				8	—	—
Shelter coat	3			2½	4½	—	—

The lime putty is always screened through a 1·18 mm mesh after slaking. Further screening takes place according to the function of the mortar.

The final colour of the repair is dependent on the selection and blending of the aggregates and the proportion of lime used, the method of placing the repair and the rate of drying out. Minor variations in colour continue to take place indefinitely just as the colour of a stone surface will continue to respond to variations in humidity. Successful 'instant effects' are not necessarily the most satisfactory after a period of weathering and only considerable experience can design for this and select the mortar constituents accordingly. At Wells this experience has been primarily concentrated on matching Doulting and Dundry stones.[7]

When the conservator goes onto the scaffold to place the repair mortar a number of pre-mixed mortars, sometimes as many a sthirty for two stone types, will have been prepared in separate plastic tubs, covered with a piece of wet cloth and the tools and materials necessary for the operation will be conveniently laid out on a board ready for use. These will include hand spray bottles full of water, cotton wool packs, a small trowel, dental picks and plugging tools, spatulas, two or three small bristle brushes and rubber gloves. The following sequence of working is typical.

1. Cavities and cracks are flushed out again with water from the hand sprays to avoid an otherwise dry stone surface de-watering the repair as it is pressed into position. The surface should be damp without water actually shining on the surface.
2. Deep cavities are treated at the back with a slurry of repair mortar followed by a filling into which small pieces of Dundry or Doulting stone are inserted to reduce the thickness which needs to be built up in fine repair mortar.
3. A thin slurry of repair mortar containing 'HTI' powder is brushed into the cavity or fracture to provide an additional key for the repair.
4. After one or two hours, when the slurry has dried, the cavity is wetted up again and the first repair mortar is kneaded and pushed into place with the fingers, exerting as much pressure as possible. With few exceptions, not more than 5–6 mm should be pressed in at one time. Dental plugging tools and spatulas are used to assist in the filling (*Fig. 10*). Throughout the entire sequence compaction of the amalgam by pressure is absolutely essential to achieve good adhesion and minimum shrinkage.
5. As each filling is completed precautions must be taken to avoid rapid drying out by protecting the area from direct sunlight or strong draughts (*Fig. 11*). When dry, the cavity must again be wetted and Stage 4 repeated until the cavity has been filled completely. Overfilling is a useful aid to compaction and surplus morter can be trimmed off with a spatula to the desired profile on completion. A texture matching the stone can be achieved with a dry sponge, taking care not to press hard and absorb moisture from the repair, hessian pads, stencil brushes and purpose made plastic scrapers.

[7] Dundry and Boulting limestones weather in subtly distinct ways and are always distinguishable in colour. The Wells team have developed a palette of mortars which can be used as repair mixes or as shelter coats, and which make use of the same aggregates in varying proportions. Dundry stone varies from a light cream to dark brown and light grey. Doulting varies from a pale buff to different and often darker browns and greys. The aggregates used to match these colours are not obtained by crushing stones of the same kind, but of rather richer coloured stones with good staining properties.

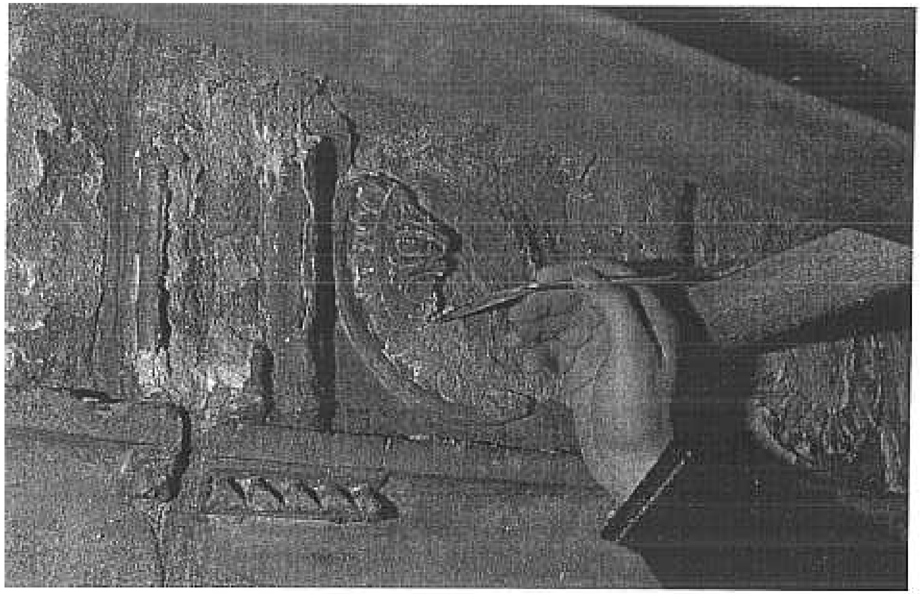


Fig. 10. Sculpting and dental tools are the most appropriate to clean out and to place mortar amalgam under the fragile sulphated crust of this detail in the frieze at Old Gorhambury.

As a general rule no modelling is carried out in the repair morter. Its role is to fill cavities and cracks and to provide a weak, porous capping to vulnerable, friable areas; it is designed to draw moisture and therefore soluble salts to itself and finally to fail before any further stone is lost. Ideally it will then be replaced. To ensure slow drying, wet cotton wool packs are laid over the finished repair and left in position for as long as is thought necessary.

Shelter coating

The final stage of the work is to apply a thin surface coating to all the cleaned and repaired stone. This is intended to slow down the effects of weathering on the surviving surfaces by providing a sacrificial layer which may be removed by direct rainfall or disruption by salt crystallisation activity associated with wetting and drying cycles. In the case of stones which were once covered with gesso and coloured with tempera the shelter coat may be seen as a substitute protection. The suggestion has also been made that the shelter coat provides a warmer surface than the untreated stone and that this inhibits the formation of

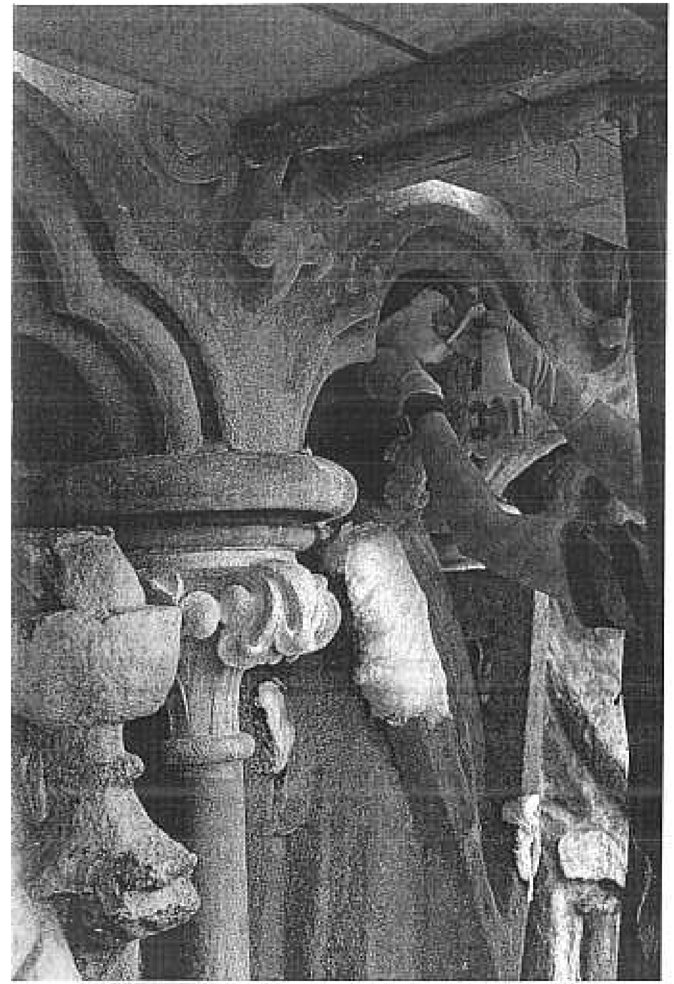


Fig. 11. Lime mortar repairs are protected from rapid drying by packs of wet cotton wool. Drying rate is very critical to the immediate and long-term performance of lime mortars. Re-wetting of the packs is carried out by hand spray-mist.

condensation. Whilst this might conceivably be the case with a thick limewash it is difficult to believe that a fine shelter coat could have such an effect. One of the most obvious and striking developments noticed by observers who have been familiar with the technique since its early days is the increasing fineness and subtlety of the shelter coat,[8] although thicker coats are still applied to ashlar and simple architectural mouldings, as they have been at Wells since 1980. Shelter coats have been applied to figure

[8] One observer, only slightly misquoting Hans Christian Anderson in his story of The Emperor's New Clothes, insisted that the stones 'had nothing on at all'!

sculpture as general policy since 1977, and were pioneered by Professor Baker twenty years earlier.

Practitioners insist that a shelter coat is not a paint, largely because of the method of application; it is, however, a coloured surface treatment requiring periodic maintenance, so the distinction is somewhat academic. The shelter coat is of similar or the same composition as the repair mortars, but the aggregate to lime proportion is slightly higher and sand and stone dust are crushed more finely. Water is added to the fine lime and aggregate mix until a consistency of thin cream is reached and thorough mixing continued for 20 to 30 minutes. Martin Caroe has introduced a heavy duty food mixer at Wells to carry out this part of the operation. At the end of the mixing period casein and formalin may be added.

Careful colour matching of cleaned, weathered stone precedes the full application. This matching can be carried out on a separate piece of the same stone in similar condition, but it is better to lay the samples on the stone itself or on, for instance, an adjacent moulding. Considerable skill is required in colour matching, as in matching repair mortars. All trial colours must be completely dry before a decision can be made about its accuracy. Sometimes a hot air-blower may be used to hasten the drying of the trial colours.

The surface is prepared for application by careful but thorough spraying with water. Spraying is carried out with hand bottles until water begins to sit on the surface and is no longer absorbed into the stone. At this stage, as soon as the water has ceased to glisten on the surface, the shelter coat can be laid on with a soft bristle brush (*Fig. 12*). A second, short-haired (or worn) bristle brush is used to work the shelter coat into the texture of the stone. Traditionally, pads of hessian (sacking) are used

Fig. 12. Architectural detail at Christchurch Priory is shelter-coated after cleaning. The thin lime casein coat has been applied by brush and is being rubbed in by hand, using a small pad of coarse cloth.

Fig. 13. The 'resurrection tier' at Wells Cathedral, showing cleaned, consolidated and shelter-coated sculpture. The stiff-leaf capitals have been repaired by mortar and, in some cases, re-carved.

Fig. 14. Cleaned, consolidated and shelter-coated head at Crowland Abbey. The surface is sound and deep weathering has been partially filled with shelter-coat to exclude water traps.

for rubbing in to achieve the maximum compaction possible. The hessian must have been washed to remove the starch and any impurities. Compaction by rubbing is a very important part of the process and serves to fill the minute hollows of textured stone whilst wiping off all but a smear from the high spots. The treatment is always applied to complete stones, and sometimes, as in the case of sculpture, is carried across joints as well.

Drying out must be as carefully controlled as the drying out of mortar repairs. Polythene shrouds are often used and intermittent mist spraying by hand during the first few hours avoids any risk of rapid drying which can result in a powdery and useless shelter coat and undesirable

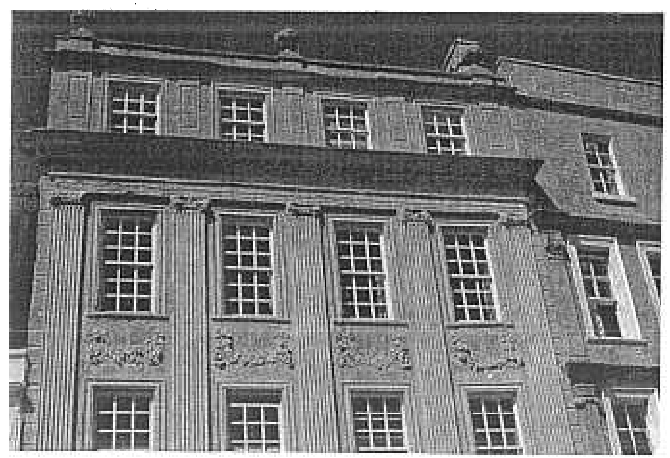
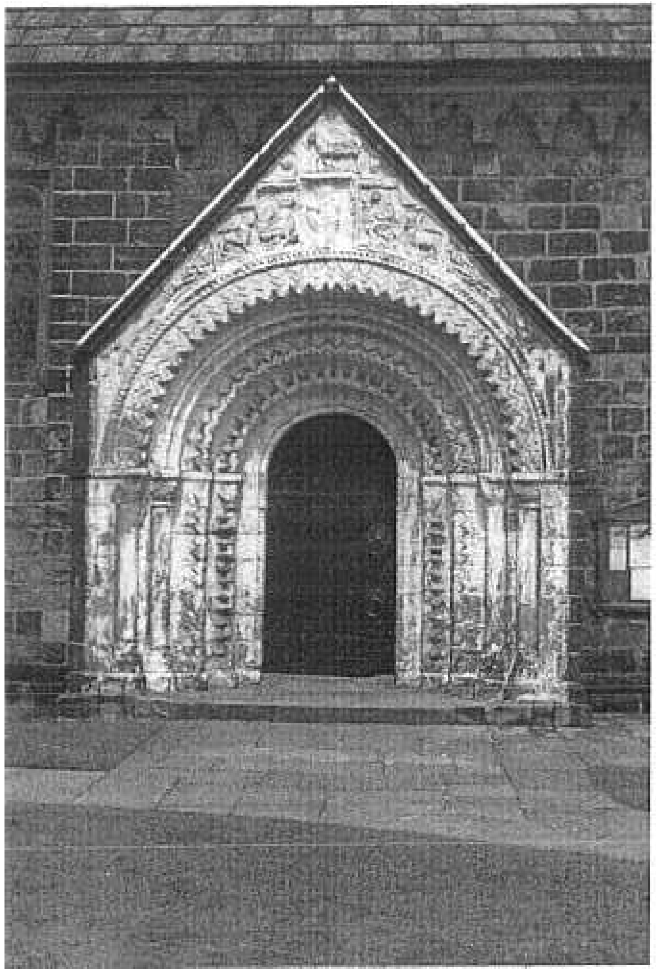


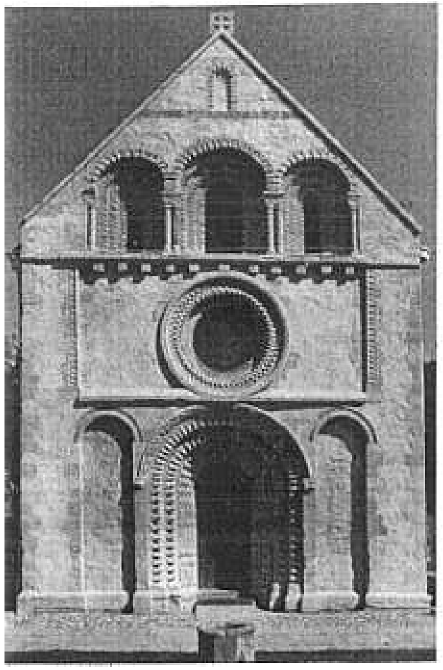
Fig. 15. Marshal Wade's House, Bath (a National Trust property) was cleaned, and the detail consolidated with lime water and finished with shelter coat under Professor Robert Baker's direction. This eighteenth-century facade is an early example of a secular subject which has received this treatment.

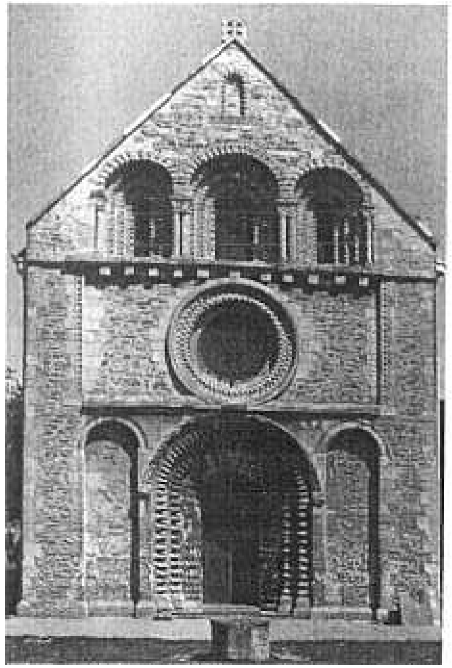
FIG. 16. Limewash and lime water have sometimes been applied inadvisedly to sandstone subjects. As the lime coat fails, water washing over the lime surface tends to exacerbate the decay of the sandstone. The lime method is appropriate only for limestone, although the consolidation of marble has been attempted in Bath, and is of interest.



modifications in colour. During the first stages of drying out small additions of colour in the form of finely ground stone dust or even powdered charcoal may be dusted on to achieve minor, subtle variations in the final appearance (*Figs 13, 14*).

Shelter coating is the most visually striking part of the 'lime method' process but should never be too obvious. Inexpert handling can result in a bland, woolly appearance which on the scale of the west front of a cathedral would be an aesthetic disaster of the first order. However,





FIGS 17, 18. St. John's, Iffley, Oxford. The west front has been cleaned, consolidated and re-plastered by Richard and Sally Strachey under the direction of Professor Baker. The rubble masonry between the dressed stones has been carefully re-plastered as it undoubtedly was originally, affording weather protection and removing the distracting fussiness of the small walling stones. The lime plaster, ironed on hard, follows the contouring of the substratum. The detail has been cleaned and consolidated by the 'lime method'. Iffley is a very remarkable and successful example of the complete 'lime-method' approach.

properly carried out with sufficient sensitivity to the colour and tonal variations of the worn stones it can greatly enhance their appearance (*Figs 15, 16, 17, 18*).

Conclusions

The 'lime method' is here to stay. Increasing discussion with its practitioners and the invaluable notes and papers many of them have prepared, together with the scientific scrutiny which is now being applied to it, ensure that it will develop and will be refined.

Acknowledgements

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Resumen

En Inglaterra, la fachada occidental de las catedrales de Wells y de Exeter, y la fachada occidental en ruinas de la abadía de Crowland han experimentado interesantes transformaciones durante los últimos años. Esculturas en piedra caliza cubiertas de suciedad y mal reparadas, y valiosas superficies debilitadas por desconchados a causa de una película de sulfato han sido rescatadas en algunos casos de lo que parecía el borde de la destrucción. Algunos observadores ven una nueva vida, claridad y estabilidad en estas fachadas; otros ven una uniformidad no natural, un difuminado de detalles y un futuro dudoso. Estas fachadas han sido limpiadas, reparadas y consolidadas utilizando técnicas resumidas en su conjunto como el 'método calizo', que se comenta en este artículo y otro que se publicará en el número de diciembre de 1984 de *Monumentum*.

Al comentar el 'método calizo', el autor indica que no existe nada nuevo en algunos aspectos del tratamiento, tales como la utilización de cataplasmas calientes de cal para limpiar manchas de la piedra caliza, o de mortero de cal para reparaciones plásticas, o de lavados con cal para la protección externa contra la intemperie. Mantiene que la técnica se basa en el sentido común y en materiales tradicionales, dos cualidades que lo han recomendado a los conservadores que dudan del empleo de métodos sintéticos o no comprobados; pero añade que el éxito de Wells, Exeter y Crowland no debe estimular el uso indiscriminado de la técnica como remedio a todos los problemas de la piedra, o incluso los de piedra caliza.

El 'método calizo' puede describirse de modo práctico de acuerdo con esta secuencia: examen; reparación estructural; limpieza; consolidación; reparación de la superficie; y capa protectora. Se describe cada uno de los procesos, con valiosos consejos prácticos sobre los aspectos que hay que vigilar durante la aplicación. El autor concluye diciendo que el 'método calizo' ya no será abandonado. El aumento de interés por parte de los que lo emplean, así como las valiosas notas e informes que muchos de ellos han preparado, además del escrutinio científico al que está siendo sometido, aseguran que seguirá desarrollándose y perfeccionándose.

Résumé

La façade ouest des cathédrales de Wells et d'Exeter en Angleterre ainsi que la façade ouest de l'abbaye de Crowland ont subi d'intéressantes transformations au cours des dernières années. Des sculptures très noircies et mal réparées, de précieuses et fragiles surfaces avec une peau sulphatée écaillée ont été sauvées alors que plusieurs d'entre elles étaient presque détruites. Pour certains observateurs ces façades ont acquis une nouvelles chaleur, une nouvelle clarté et un nouvel équilibre; pour d'autres leur uniformité n'est pas naturelle, les détails ont perdu de leur netteté et l'avenir est incertain. C'est que ces façades ont été nettoyées, réparées et consolidées grâce à une technique dite 'à la chaux' qui est décrite dans cet article et dans un deuxième qui paraîtra dans le numéro de décembre 1984 de *Monumentum*.

L'auteur fait remarquer que beaucoup d'aspects du 'traitement à la chaux' n'ont rien de neufa en particulier les applications de chaux vive pour nettoyer les taches du calcaire ou l'utilisation de mortier de chaux pour les réparations ou de lait de chaux pour protéger les surfaces extérieures. Il souligne que cette technique fait appel au bon sens et aux matériaux traditionnels, deux éléments qui ont encouragé ceux des conservateurs peu enclins à se fier à des materiaux synthétiques ou à des méthodes qui n'ont pas fait leur preuve à l'utiliser. Mais il ajoute une mise en garde: la réussite à Wells, Exeter ou Crowland ne signifie pas qu'il faille utiliser cette technique pour toutes les conservations de la pierre ou même de la pierre calcaire. Le 'traitement à la chaux' peut être décrit selon les étapes suivantes: (a) étude, (b) réparations des structures, (c) nettoyage, (d) consolidation, (e) réparation de la surface, (f) enduit de protection. Chaque processus est décrit en détail, avec des indications précieuses sur des points précis à surveiller au cours de l'opération. L'auteur conclut que le 'traitement à la chaux' continuera à être utilisé.

Il est de plus en plus connu et les précieuses notes publiées par les conservateurs qui l'ont pratiqué aini que l'examen scientifique qui en est fait actuellement font que ce procédé sera certainement développé et affiné.