Society for the Protection of Ancient Buildings

Cleaning stone and brick

Technical pamphlet 4

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Contents

Most moderately soiled stone on buildings is cleaned for aesthetic reasons. Dirt disfigures and obscures the colour and character of different stones, reducing them to an unattractive uniformity; on older buildings a wealth of detail, especially at high level, may be lost completely under black sooty deposits.

Advanced soiling is not simply an aesthetic problem because dirt, as well as hiding open joints and structural faults such as cracking, is also a major cause of decay. Sulphur compounds in the atmosphere react with calcareous stones to form calcium sulphate, causing spalling and blistering; the reaction with sandstones and granites results in a thin, hard dirt-collecting film which is virtually insoluble in water.

This pamphlet describes the various methods available for cleaning stone and brick, their suitability for different building materials and the techniques which have produced the most effective results. Common problems associated with cleaning are analysed and remedies proposed.

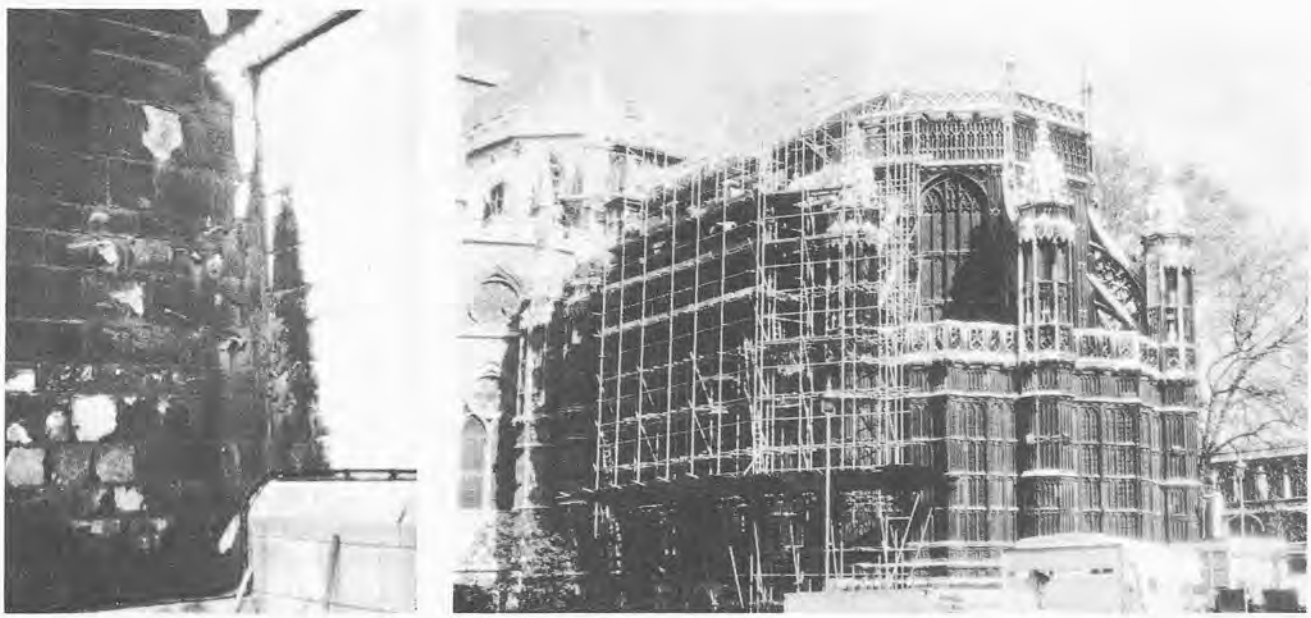


fig. 1: *Soiling on old buildings is not something that can be ignored. A decision must be made on whether or not the dirt deposits are harmful and whether they should be wholly or partly removed. If they are to be removed, what is the correct method and are the skill resources available adequate to carry out the work sensitively and safety? A building of the complexity of Henry VII's Chapel at Westminster cannot even be examined properly without the removal of some of the dirt, which builds up into encrustations of a positively harmful kind. The detail (left), from the Palace of Westminster, shows splitting and spalling sulphate skins on sheltered limestone contrasting with the sound, regularly rain-washed surface adjacent. Natural weathering effects in a polluted environment often present a strong case for maintenance washing.*

1 Choice of method

The available methods of cleaning stone and brick buildings are washing, mechanical and chemical. The first and last of these may incorporate some form of poulticing. Sometimes two or even three methods may be used together.

The selection of a method is governed by the type and condition of the substrate and the type and quantity of the soiling. The use of the building and its accessibility also affect the choice.

Once a sensible choice of method has been made, perhaps with the help of a feasibility study including some trial cleaning, success depends on the skill and experience of the operatives. The availability of adequate skills must also be a factor in deciding whether or not to clean. Good supervision and the proper preparation and protection of the building are also essential for the safe, smooth and economic running of the work.

2 Washing

Traditionally limestone and brick are cleaned by softening accumulated dirt with water sprays, which wash the dirt away. Brushing and scraping assists removal. This is still the simplest and often the best way to maintain the clean appearance of a building. But because so many buildings of every age are only now being cleaned for the first time the quantities of water needed to remove the dirt are liable to have deleterious side effects. Often whole buildings are saturated without need, in the attempt to soften a few stubborn areas, encrustations under mouldings or hard tarry spots in pieces of carving. This is obviously undesirable.

There are a number of objections to washing limestone, the least important but most frequently raised being the aesthetic one. Dirt, adhering to the porous surface of stone over a long period of time, becomes attached to the stone with a binding matrix of calcium sulphate. Constant wetting of this skin over the years drives dirt into the pores of the stone, so that it is almost impossible to wash all dirt out of a heavily soiled surface in one washing operation. The removal of superficial dirt is often followed by an almost immediate brown or 'ginger' staining caused by a tarry solution from the pores drying out on the surface.

This staining is directly related to the amount of soiling and the porosity of the stone, and so is particularly a problem on very old buildings. Subsequent washings reduce this staining, which in any case fades with time. The phenomenon is most noticeable on light coloured stones such as Portland and Kent rag, but it is scarcely a problem on brown or yellow stones, such as Ham Hill or Anston.

A more serious disadvantage is water penetration; at no other time in its life is a building subjected to such a concentration and quantity of water as during washing. Hidden iron cramps out of the normal wetting zone may be exposed to washing water and spend some time in saturated stone, resulting in rusting, staining and even spalling; cracks and open joints may allow the build up of water around buried timber or behind panelling. Also the relative porosities of stone facing and brick backing may hinder the drying of the backing and lead later to dry rot. A further disadvantage is that washing must be programmed to take place during frost-free months.

fig. 2: *New Palace Yard, Palace of Westminster, showing Anston, Clipsham and Portland stone cleaned by intermittent washing and small "suction gun" air abrasive tools. This is a typical successful combination of two methods.*

Most of these objections can be overcome by careful planning, proper preparation of the building, constant and conscientious supervision and by using supplementary techniques, such as hand rubbing with abrasive stones, non-ferrous wire brushes, or even a limited amount of blasting on heavy encrustations.

A particular benefit of washing is that it gives 'in depth' cleaning; a dramatic surface clean such as blasting often disappoints building owners because browning follows rapidly. This browning is not further soiling but a light tarry solution released by rain from the dust-filled pores. The brown colour of a calcium sulphate skin on a light coloured limestone will likewise be apparent again after rain washing.

Soaking with sprays softens dirt deposits and dissolves the soluble binding matter; the softened deposits may then be removed with brushes, scrapers or water jets. Mains water is normally used (even when this is chlorinated). It is applied through fine to medium v-jets or cone jets arranged on booms which can be moved up and down the facade as required. These should be spaced to give even saturation of the facade and should be individually controlled to avoid waste on clean areas or unwanted water on windows. Booms may be supplemented by individual spray heads on hoses looped and tied to the scaffold, but this arrangement is not acceptable for cleaning a large facade because positioning is limited and the nozzles tend to slip and change position. In some circumstances an oscillating 'rain-fan' boom may be useful.

There is no advantage in using coarse rather than fine jets. A fine spray discharging 110 to 140 litres per hour is satisfactory but there is a good case for using nebulous sprays discharging approximately 45 litres per hour where fine or fragile detail is to be cleaned. Nebulous or 'hydraulic atomised' sprays create a wet mist and substantially reduce the amount of water cascading down a facade. But to be effective they must be clustered close to the dirty surface and tightly screened to prevent the mist spray blowing about. Although nebulous sprays have always been recommended for reducing the quantity of water, their use in commercial practice has always been very limited. They should certainly be considered more often on valuable and vulnerable historic work, and under special circumstances internally.

A useful development in washing has been the control of fine sprays by a pre-set clock. Intermittent or 'pulse' washing controls the water flow electronically. A typical timing sequence involves six-second bursts of water with six-minute intervals. This kind of system allows a progressive softening of the dirt without cascades of water.

Two other forms of washing, operated by pumps with water delivered through lances held by the

operative, are available. The cutting action of the *high pressure lance*, using cold water, is useful in removing stubborn patches of dirt. It is a useful adjunct to both washing and blasting where it is used to freshen up the facade and clear it of dust, and also in chemical cleaning where it removes both the dirt and cleaning agent. Chemicals, both acid and alkaline, disinfectants, and petroleum emulsions for special uses can be incorporated. High pressure water and chemical cannot, however, be expected to remove heavy soiling without preliminary softening up. The usual precautions in preparing a site for this treatment should be followed as described under 'Chemical cleaning'. Detergents are included in some chemical cleaners where the principal use is as wetting agents.

fig. 3: *South Porch of Malmesbury Abbey. The cleaning here is a museum technique using pencil-sized air abrasive tools and very fine abrasives. The rate of working is essentially slow, and demands consistent patience and craftsmanship. Very vulnerable pieces of detail may need supporting with lime putty and stone dust, or fine lime grouting before later consolidation. Because the action of weathering and the aggressive activity of soluble salts continues, a subject of this value must remain under regular observation.*

Light soiling may sometimes be removed very successfully with 'safe' (i.e. neutral PH) soaps mixed with water or white spirit.

Detergent powders containing sodium sulphate should be excluded.

Steam was used quite extensively before the last war when it fell into disrepute partly because caustic soda, added to the boiler water to avoid furring, was deposited on the cleaned surface and remained there to cause decay. Steam generating equipment takes mains water and usually passes it via an electric pump to a paraffin-fired flash boiler. But because steam condenses so quickly the method is little more than a hot water wash with rapid drying. A useful application of steam has, however, been demonstrated in recent years on paving of public areas to remove unsightly, trodden in chewing gum. The combination of steam and high pressure is very successful in dealing with this unsightly problem.

Hot water is useful where there are greasy deposits and may accelerate the cleaning action of some chemicals.

3 Mechanical cleaning

In the past, sandstone, brick and terracotta were frequently cleaned by dragging, scraping and 'discing'. All these methods clean by destroying the surface. They are better thought of as 'redressing' techniques and as such must never on an any account be used on brick and terracotta. Occasionally they may be used in the last resort on badly stained, blistered and already damaged surfaces.

Power tools with carborundum heads, rotary wire brushes, or abrasive blocks (both artificial and natural, such as Derbyshire grit stone) may be used. Mechanical cleaning is best used on flat areas or large-scale simple moulding. Great skill is required to achieve a good finish. Another consideration is cost, for while discing may compare favourably in price with a straightforward blasting, if the surface is to be hand-rubbed the price may be 30 or 40 per cent more.

Experimental needle scaling, using a compressed air tool has proved effective but much too harsh, even on Kent rag, to be a suitable technique for masonry.

Sand and grit blasting are also forms of mechanical cleaning.

The cleaning technique of using a compressed air and grit stream was developed initially to remove rust and scale from iron and steel sheet. During the 1960s it was applied to cleaning masonry; first on sand and grit stones, then on limestones. Since then it has been extensively used on all types and conditions of stone, brick and even terracotta.

Early enthusiasm led to some unfortunate mistakes where the use of blasting was very ill-advised; blurring, pitting and loss of surface is still an all-too-frequent sight where blasting has been too severe. However, blasting has proved its worth on heavily soiled masonry, especially on siliceous stones; it is often the only way to remove the heavy encrustations present on 'first cleans', and so it can supplement washing or chemical cleaning.

The main attraction of blasting is speed and the immediate and often dramatic overall result. The associated noise and dust nuisance may be thought a small price to pay for these twin benefits, especially as with dry blasting the fears of water penetration and tarry staining are removed. Very good results can be achieved where hardness of stone, boldness of detail and a craft approach by the operative come together. On the debit side, irreparable harm can be done by indiscriminate blasting of soft stone which could have safely been cleaned by water or even simply by a change of abrasive and a smaller gun.

One unfair criticism of blasting is that it removes 'case hardening' on the stone thereby exposing it to accelerated weathering. 'Case hardening' usually refers to an irregular crystalline calcium-sulphate skin on limestone; on some limestones this will in time craze or erupt in unsightly blisters. Occasionally this skin may well be more resistant to blasting than to water. On two comparable and adjacent areas of Portland ashlar, water saturation dissolved some of the calcium sulphate leaving a rough surface while blasting cleaned the skin, but left it intact.

Blasting cleans by means of a *compressed air jet* containing an abrasive, either sand or non-siliceous grits, e.g. ground copper or iron slags. More sophisticated abrasives are available for special work. These include glass beads, wheat husk and crushed egg shell. Compressed air is fed to a pressure pot containing the abrasive, and the two are then passed along a hose to a blasting gun.

An alternative system to the pressure pot is the gun operating on a venturi system, the so-called "suction gun". This is operated by a trigger and is easily controllable, responding immediately to the operative's requirement. This equipment is extensively used on good quality work.

Various grades of sand and grit are

available. Generally speaking very coarse grades are no advantage and tend to block and spurt unevenly from the gun. Finer grades have a smoother flow and usually remove dirt faster unless the stone has a very rough texture. The choice between sand and non-siliceous abrasive is usually determined by cost, for although it is a health hazard, sand is cheaper than most grits. Relative cutting speeds vary with the type of stone and the operative.

There are a variety of pressure pot and gun sizes; the smallest types allow the operative to control the spread of abrasive and to use the gun on carved work where arrises would be vulnerable to the wide spray of abrasive from the larger guns. Fine abrasives only should be used with these small guns because they would be blocked by coarse grades. All abrasives should be sieved into the pressure pot to avoid blocking.

For small-scale internal work, a vacuum-blast is available which removes dust and dirt whilst cleaning. It is a slow process but cuts down the nuisance.

Operatives engaged in dry blasting should wear protective clothing, the most important item being an 'air-line' helmet which by maintaining a positive air pressure inside prevents the ingress of dust.

The *dry blast* may be adapted to a *wet* process by use of a 'wet head' gun. There are several types of wet head which introduce water into the air and abrasive stream, either with single or multiple small jets. A mixture of water and abrasive tends to be less harsh than the dry abrasive, but this benefit if offset by the amount of slurry generated at the wall face. This slurry makes wet blasting unpopular with operatives because even when they are properly attired, it tends to obscure the work by covering the plastic window in the helmet and by adhering to the wall face and collecting on ledges and in mouldings. The net result is that a light and dark mottled effect (known as 'gun-shading') and cementitious build-ups of dirt and slurry may be left behind.

An important advantage of the wet blast is that it reduces to a minimum the free dust which can be such a nuisance with a dry blast. Thus it is a pleasanter method for those using the premises, but the obvious temptation for some operatives to reduce or cut off the water during wet blasting must be guarded against. A wet-blasted facade should be well washed after completion, preferably with a high-pressure water lance, to remove dried films of slurry; build-ups of slurry on the scaffold and at ground level should be cleared away each day to avoid blocking gullies and surface water drains. But even though considerably less water is used during wet blasting than during washing, tarry 'drying out' stains must be expected where there have been heavy dirt deposits on porous blocks.

A *water/abrasive lance* is a further system which effectively cleans limestone and sandstone with water and sand metered together through the hose to a long nozzle which, it is claimed, reduces the pressure at the wall to about 25 p.s.i. There is, of course, no dust with this system.

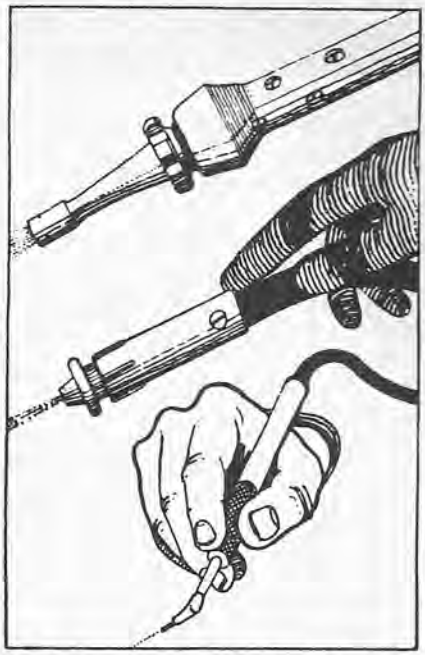


fig. 4: *Comparison of standard blasting nozzle (top) with small ceramic nozzle for small-scale detail: the very small pencil gun may be used with fine abrasive and low pressure where utmost delicacy is required, capable of removing varnish layers from canvas without damage to surface below.*

The means of combating noise and dust have received a good deal of attention. The clouds of dust and abrasive can be contained by tightly screening the scaffold with reinforced translucent sheet and by sealing windows with tape, peelable plastic coating and sheet. But even when every precaution has been taken it would be unwise to exclude the possibility of infiltration of the finer dust particles. Although this is often an acceptable nuisance there will be special circumstances where this risk will rule out this method or at least dictate the use of a wet head. An abrasive pot is available with a drip dampener to cut down the dust nuisance. This can be moderately successful in dealing with the problem.

Noise may be a more serious problem, and again in certain circumstances may be a positive deterrent. There is no appreciable difference in noise levels between wet and dry blasting. The main problem is, of course, the noise of the gun and the impact of air and abrasive in the target area, rather than the background noise of the compressor which can be substantially muffled and sited to reduce the nuisance.

4 Chemical cleaning

Chemical cleaners are usually based on alkalis or acids. Most either contain soluble salts or react with stone to form soluble salts, and this means that the cleaner must be completely removed at the end of the cleaning operation. The only chemical cleaner known to leave no soluble salts in masonry is hydrofluoric acid, but because this is extremely dangerous in inexperienced hands, its use should be left to firms employing trained operatives.

Hydrofluoric acid is available as a commercial concentration and is diluted before use, but no acid other than a proprietary brand of known concentration suitable for masonry surfaces should be allowed on site. It does not leave harmful deposits in the stone, but is highly corrosive, which is why its use is principally restricted to removing soiling from sandstones and granites which water cannot touch. It is also used to clean soft and heavily soiled brickwork which would not respond well to washing or would be irreparably damaged by blasting. Aqueous solutions of hydrofluoric acid can cause serious and painful burns and can be absorbed into the blood through skin contact, causing acute poisoning. For this reason it is not generally used on materials (such as limestones) which can be cleaned by other means. Solutions of ammonium bifluoride are an alternative because they contain free acid. However, ammonium salts can harm porous stones, and so ammonium bifluoride is recommended principally for use on granite.

Hydrofluoric acid is applied by a brush or spray to a pre-wetted wall and left for a short time, washed off, reapplied and then thoroughly

washed off with a high pressure water jet. If the acid remains on the wall for too long colloidal silica will be formed which appears as a white bloom and is difficult to remove. The method usually achieves a high standard of cleaning, and is quiet and relatively cheap. In some cases of heavy soiling it will be an advantage to reduce the depth of soiling with preliminary blasting.

The disadvantages of using hydrofluoric acid are the dangers of etching glass, and attacking the polish on marble and granite or glazed tiles. It may also attack free iron in some sandstones, causing rust staining; a proprietary rust inhibitor will overcome this.

Safeguards to the building and to the public are of course of prime importance. Scaffolding, windows, polished surfaces and metal fixtures should be properly protected with two coats of peelable latex and sheeting, and scaffold tubes should be sealed to prevent reservoirs of acid forming which may cause burns when the scaffold is struck. On completion, the scaffolding should be washed at the same time as the building. If the scaffold is left in position after cleaning so that repair work can be carried out, acid impregnated boards may etch glass with acid vapour.

All operatives using these acids should wear helmets, full face protection, pvc suits, gauntlets and rubber boots. Spilled acid should be doused with water and neutralised with lime before washing away, and plenty of running water should be kept available in case of accidents. Hospital treatment is essential for

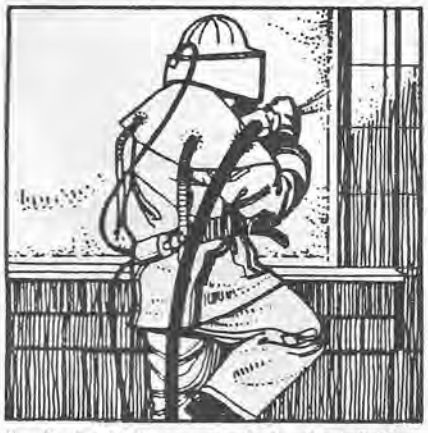


fig. 5: *Acid clean general: the Craigleith sandstone is being cleaned with solutions of hydrofluoric acid and some limited abrasive blasting in support.*

even minor splashes on the skin, but immediate site treatment can be given by dousing with water and treating the burn with sodium bicarbonate paste. There is much to be

fig. 6: *Craigleith sandstone terrace houses in Edinburgh show the typical cleaning effect achieved by the use of dilute hydrofluoric acid; the dark staining in saturation zones is an unfortunate effect of weathering which cannot be removed and must be anticipated on some light coloured sandstones.*

said for using a proprietary material which comes pre-diluted ready for use. Other acid cleaners are available which are less dangerous to operatives but they do involve the risk of damage if residues are left on the building.

Most *alkaline cleaners* are based on caustic soda with additives to control penetration and promote surface activity. Their main use is cleaning moderately or lightly soiled limestones and, to a lesser extent, glazed bricks and faience. They are also sometimes used on ordinary porous brick but this is not advised because more of the cleaner may be absorbed than be satisfactorily washed off and soluble salts will be left behind.

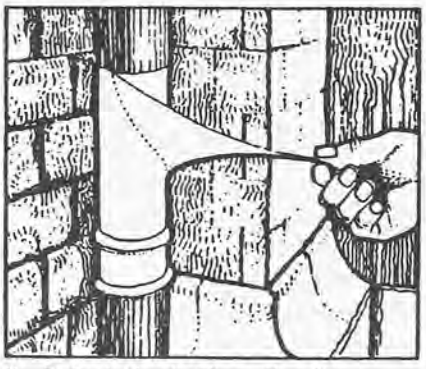


fig. 7: *Peelable plastic coating for protecting glass and paint while cleaning with chemical or air abrasive. Two coats are normally required for blasting, and always for protection against hydrofluoric acid.*

Alkaline cleaners compete with water washing, rather than blasting. Encrustations, heavy soiling, or indeed any soiling which requires more than two or three applications of the cleaner should be finished by another method. The soiled area should be first wetted, working from bottom to top to minimise the risk of streak staining and each application should be jetted off with clean water before the next is applied.

The final removal of the chemical by washing is imperative, or efflorescence and bloom will result. The presence of these injurious and disfiguring salt crystals is still an all-too-common aftermath of alkaline cleaning, and may be attributed to careless or incorrect application and washing off or incorrect selection of method in the first place.

The advantages of the method over water are the considerable reduction in the quantities of water necessary to achieve a good result, reduction of the risk of staining and speed. Proper preparation of the site is essential. The low volume, high-pressure water lances often used in jetting off chemical cleaners can force the chemical into open joints and cracks which have not been adequately sealed.

fig. 8: *Chemical cleaning using caustic alkali: the operative, properly clad for chemical handling, is using a high pressure low volume water lance to wash off the alkali.*

5 Special cleaning problems

Suitable materials for cleaning brick are shown in Table 1. Non-abrasive systems are obviously most desirable, which means that water and chemical systems should be selected. Great caution should be taken with timing if hydrofluoric acid is used, or white insoluble silica will be formed. If other acids or caustic alkalis are used, preparation of all the joints, pre-wetting and thorough washing off are absolutely esential.

Common disfigurements of masonry are rust staining from ferrous window bars and hidden fixings, green stain-

ing from copper and bronze, green and black algal slimes, efflorescence, old paint and limewash and oil or grease stains. Soluble limestone dressings can also mar nearby brickwork. Reference to several of these problems is made in *BRE Digests 21 (First series) and 177.*

Long-standing metal stains are almost impossible to remove. Some acids may be successful on stains of only a few months' duration and specialist firms will undertake such work. Ammonia solutions are useful for copper stains and for washing off and inhibiting the regrowth of algal slimes. Water repellent liquids and neutralising liquids may be used to combat efflorescence by changing the moisture content on the wall on which it forms, although if practicable, simple brushing-off from time to time may be a better method. The use of silicone water repellents is currently being observed (English Heritage) on brickwork subject to staining from soluble *limestone* dressings with the object of improving the self-cleaning properties of the wall and preventing the formation of stains and deposits.

Iron stains may be removed from granite or sandstone by application of orthophosphoric acid, or from limestones, marbles and calcareous sandstones by solutions of sodium hydrosulphite. The stone must be prewetted and washed off thoroughly after application.

Old sulphated *limewash* in multiple applications is often too difficult to scrub and wash off; it should be either wet poulticed over a long period to soften the limewash or, if the wall will stand it, blasted with abrasive.

Grease and oil stains may be removed using carbon tetrachloride, dichloromethane, white spirit or proprietary dry cleaning agents in well-ventilated conditions: application is either by sponging or by a series of poultices using whiting or one of the natural clay earth mediums available. A useful de-greasing caustic alkali cleaner is available to break down greasy surface soiling, particularly on surfaces exposed to pollution from vehicles, and may successfully be used as a preliminary preparation for cleaning by other methods.

The clay earths have the advantage of being easier to remove; there is no pore filling nor any necessity for scrubbing after the poultice is removed. Poultices are widely used, with and without gelling agents and detergents for cleaning statuary and marble. The cleaning agent is employed with an inert powder such as clay earth, wood flour, whiting or tale. The poultice serves to absorb the staining material and prolongs contact of the cleaning agents with the stain. They could well be used more on carved detail on buildings where prolonged treatment by other methods carries too great a risk. The English Heritage and the Building Research Establishment are also carrying out exploratory work on removing soluble salts from walls by this method.

The removal of *aerosol paint* is always difficult because of absorption. Solvents and high-pressure water jets will be partially successful but may bleach. Combined with poulticing, solvents can be effective against felt tip pen graffiti. Masonry dust rubbed into the surface will restore the appearance to some extent. Graffiti repellents are available which, if pre-applied to vulnerable areas enables paint to be removed easily. A number of caustic gels, applied by brush, or caustic paste applied by trowel are available for removal of difficult paint stains, and naphtha is useful in breaking down *bitumen.* After applying caustic materials washing and clean clay poulticing should follow to remove any caustic residue.

Organic growths such as lichens and algae do not appear to play more than a small part in stone decay. However, in excess they can be disfiguring where much dead growth is present, and can be the first stage in the build up of higher plant growths. Removal using a 1 per cent aqueous solution of a quaternary ammonium compound, followed two weeks later by an inhibitory treatment of tributyl tin oxide and a quaternary ammonium compound have proved very effective. Wet scrubbing should be avoided. Stains from organic materials may sometimes be removed with hydrogen peroxide solution, which is preferable to ammonia solution as it does not leave harmful residues in the stone.

6 Selection of method

Even a brief study of cleaning techniques will show how mistaken it is to adhere to any single method as correct especially with the problem of the 'first clean'. Different stones, conditions and amounts of soiling demand a flexible approach to the choice of method.

Ideally, all abrasion and saturation would be excluded and whatever caution at present rightly surrounds the use of chemicals, it is the use of these in the future which may solve most of the present difficulties associated with other methods. It is to be hoped that research in the field of chemical cleaning will eventually overcome the hazards of hydrofluoric acid and the soluble salt problem of

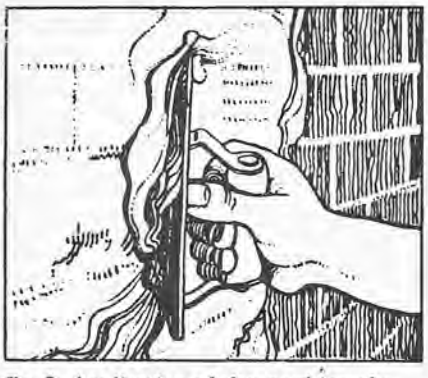


fig. 9: *Application of clay poultice: the wet clay has good adhesive properties, and may be thrown onto the wall, before spreading evenly with a float to an average 15-20 mm thickness.*

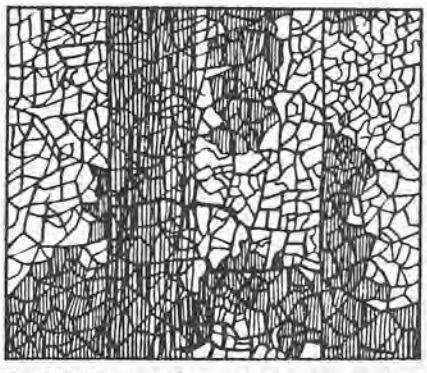


fig. 10: *Dry poultice ready for removal: the clay has separated from the wall, indicating that its usefulness is over. Wire mesh embedded in the clay on application aids adhesion and removal.*

fig. 11: *Pointing up fine joints and cracks with non-shrink mortar before cleaning: preparation of this kind is essential and should precede the start of any cleaning operation.*

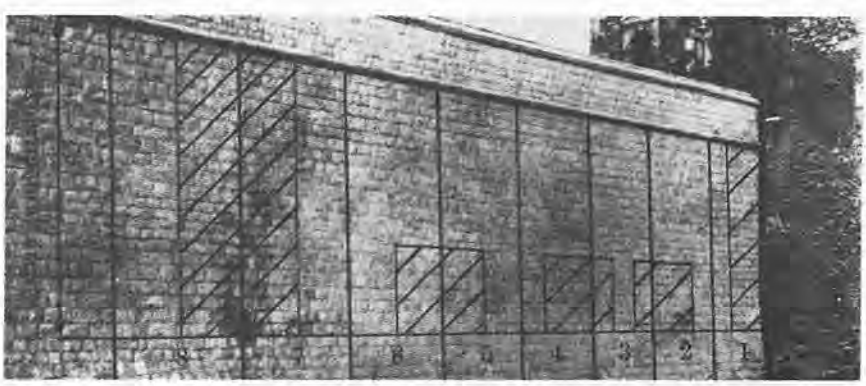
alkali (sodium hydroxide) cleaners. For the time being however, these methods must take their place with the other techniques, to be used correctly or not at all.

There is no justification for taking unnecessary risks on valuable buildings with unproven methods, however plausible the method may seem. An important building which has accumulated dirt for a hundred years or more can well wait to see the method proved on lesser facades. On the other hand there should be no unreasoned prejudice against a method because of one or two bad results, when there is ample evidence of satisfactory cleaning available elsewhere.

7 Maintenance of cleaned surfaces

Dirt inhibition after cleaning may be achieved by the application of a water repellent treatment such as silicone water repellent or aluminium stearate. However, these treatments are expensive, and their effective life as inhibitors may be considered too short to justify the initial expense of the operation. Although experimental treatments in London during the 1970s indicated that treated areas stay marginally cleaner than cleaned untreated areas, the breakdown of these treatments after a period of approximately five to eight years resulted in a rather patchy appearance. The general view is that the dirt-inhibiting benefits of such treatments are not justified in the long term. Such treatments should not be expected to take the place of maintenance cleaning. All surfaces, once properly cleaned, should ideally be washed lightly at intervals to avoid the build-up of dust and dirt again. A low volume medium pressure water lance is useful in this context and can be operated from a mobile hydraulic platform. Observation of local conditions will indicate at what frequency these maintenance washes should take place, but five years in an urban environment would at present seem to be desirable.

Surface treatments such as these must not be thought of as 'preservatives'. Shallow treatments do not generally have any beneficial effect, and in some circumstances will accelerate decay of friable masonry. Research at the Building Research Establishment and elsewhere is continuing into the deep impregnation of masonry with suitable resins to immobilise the crystallisation of salts and reduce decay.



8	7	6	5	4	3	2	1
wet sand blast	water spray	coarse grit blast	medium grit blast	fine grit blast	dry sand blast	water spray	high pressure water spray

non siliceous abrasive blasting (dry)

After cleaning, the hatched areas were treated with water repellents to observe dirt inhibiting effects.

fig. 12: *Section of Kentish Rag curtain wall (Mint Street) Tower of London, used as a cleaning experiment by the Building Research Establishment in co-operation with the Directorate of Ancient Monuments and Historic Buildings (1971). Wet grit and steam were included in the techniques examined, but medium grit dry blasting and dry sand blasting proved to be the most successful on this experiment.*

TABLE 1: Methods of cleaning stone and brick

Method	*Calcareous (eg limestone)*		*Siliceous (eg sandstone, granite)*		*Brick*
	Heavy soiling	*Light soiling*	*Heavy soiling*	*Light soiling*	
A Washing	✱ (1)	✱		✱ (1) (2)	✱
B Dry blasting	✱		✱	✱	✱ (3)
C Wet blasting	✱		✱	✱	✱ (3)
D Chemical (alkaline)		✱			✱ (4)
E Chemical (acid)			✱	✱	✱
F Mechanical	Rarely		✱		

(1) Plus B/C on hard stone
(2) Plus E on soft stone
(3) To prepare for A or E on very heavy soiling
(4) For glazed bricks, faience etc.

TABLE 2: Common defects associated with cleaning

Method	*Defect*	*Cause and notes on avoidance*
Washing Wet blasting Pressure lancing	Tarry stains	Tarry solution, formed during wetting, drying out of pores. Can be reduced by avoiding prolonged saturation and by further washing. Some tarry staining unavoidable.
	Dry rot Rust expansion Flooding	The results of penetration can be minimised by careful sealing of all open joints and cracks before cleaning, and by taping and sheeting all openings. Watersheds and catchment sheets on rigid supports with falls to gullies will avoid flooding risk.
Dry blasting Wet blasting	Pitted surface Blurred arrises	The result of wrong choice of method on stone which is too soft or a careless operative or the use of too harsh abrasive.
	Gun shading	Especially on wet blasting erratic movement of blasting gun leaves mottled effect. Slight appearance often unavoidable. Pronounced appearance the result of using inexperienced operative.
	Blasted glass	Careless use of gun and inadequate window protection. Glass should be coated with peelable protection.
	Slurry deposits and film	Unfinished job. All dust deposits and slurry should be hosed or jetted off.
Hydrofluoric acid	Brown stains on sandstone	Stone with high iron content. Acid combined with rust inhibitor should be used.
	Etched glass	Lack of protection or if occurring after cleaning, due to acid vapour on scaffold. Peelable plastic coating should be used on glass and scaffold boards washed and lifted. Scaffold tubes should be sealed.
	Pavement staining	Splashes of acid not neutralised and washed away.
	White bloom	Acid left on too long. Very difficult to remove.
Alkali	Efflorescence	Excessive number of applications used, careless washing off or wrong use on too porous a material.
	Streak staining	First wetting and application carried out from top to bottom. Risk can be reduced by working upwards.
Mechanical	Scour marks	Lack of skill or wrong use of method on moulded stone. Can be improved with hand rubbing.
	Wavy arrises	Lack of skill or more probably wrong choice of method on carved or moulded work.

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Fig. 11 is based on a Szerelmey photograph.

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Bibliography

From: British Standards

BS 6270: Part 1: 1982 Code of Practice for Cleaning and Surface Repairs of Buildings. Part 1. Natural Stone, Cast Stone, Clay and Calcium Silicate Brick Masonry.

BS 3826: 1969 Silicone Based Water Repellents for Masonry.

BS 6477: Water Repellents for Masonry Surfaces.

From: Building Research Establishment Digests

139 Control of Lichens, Moulds and Similar Growths.

177 Decay and Conservation of Stone Masonry.

280 Cleaning External Surfaces of Buildings.

From: English Heritage Technical Notes

TN1 Control of Organic Growth.

TN21 Masonry Cleaning.

TN29 Repair and Maintenance of Terracotta and Faience

TN33 Colourless Water Repellent Treatments.

TN37 Cleaning of Marble

The Lime Method. John Ashurst (Reprints of paper in *Monumentum* 1984)

Advice on Cleaning Contractors:
1. Architectural cleaning.
Stone Federation Handbook and Directory,
82 New Cavendish Street
London W1M 8AD
Tel. 01-580 5588.

2. Sculpture cleaning (Conservators).
UKIC Stone Group
c/o British Museum.

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