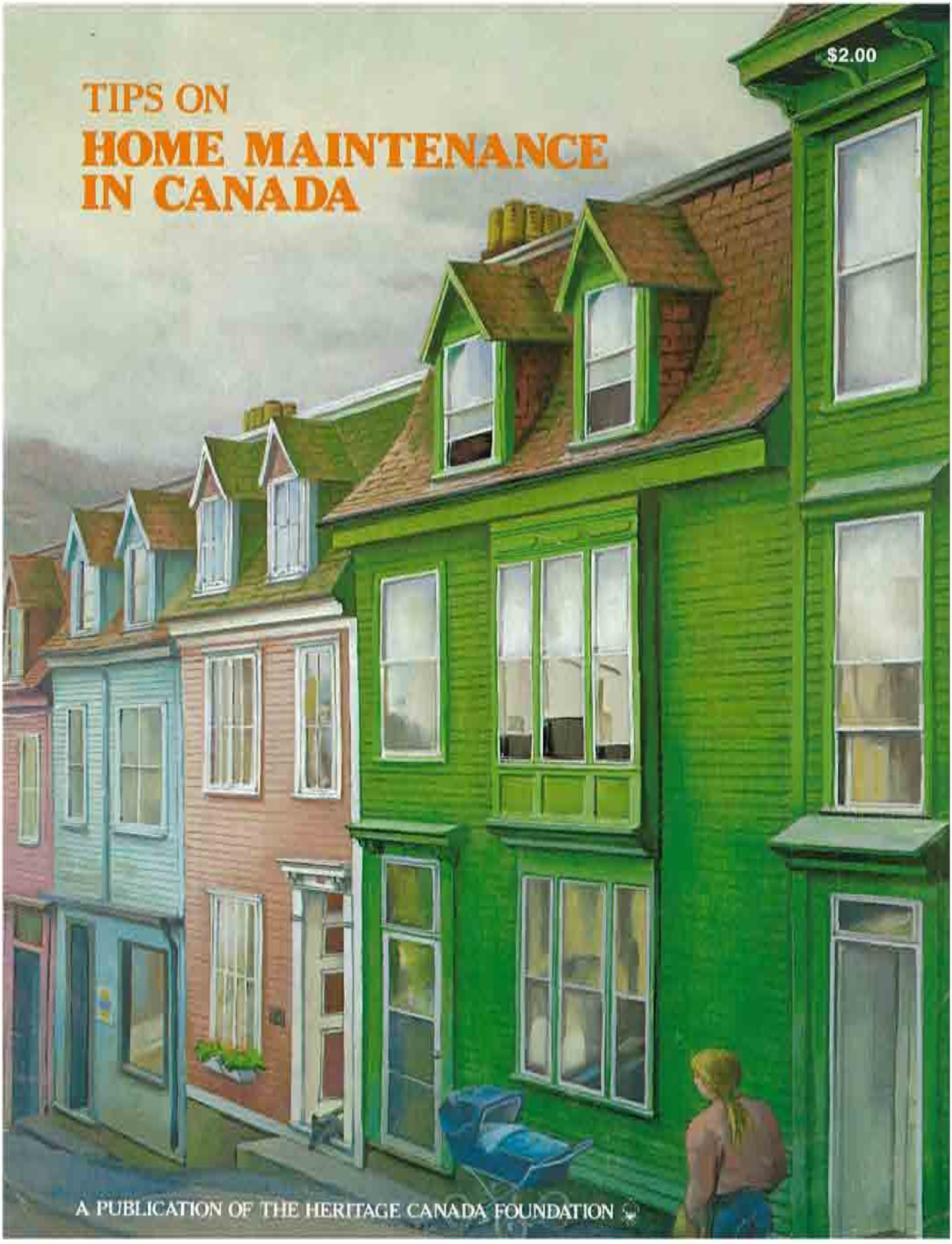

$2.00
TIPS ON
HOME MAINTENANCE
IN CANADA
A PUBLICATION OF THE HERITAGE CANADA FOUNDATION

TABLE OF CONTENTS

technical notes

Still in doubt about removing old paint? Read on.

Martin Weaver

WHEN AND HOW TO REMOVE PAINT FROM OLD EXTERIOR WOODWORK.

In the summer of 1978, a heritage home in Ottawa was damaged by a fire which should never have occurred. The roof and upper floor of the building were quite badly damaged and some valuable antiques and paintings were also damaged by smoke and water.

Why is this fire of interest in the present context? The fire was the accidental result of "burning-off" old paint from the wooden exterior cornice. When a butane torch or similar flame producing apparatus is used to remove old paint accumulations from wood, there is a considerable risk that unseen flames will get through cracks in the woodwork and ignite hidden wood or rubbish within the wall or roof. A fire can start hours after the initial application of the flame because wood or shavings can smoulder for long periods before igniting. The eaves of roofs are particularly hazardous for burning-off because birds and squirrels will often pile up nesting material in such snug and hidden spots. Sash window casings are another typically hazardous location where there are often accumulations of wood shavings and pieces of paper.

The only completely safe answer to the problem is to avoid the use of flame producing apparatus on heritage woodwork. Many organizations which own and maintain heritage properties have a complete ban on the use of flame producing apparatus for removing paint and will only permit welding, soldering, brazing or cutting operations on metalwork under very strictly controlled conditions. The Greater London Council's Historic Buildings Division in the U.K. is an example of such an organization.

Before discussing methods which can be recommended for the removal of old paint, we should consider why the paint should be removed in the first place.

There are two basic justifications for removing paint from exterior woodwork. First, because the accumulation of paint layers has become so thick that it is obscuring architectural detail such as mouldings or fretwork; and/or second because the paint surface or sub-layers have deteriorated to such a degree that they cannot be painted over. Unless one or both of the above conditions exist the removal of paint layers will most probably be a waste of time and money in addition to being damaging to the original "artifact". To understand the latter point one need only consider the current values of pieces of early Canadian painted furniture. It is well accepted that a piece which has its original paint finish is worth many times more than one which has been stripped. The original paint finish is an integral part of the artifact and should be left alone unless it is essential to remove it.

‘Always use safety goggles when using paint removers. They may be a little inconvenient but a lost eye is a great deal more so.’

In most cases failures of paint "films" or layers are due to moisture resulting from defects in the structure or defects in the paint surface, insufficient preparation of surfaces, or poor painting. The following descriptions of paint failures will help the reader in deciding whether or not paint needs to be removed.

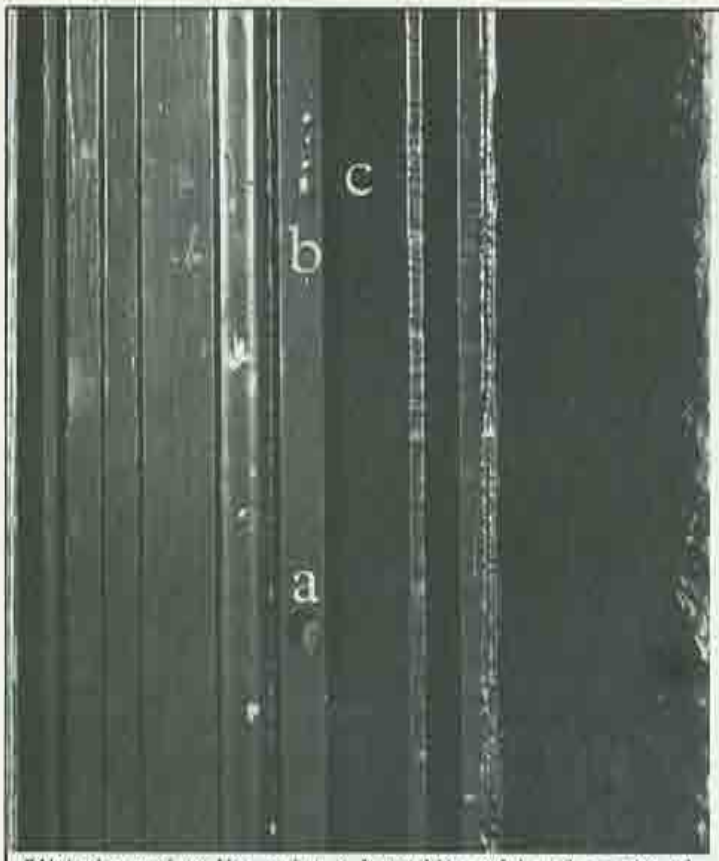
— Blistering and peeling is usually caused by moisture, in and behind the wood, being drawn out by the heat of the sun. Whenever the adhesion of the paint film is weak, the moisture builds up to form blisters filled with water. The blisters burst and peeling continues to occur as more water gets in through the broken film. Areas of blistered or flaking paint should be removed and it is essential that the sources of the original moisture should be traced and eradicated. Sometimes blistering is caused by the sun heating up unevaporated solvents, particularly in dark paints and causing them to vaporize and blow up the surface film. This is usually a problem which occurs during painting and is avoided by painting while the surface is shaded. It will most often occur on the south side of buildings where solvent rich paints were used or where paint was applied over very resinous wood. In the latter case the paint should be removed and the resin sources sealed off with a coat of shellac or patent "knotting".

— Cracking occurs when the wood beneath the paint expands and contracts due to wetting and drying. Old paint which has grown brittle and has lost some of its adhesive qualities will crack under strain. The paint should be removed and again sources of moisture should be traced and eradicated prior to repainting.

— Staining is the result of water soluble colouring matter from the wood being redeposited on the paint surface wherever the coloured water evaporates. Stains can usually be removed with a mixture of one part of water to one part of denatured alcohol. Unless cracking or peeling is occuring it is not necessary to remove the paint. Once the surface has been cleaned and washed with mineral spirits to remove traces of oils and greases, any disfiguring stains can be painted over.

— Intercoat peeling or "tissue paper" peeling occurs when the last paint film or two let go and peel away from sound coats beneath. The problem is caused by water soluble salts deposited on a surface that are not cleaned off prior to repainting. Faulty surface coats should be removed, the surface cleaned with water from a garden hose, wiped dry and repainted before more salts build up.

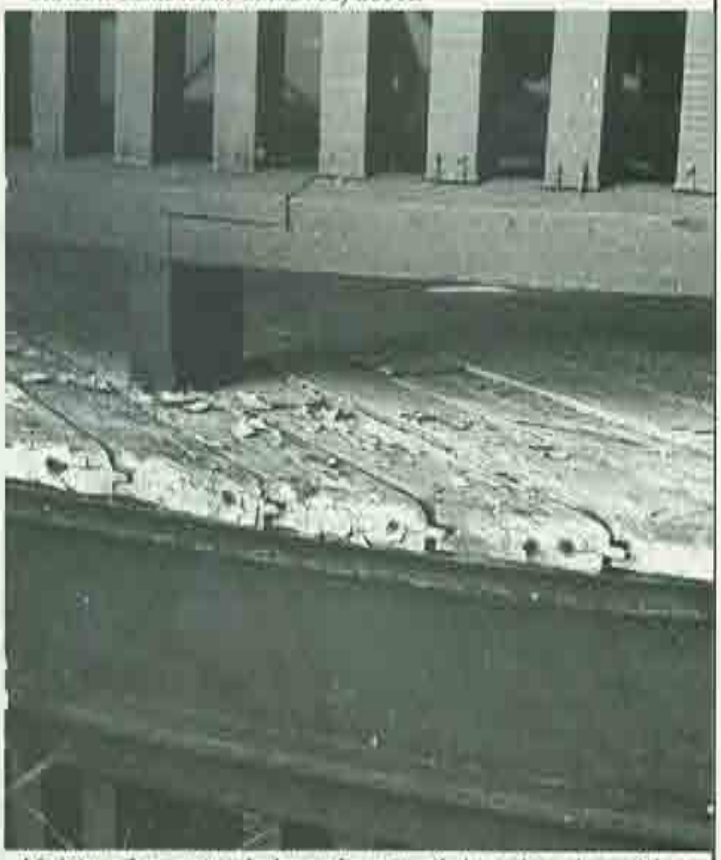
— Alligatoring or checking is caused by the surface of the paint drying out and embrittling before the underlying layer. As the lower layers dry out they contract and will often cause the dry inelastic surface to crack under tension. Alligatoring also occurs if the undercoat or previous paint films are softer than the



Blistering and peeling paint. A burst blister (a) and a series of fresh blisters (b) are seen here on a dark brown south-facing door frame. Alligatoring is just developing to the right of the upper blisters. (c)

Water soluble salts often build up on sheltered surfaces like this porch ceiling where the rain never reaches. Intercoat peeling is occurring in association with cracking which may indicate some leaks in the roof above.

Cracking is here occurring in the heavily painted boards of an old porch deck.



Moisture has entered the end grain of these boards and has caused the wood to expand cracking the old brittle paint. So much moisture has then got into the wood that all the paint has come off.

All illustrations, Maldahon Productions

latest finishing coat. Alligatored paint should be removed to sound layers, sanded and repainted.

— Chalking describes the phenomenon of a powdery surface which rubs off on your hand. Such surfaces should be washed with water, dried, and then painted over.

— Dirt, soot and pollution should be removed with water and "non-ionic" detergents. Rinse well with clean water afterwards. It may not be necessary to repaint.

— Mildewed paintwork is washed off with non-ionic detergent in water and then rinsed. Remaining mildew can be scrubbed off with a solution of one part by volume of household bleach and three parts of warm water. This solution should be allowed to remain on the surface for a few minutes and should be rinsed off with clear water.
CAUTION: **NEVER** MIX HOUSEHOLD BLEACH WITH AMMONIA OR DETERGENTS OR BLEACHES CONTAINING AMMONIA, OR WITH MURIATIC OR HYDROCHLORIC ACID. SUCH MIXTURES PRODUCE VAPOURS WHICH CAN BE VERY DANGEROUS.
For your safety always use goggles and rubber gloves.

— Staining from rusting or corroding iron and copper can be painted over after cleaning and sanding but the original source of the corrosion should be treated to prevent further staining.

Having briefly discussed some of the major types of paint problems and the reasons for removing paint, we can now consider appropriate removal techniques.

Paint removal techniques are of four basic types:

— softening and raising paint layers by applying heat;

— softening paint with chemical solvents or "strippers";

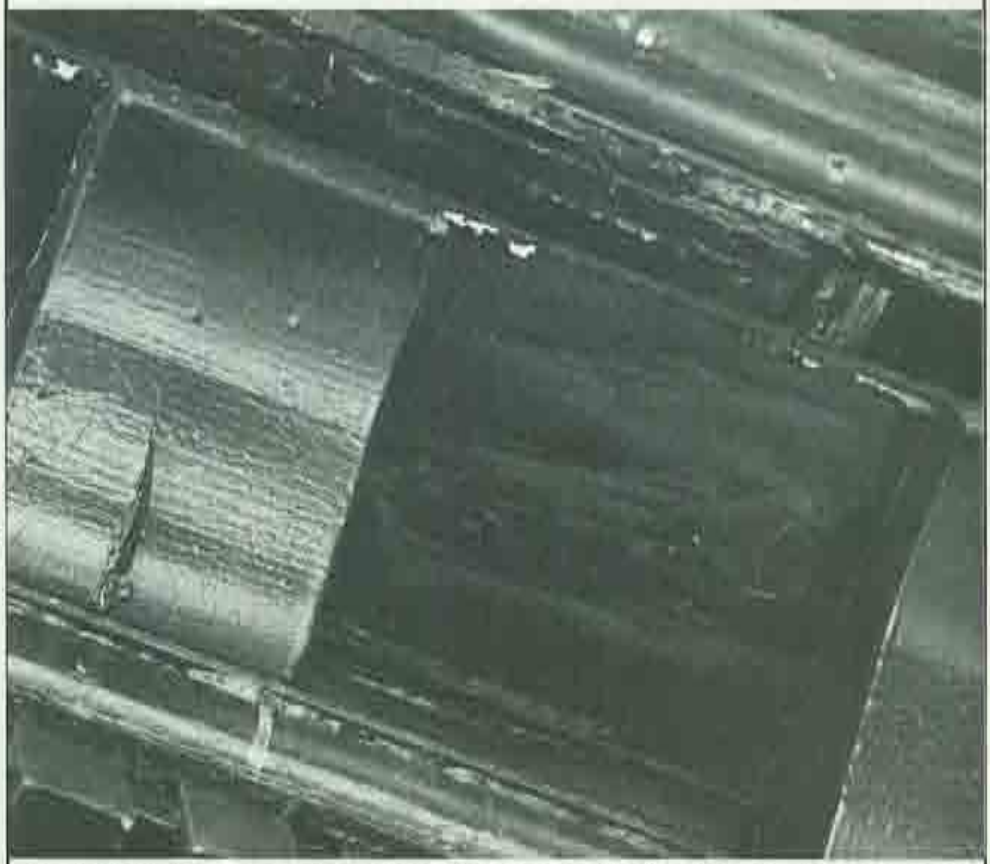
— paint removal using various types of abrasion;

— combination techniques using some or all of the above techniques.

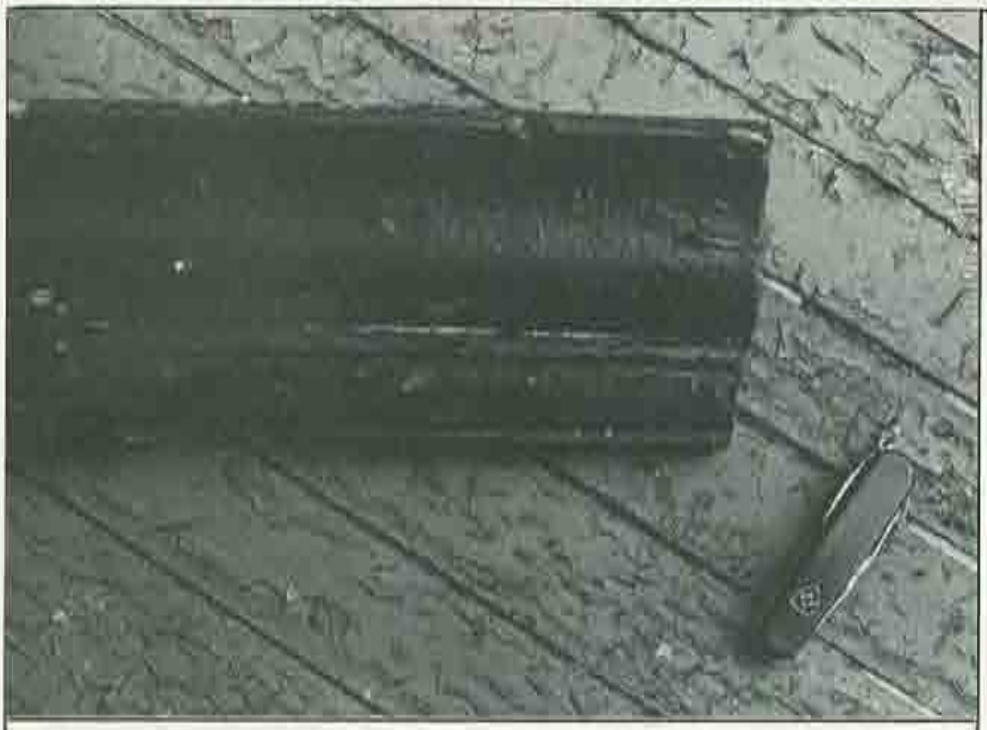
For the removal of paint from heritage buildings, we have already stressed that burning-off with the butane torch is not normally an acceptable method. However, if a torch is used on plain areas where there are no major fire hazards, there is a further hazard if one is removing old lead-based paints. The flame of the torch will cause the formation of extremely toxic lead vapours. Even in well ventilated exterior conditions it is good to avoid burning-off lead based paints.

Probably the best removers using heat are the electric heat guns which work on the same principle as a hair dryer (See sources list at end of article). One can also use infra-red lamps, special heat pads, and "hot wire" paint removers. All these devices use electricity and can cause fires if left on too long or if misused in some way.

The base of this wooden column shows a combination of cracking and alligatoring. There are so many layers of paint on the mouldings that their profiles are beginning to be lost.



The distinctive warping and cracking visible in the underside of this wooden cornice is due to an attack by a wood destroying fungus. No amount of paint treatment will cure this problem which basically concerns the wood beneath the paint.



This section of wooden cornice moulding shows many forms of paint deterioration related to moisture. It fell off because the wood was rotting and the fixing nails had corroded away. Its restoration is not just a matter of removing paint and repainting.

It is a good idea to use dark glasses when using the infra-red lamp.

Of the chemical removers the best are undoubtedly the water rinsable paste or thin jelly-like removers which are non-flammable. These removers usually contain methylene chloride and it should be remembered that this too gives off vapours which are harmful to your health. Always work in well ventilated conditions and if you are using a lot of methylene chloride based remover, invest in a protective mask with special filters for organic solvents. Some chemical removers contain carbon tetrachloride or benzol, both of which have toxic fumes. Benzol or benzene is also flammable and if one must use it, great care should be taken to avoid all open flames, sparks, heaters, and electrical equipment. (It is generally *inadvisable* to use benzol-type removers indoors because of their hazardous nature.)

Chemical removers all require the scraping-off of the sludge. For scraping-off use a putty knife, a wallpaper stripping knife with the sharp corners ground-off so that it doesn't dig-in; or an especially profiled scraper for mouldings.

The sludge can cause an awful mess if not properly disposed of. A useful hint is to stretch a wire across the top of an old one gallon paint can and to wipe the scraper blade across the wire so that the sludge drops neatly into the can.

Always use safety goggles when using paint removers. They may be a little inconvenient but a lost eye is a great deal more so!

Sandpapers and various grades of steel wool are used to take off remnants of paint sludge and to prepare old paint and wood surfaces for repainting.

Rotary sanders and wire brushes can also be used for paint removal but care should be taken not to gouge down into the wood.

All the above methods may be used in combination providing one observes the safety precautions and uses common sense. A useful combination method for tough paint removal problems has been recommended by the National Paint, Varnish and Lacquer Association of the U.S.A. The Association suggests that first you apply a water-rinsable paint remover. Then after allowing it to stand for 15 minutes you apply steam through the pan of an ordinary wall paper steamer. The pan is moved slowly across the surface and is followed with a wide-bladed scraper. Be sure to have adequate ventilation and don't use steam with removers containing benzol or carbon tetrachloride.

As a final comment it is worth repeating some safety hints:

— Always read and follow manufacturer's instructions.
— Always find out the major chemical ingredients of a paint remover. In event of an accident which necessitates a visit to the doctor, an effective treatment will depend on this information. If in doubt take the labelled can to the doctor.
— Use safety goggles and masks. Chips of paint are especially liable to fly up when scraping and sanding. Paint chips can be very sharp and can seriously damage an eye.
— Always have fire extinguishers and plenty of water handy. The water is for putting out accidental fires and for quickly washing off spots of paint remover which have managed to get on your skin.
— Use rubber gloves when using paint removers.
— Keep a clean and tidy site and don't get drips of paint remover or sludge all over the place. Watch out particularly for drips on ladders and on electrical equipment or cables, these can cause serious accidents.

If you are still in doubt about removing paint from the exterior of a particular heritage building, you would be best advised to leave it alone. The worst thing you can do is to rush in and strip-off exterior painted woodwork only to discover that you have destroyed the only evidence for the history of the external appearance of the building. The restoration of original paint colour schemes will be the subject of a future technical article in this magazine.

Sources list

The following sources might be useful for obtaining further information:

Property Owner's Guide to Paint Restoration and Preservation Technical Series/No. 1 Preservation League of New York State. Available for $1.00 from the P.L.N.Y.S. 184 Washington Avenue, Albany N.Y. 12210. U.S.A.

Paint Colour Research and Restoration by Penelope Hartshorne Batcheler. Technical Leaflet 15. American Association for State and Local History. 50¢ from the A.A.S.L.H. 1400 Eighth Avenue, South, Nashville, Tennessee 37203 U.S.A.

The Old House Journal: various issues, including Vol. II No 8 August 1974
Vol. III No 4 April 1975
Vol. V No 4 April 1977
Back issues are available from:
The Old House Journal
199 Berkeley Place
Brooklyn N.Y. 11217
N.B.: O.H.J. also markets an electric heat gun.

Conservation and Architectural Restoration Supply Sources and Brief Bibliographies edited by Richard O. Byrne. A.P.T. Publication Supplement. $3.00 + 50¢ postage.

Paint Colour Research and Restoration of Historic Paint edited by Kevin Miller. A.P.T. Publication Supplement $3.00 + 50¢ postage. Available from The Association for Preservation Technology Box 2487 Station D, Ottawa, Ontario. K1P 5W6

An electric heat gun, Model No. HG501 manufactured by Master Appliance Corporation, Racine, Wisconsin is distributed wholesale in Canada by White Radio Ltd. 4445, Harvester Road, Burlington, Ontario L7L 4X1 (416) 632-6894. Price in U.S.A. $60.00. Price in Canada $73.50.

Letters

Paint Removing

Following the publication of my short article "When and how to remove paint from old exterior woodwork", we received a letter from H.E. Ashton of the National Research Council expressing concern over some points which I had raised. Since Mr. Ashton is probably Canada's leading expert on architectural paints, I would like to discuss his comments.

His first comment related to my statement about paint blistering being caused by moisture being drawn out by the heat of the sun. Mr. Ashton rightly took me to task, saying that this was against the laws of physics, and that the moisture was in fact moving from an area of high pressure, resulting from high temperature, to one of low vapour pressure i.e. low temperature. Our readers will see that although the heat of the sun can cause the phenomenon, it causes the moisture to move by creating vapour pressure differentials. In trying to save space, I fear I made a slightly misleading simplification. Mr. Ashton added an important extra point — that in winter, moisture is frequently driven from the interior of buildings when temperature and humidity are high, through walls to the exterior where temperature and humidity levels are lower. In old buildings with no vapour barriers, this is often the cause of paint failures on wooden siding.

On another point, Mr. Ashton drew our attention to the fact that the National Painting Standard being prepared on the basis of a manual issued by the Master Painters and Decorators of B.C., states that Shellac should no longer be used for sealing knots and resinous areas. Although they are still not completely guaranteed to solve all problems, current practice recommends the use of either knot sealer C.G.S.B. Standard 1-GP-126, or aluminum paint.

Readers are referred to the Canadian Building Digest and the other excellent publications issued either free or at a low cost by the Division of Building Research of the National Research Council, Ottawa, Ontario, K1A 0R6. Write to the Publications Section at the above address for information and lists of available material.

Martin Weaver
Ottawa

Blast It?

Sandblasting endangers old buildings

Every owner or manager of a heritage masonry building is sooner or later faced with the question of whether or not the exterior or the interior should be cleaned. Very shortly after the question is posed, you can almost guarantee that somebody will raise the subject of sandblasting.

Professional conservators of buildings have been known to become almost violent on this topic. If you are concerned with the preservation of masonry structures, you need to know why these usually peaceful individuals get so disturbed about sandblasting.

Sandblasting is just one of a number of abrasive cleaning techniques. The family group includes not only the use of abrasive materials which are blown against the surface under pressure by air or water or by both, but also the use of abrasive mechanical or hand tools such as grinding wheels, sanding discs or wire brushes. The blown materials cover a bewildering assortment of likely and very unlikely materials which can be blown through a nozzle. They include sand — in a very wide range of grain sizes and configurations — ground slag or volcanic ash, ground walnut or almond shells, rice husks, corncobs, ground coconut shells, crushed eggshells, glass beads and microballoons, powdered limestone, finely chopped plastic, and even crushed lignite.

So, where is the problem? Abrasive methods "clean" by eroding the dirt or whatever it is that you wish to remove, but at the same time such methods can and will rapidly start to erode the underlying building material. It is this simple fact which causes all the trouble.

Unless all the following factors are perfectly controlled and balanced, the cleaning of a building can quite suddenly and disastrously change into its eradication. The critical factors are as follows (not necessarily in order):

— the type, condition and hardness of underlying masonry material
— the density and hardness of the abrasive
— the size and sharpness of the particles
— the pressure with which the abrasive is sprayed against the masonry
— the distance between the wall surface and the nozzle held by the operator
— the angle at which the abrasive stream hits the surface
— the constancy of the pressure
— the skill of the operator
— the visibility of the surface being cleaned.

Many of these factors can vary from second to second, and with the best will in the world it is almost impossible to keep the "juggling act" going without running a severe risk of losing control.

It is a well established principle of conservation that the cleaning of historic artifacts or structures should be undertaken with the gentlest means possible. If a cleaning process damages the original material then that process should not be used.

The "gentlest means possible" is going to vary from case to case, possibly even from one area to another on what appears to be a homogeneous structure. It follows that any cleaning process is therefore automatically associated with a testing process to establish the safest and most appropriate method and to establish an acceptable level of "clean". It is typical of an expert operative that he will establish for the client a point in the process of cleaning, beyond which he will not go because he knows that to do so will start to damage the "substrate" or underlying original.

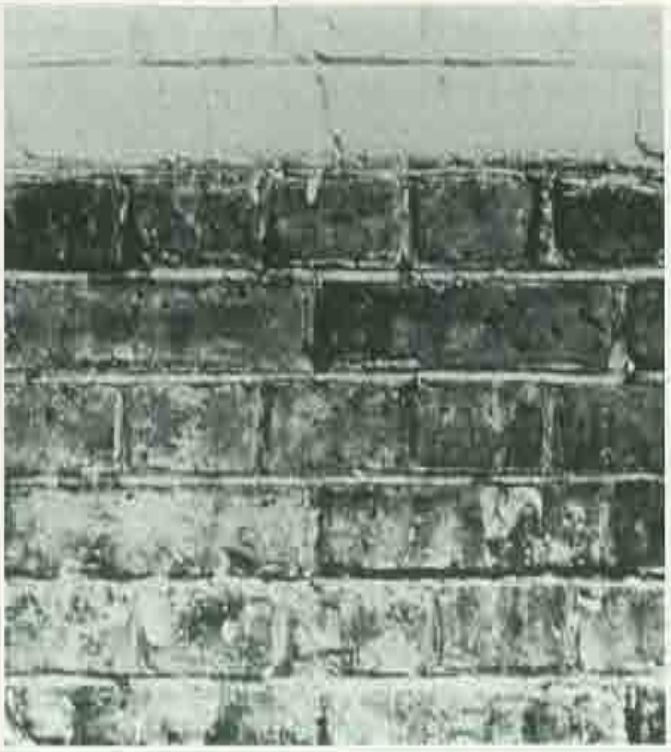
Let us go back for a moment to the beginning of the process because it is here that the first mistake usually occurs. When the question of "cleaning" first arises, you should be able to give satisfactory answers to two questions.

First, why do you want to "clean" the building? Second, what is the nature of the "dirt" deposit, or coating that you wish to remove, and how does it adhere to the building? Riding on the second question, comes a third — should the offending material be removed?

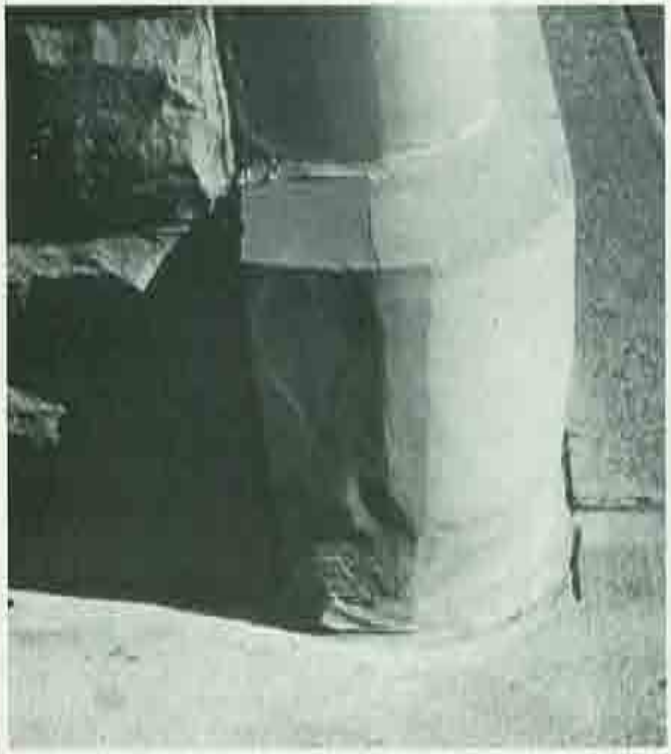
In answer to the first question, you will frequently hear the response — because it is dirty! Yet when you go on to the answer to the second question, you may discover that the so called "dirt" is in fact produced by the natural weathering cycle of the material

Photos: Michel Hogue

Above left: these bricks and the mortar pointing are part of an historic residence. They show the typical bad effects of an inappropriate sandblasting job. Above right: at the side of the building shown in Fig. 1, one can see the paint which the sandblasting has removed from the front.



Above left: a close-up shows how sandblasting has removed the relatively soft pointing mortar, up to 1/4" of the surface of the brick, and has exposed and eaten out a large number of softer spots in the bricks. The removal of the pointing has increased the exposed surface area by 41% thus increasing the available surface to take in moisture. 40% of the additional surface area is in the form of horizontal ledges which trap water. The whole exposed surface is softer and more absorbent than when it was painted. Above right: the relatively smooth surface of the brickwork covered with several of oil based paint (top of photo) changed drastically after five treatments with a high pressure jet of water and crushed lignite. The very high pressure — 2000 — 2500 p.s.i. — and the large volume of water spraying back off the wall in a cloud make the process almost impossible to control. Softer bricks have cavitated along with soft zones within each brick.



Above left: severe disfigurement of stone plinth block caused by abrasive disc "cleaning". Above right: Gothic revival sandstone window arches and decorative bosses on the East Block of the Parliament Buildings, Ottawa, proved to need several different types of cleaning/conservation treatment. During initial experiments a stone cleaning expert from the U.K. demonstrates a micro abrasive technique using 100 mesh silica at 30 p.s.i.

— e.g. patina on stone produced by oxidation and other natural phenomena. To try and remove this will involve removing the surface of the stones and can actually be detrimental to preservation because you are removing a beneficial protective layer. Another major reason given for cleaning is the presence of paint — particularly on brickwork. It is here that the answer to that third question becomes supremely important.

Today, there is a common misconception that all historic masonry was meant to be unpainted whereas, in fact, many masonry buildings, particularly in the nineteenth century, were painted as soon as they were built. Moreover the masonry materials were often unsuitable for external exposure unless they were protected by paint. In other cases, protective layers of paint were added to solve maintenance problems caused by original low quality materials, poor construction and moisture penetration. In all these cases, it can be highly inappropriate to remove the paint.

Another frequently given reason for removing paint or other materials — particularly in rehabilitation projects — is to give the building a new "brighter" image in response to contemporary design trends. In the November 1978 issue of The Old House Journal, in an article entitled *The Bare-Brick Mistake*, attention is drawn to the foolishness of stripping plaster off interior walls to achieve the "charming and rustic touch" of exposed brick which so enchants many inexperienced renovators. This is a very common problem usually involving sandblasting to remove all final traces of plaster. Three very good points were made in this article:

— plaster was integral to the original design. If you rip it off you are not "restoring". On the contrary, you may be destroying the original flavour and character.
— plaster is a thermal insulator. Don't remove it from exterior walls unless you can stand the cold consequences.
— plaster is a sound insulator. Party walls which have been stripped of plaster may suddenly be found to transmit even conversations from one house to another.

An Ontario newspaper about two years ago enthusiastically described the "restoration" of a warehouse for commercial offices, as follows:

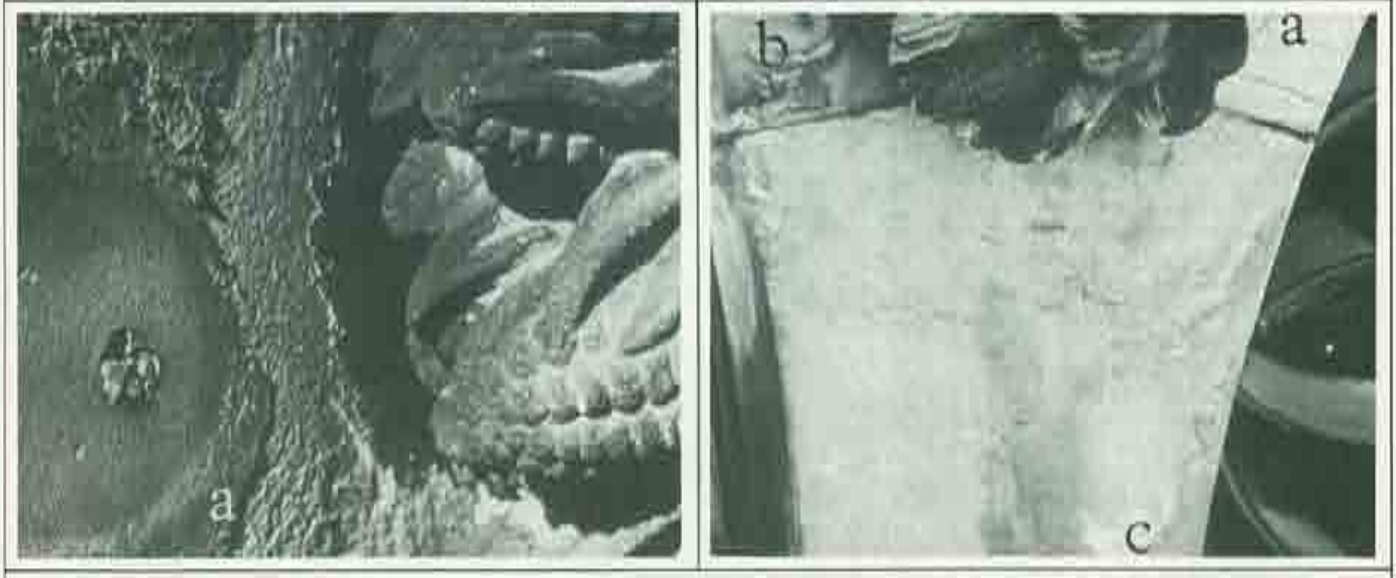
"Instead of re-facing the brick exterior, it was sandblasted to bring back the original brick red so familiar in many of the old structures . . . " and " . . . . solid brick walls were allowed to remain and sandblasting removed the dirt and grime of a century of use . . . huge solid wood beams and wide-plank ceiling were cleaned, scraped and sandblasted to bring out the richness of natural wood that is simply too expensive to be used in buildings going up today". This type of text can be simply misleading, but is usually horribly wrong. Unfortunately, an image has been created. It is a very pleasant and cosy image of mellow reds and the charm of natural materials — the terms are those of the advertiser who plays on the emotions — warmth, charm, richness, naturalness . . .

The facts of the case are usually as follows. Not only have original finishes been removed — blasted away in a cloud of dust — but so has perhaps a 1/4 inch of the original surface complete with original surface features. The so-called richness of the natural grain of wood beams is in fact a wood finish which would be appropriate for a wrecked ship which had lain for years on a sandy beach, or worse still you have a splintery fibrous surface which you cannot touch without getting a hand full of splinters. The "original brick red" is usually the colour of the soft core of the brick exposed by the removal of the original harder surface zone. Once that original surface is removed the soft core can deteriorate swiftly and the sandblasting has in fact drastically shortened the life of the building.

If the sandblasting was carried out on decorative work, it is more than likely that fine detail has been eradicated.

Sandblasting is among the cheapest forms of cleaning methods: it is fast and the materials are usually cheap. If you value your building, you must look further than the initial attractively cheap estimate. You should look at other buildings which have been cleaned by the various available cleaning contractors. If previously cleaned buildings look as though they have lost their original surfaces and the masonry looks like half dissolved and pitted candy, then you do not have to be an expert to know that this is not what your building needs. Having established that you really do want to clean the building and that sandblasting may not be the answer to your problems, what alternatives do you have?

Again you should return to the actual masonry and check three things:
— What is the exact nature and condition of the underlying masonry material i.e. hard or soft; does it contain limestone or lime mortars which would be adversely affected by acids; is it watertight, and what would happen if it got very wet?
— What is the "dirt"?



Photos: Morris Rosen

Above left: the stone ear of corn on the right has been cleaned to a point which the expert states is the acceptable level of "clean". There is still some black carbon pollution soot in the pores of the stone but to go further in trying to remove it will risk damaging the original stone. The damage at a. is largely caused by the crystallization of water soluble salts, a phenomenon known as efflorescence. Above right: a leaching pack (a) is used to remove water soluble sulphates which are damaging sandstone. Hygroscopic — water attracting — sulphate efflorescence can be seen at b and c. The cracking shows that the leaching pack has dried out and is ready to be brushed off. The salt contaminated material should be disposed of in plastic bags. Never drop salt on the ground where it can get back into the masonry.

— How is the "dirt" adhering to the masonry?

If you discover that the masonry is sound and that the "dirt" is not stuck on with oily or greasy residues, the mansonry can be cleaned with lots of potable water, stiff bristle brushes, and perhaps non-ionic detergents for the more intractable deposits. Paint is best removed with chemical paint removers; and other "dirts" and deposits, particularly "oily" ones, are best removed with specially formulated chemical masonry cleaners. These products are usually available in two main types, one for brick, sandstone, and non-calcareous materials; the other is for limestones and marbles. The first type is usually a combination of acids, wetting agents or surfactants, and chelating agents (molecules that coordinate metal ions in two or more places, are specially selected for their capacity to attach themselves to metal ions which may be causing stains — once attached, they can be removed.) The second type usually have alkalies instead of the acids but otherwise the formulation is similar to the first.

Apart from the above, there is one other major cleaning method available at this time. Steam cleaning has been successfully used for many years to remove dirt deposits from buildings and equipment, and there are many jobs for which steam cleaning — possibly in combination with the use of detergents — may very well be appropriate.

Two further techniques which were developed by conservators of artifacts have been adopted for cleaning on a large scale. The first is the poultice or "leaching pack". The poultice consists of an inert powder such as "fullers earth", or diatomaceous earth* which is used together with water or another solvent selected for its ability to dissolve whatever is causing the unwanted deposit or coating to adhere to the masonry. The method involves wetting the masonry with additional water or solvent, then applying a paste composed of the two ingredients. As the solvent evaporates, the dissolved dirt or deposit is drawn out into the poultice. When the poultice has dried, it is brushed off and the deposit or coating goes with the poultice. The technique is gentle and can be repeated until the undesirable material has been removed. This technique is most appropriate when the masonry has been adversely affected by water soluble salts such as calcium chloride, sodium chloride and various sulphates. Years of ground salting to melt snow and ice is a particularly common source of salts which effectively destroy masonry. The sulphates usually get into the masonry from atmospheric pollution in the rain.

The other technique is micro-abrasive cleaning. This is as different from sandblasting as a unicycle is from a 40 ton truck. In this technique, the abrasives used are very, very fine, the pressures used are very low — never in excess of 30 pounds per square inch (p.s.i.) and the spray nozzles are usually very small. The combination of low pressure, small gun and nozzle, and fine abrasives means one essential thing — control — you can see what you are doing and the small scale gives you sensitivity. Skilled operators can take the printed label off a cigarette without damaging the paper and yet with slight adjustments they can cut a triangular hole through the side of an electric light bulb. Apart from being a spectacular trick, this is an excellent demonstration of properly controlled force.

The problem with the last two techniques is that they are slow and therefore tend to be more expensive.

In the not too far distant future, we will probably see the commercial application of two revolutionary new techniques — the use of lasers and ultra-powerful flash lamps.

At the conference of the Association for Preservation Technology in Ottawa in September 1978, Dr. John Asmus of the University of California described recent work with lasers and flashlamps in the cleaning of a wide range of materials including delicate stone and plaster.

There are two main points to remember. First, there are many alternatives to sandblasting and the majority of them give better results; second, it may not be either necessary or advisable to remove "dirt" or paint from your masonry. **Martin Weaver**

SOURCES LIST

The following sources might be useful for obtaining further information.

Cleaning of Brickwork by T. Ritchie
Canadian Building Digest 194 April 1978
Division of Building Research
National Research Council

Poultice Method for Treating Bituminous Stains on Masonry Products
by B.F. Stafford, Building Research
Note No. 60, July 1967. D.B.R. N.R.C.
Obtainable from: National Research Council, Ottawa, K1A 0R6

Exterior Cleaning of Historic Masonry Buildings: Draft
Norman R. Weiss
O.A.H.P. N.P.S.
U.S. Department of Interior. 1976.

The Cleaning and Waterproof Coating of Masonry Buildings
Robert C. Mark, A.I.A.
Preservation Brief No. 1
O.A.H.P. 1975

A Selected Bibliography on Stone Preservation
Washington, D.C. Technical Preservation Service Division O.A.H.P. Heritage Conservation and Recreation Service. U.S.D.I. 1977.
Obtainable from:
Office of Archaeology and Historic Preservation,
Heritage Conservation and Recreation Service, U.S.D.I.
Washington, D.C. 20240. U.S.A.

The Old House Journal: Various issues including:

Vol. 1 No. 2	November 1973
Vol. III No. 2	February 1975
Vol. V No. 5	May 1977

Obtainable from:
The Old House Journal,
199 Berkeley Place,
Brooklyn, N.Y. 11217

Bibliographies on Slate Roofing and for the Conservation of Masonry
The Association for Preservation Technology, Newsletter.
Vol. IV, No. 11, April 1975.

Book Review of *Desalination of Stone: A Case Study*, U.K. Department of the Environment, Building Research Station. Current Paper 46/75. Reviewed in detail in A.P.T. Bulletin. Vol. VIII, No. 2, 1976
Obtainable from:
Association for Preservation Technology,
Box 2487, Station D, Ottawa, K1P 5W6

* Diatomaceous earth is available as:
CELITE Technical grade (AC-2098T) at $7.80 for 2 kg, or $19.20 for 10 kg. (not inc. prov. sales tax) from:
Anachemia Chemicals Ltd.
3549 Mavis Rd., Mississauga, Ontario L5C 1T7
(416) 279-5122
or
P.O. Box/CP 147, Lachine, P.Q. H8S 4A7
(514) 489-5711 ■

The Problem with U.F. Foams

Why the Flynns Are Into Gas Masks

Nichols, New Hampshire Times

Stephen and Wendy Flynn claim U.F. foam insulation turned their New Hampshire dream-home into a house of horrors.

Two years ago, as they were putting finishing touches to their New Hampshire dream house, Stephen and Wendy Flynn decided it would be a good idea to have the place "retrofitted" with urea formaldehyde (U.F.) spray foam insulation.

As it turned out, that might not have been such a good idea.

In the months that followed the U.F. application, Wendy suffered with a sore throat, a runny nose and runny eyes. Stephen came down with much worse. The one-time healthy Flynn began to suffer severe respiratory problems, headaches, and a persistent cough. Today, he suffers gripping chest pains and gasps for air after climbing a short flight of stairs.

Was the U.F. foam to blame?

There is plenty of evidence pointing in that direction. A 1976 U.S. National Institute for Occupational Safety and Health study showed that exposure to formaldehyde (when there is as little as one part per million in the air) can cause exactly the problems that plague Stephen Flynn. (The Flynn house registered 1.2 p.p.m. seven months after spraying).

Such stories (and there are a lot of them) suggest U.F. usage should be approached gingerly. Other stories argue the same way: U.F. foams, for example, sometimes shrink so disastrously (causing heat leakage) that CMHC recently slapped a temporary suspension on their approval of them. Another problem: when U.F. foam contracts within walls or roofs, the entire foam insulation can leak water vapour like a sieve wherever foam once met wood. And finally: there have been cases of fires which have been traced to foam insulation which prevented necessary heat loss from electrical cables.

For all its drawbacks, U.F. foam has its defenders. Some point out that although it sometimes gives off fumes and sometimes shrinks, on most occasions it works beautifully and gives completely trouble-free insulation. Defenders of the foam say the problem is usually the installer, not the material. U.F. foam insulator Doug Hansen agrees. "The foam", he says, "is one of the best insulating materials but it is critical that the installer be experienced with it . . ."

What protection does the property-owner have against faulty U.F. foam installation?

First, the potential customer should ensure that he is dealing with a reputable contractor. This means examining actual installations, talking to previous clients, and closely scrutinizing guarantees. Finally, if a contractor is hired, it is wise to open up a test area of wall just before the guarantee runs out: if there has been shrinkage, the contractor should be called to remedy the matter. If still not satisfied, customers should photograph evidence of poor installation or performance and then take the contractor to court. "I wouldn't hesitate", says the Toronto Globe and Mail's George Dalgleish "to take an insulating contractor to court if you have been ripped off. Many times it's the only recourse you have . . ." **Martin Weaver** ■

Sources

The Danger of Foam Insulation: Hank Nichols: New Hampshire Times Aug. 23-29 1978

Insulating the Old House: a publication of the Greater Portland Landmarks Inc. 1977 $1.20

NUTS AND BOLTS

It's Time for that Late-Winter Check-up

Advice for a Last Set-to with Snow and Ice

Until recently, most Canadian houses were under snow. If you are one of the lucky ones who live in parts of B.C., the rain was colder, but it didn't reach the solid state.

Canadian houses are of a number of different types depending on their construction and the materials from which they are made. When winter comes around, the forms of construction and the materials behave and deteriorate in different ways. In this article we will take a look at houses of stone, brick and wood frame construction.

The Canadian house in the winter has to stand up to one of the worst climates in the world. The wood, brick, stone, metal, and mortar of the older home have a tough time to keep up the performance that we all expect—a cozy living room and a warm dry bed!

The main secret of good performance is good maintenance and it isn't until your house is exposed to the rigors of winter that the deficiencies really show up.

Some problems are as obvious as the dripping water coming through the bedroom ceiling. Others don't show themselves until later when rot feeds on water soaked wood.

Despite our different forms of construction and different materials there are a number of common problem areas. The two biggest maintenance problem areas are the roof—particularly at the eaves—and the area where the walls hit the ground. Other problem areas are chimneys and dormers or any other feature which sticks up through the roof. Your average roof works very well as continuous shingles, or slates, or sheet metal—but as soon as you poke a chimney or a dormer through it you end up with all sorts of tricky joints which have to be made so that they will keep out rain. If we only had rain to deal with we would be well-off. Once you have snow or worse ice, the complications begin.

In many of the photographs of the different Canadian house types the reader can see the same problem at the eaves—the ice dam. What are ice dams and how can you prevent their formation?

An ice dam is a continuous strip of ice which forms at the lower edge of roofs, usually on roofs sloping at less than 40°. If the eaves are poorly insulated and unventilated, the underside of the snow melts and then freezes solid. After a few cycles the ice can build up to thicknesses of more than one foot. Melt water then piles up behind the ice dam and penetrates behind shingles, slates or flashings and then down into walls and ceilings. You can prevent their formation by insulating the eaves to prevent heat leakage from the interior of the house, ventilating the eaves from underneath and in some difficult cases installing heating cables on the lower slope to at least one foot above the area of ice dam formation. Broad metal sheet flashings on the lower slopes of roofs with medium pitches will also help to prevent water penetration if a dam does form. **Martin Weaver** ■

Things to Look Out for on a Typical French Canadian House

Figure 1. Points to check on a typical French Canadian house include:

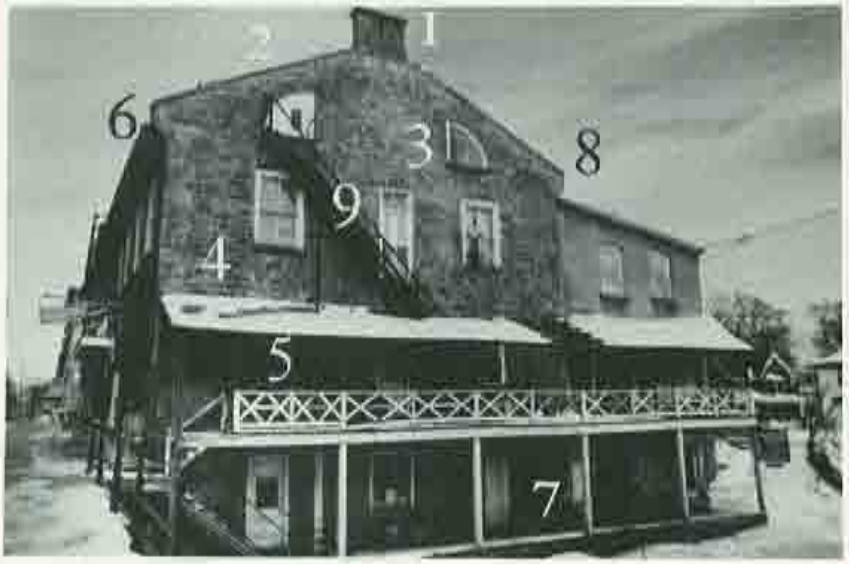
1. Chimney cap and masonry should be sound without cracks which will admit water.
2. Flashings at junction of chimney and roof should not leak.
3. Check for leaks at eaves if ice dams form.
4. Check for defective flashings around dormers.
5. Check windows and doors for leaks of not only water getting in but heat getting out.
6. Check the condition of the pointing. Missing pointing will lead to leaks followed by freezing and shattering of mortar and stones.

Nuts and Bolts

'The Canadian house in winter has to stand up to one of the worst climates in the world . . . They have a tough time keeping up the performance we expect of them.'

Watch Out for Cracked Chimney Pots

Cracked chimney pots will let water into masonry and can fall in storms. (1) This Ottawa home shows very severe ice dam formation. (2)



Photos: Martin Weaver

Points to Check on a Typical Ontario House

1. Cap stone on chimney should be well fixed; stonework and pointing should be sound with no cracks.
2. Check coping stones are not loose and that joints don't leak.
3. Check masonry pointing and check all openings for leaks.
4. Check flashings on roof and do not permit heavy snow build-up on low pitch light roofing.
5. Check that wooden ballustrades are well fixed. Winter ice could cause someone to slip and cannon into them.
6. Check roof and eaves for leaks from ice dams and blocked or frozen gutters and rainwater pipes.
7. Check staircases and walkways for ice build-ups which could cause accidents. It may be possible to divert water.
8. Winter storms will bring down cracked or loose projecting stones.
9. Steel fire escapes should be safe and properly fixed to wall. More fires occur in winter—the escape may be unsafe when most needed.

Here's a Look at a Maritime Wooden Frame House

1. Check brickwork and pointing of chimney.
2. Check that attic roof space is properly ventilated if insulation is applied at attic floor level.
3. Eaves and eavestroughs or gutters should be checked for leaks and ice blockages.
4. Peeling or blistering paint on wooden siding could be due to excess moisture in wood.
5. Leaks in door step will admit water to main timber ground plate and nearby floor beams or joists leading to rot and serious structural damage.
6. Large warps and bows in shingle siding will show that shingles are laid too close together. Wet shingles swell and without wide enough joints they can only push off the wall.

Nuts and Bolts

Ice Dams can cause a Lot of Damage

Icicles show where water is coming out of structure: a rainwater pipe is disconnected from gutter at 1, 2-3. Ice on wall and at underside of eaves shows where ice dam is causing leaks in roof above.

Soaking Walls and Rotting Wood

Ice dam in one area (1) probably due to localized lack of insulation in roof. Staining and frost on wall around

window (2) show where water from leaking roof is soaking wall. Wood structure behind brickwork (3) can rot without being seen until too late.

'The secret of good performance is good maintenance. And it isn't until the rigors of winter that deficiencies show up.'

Creepers are Blockers

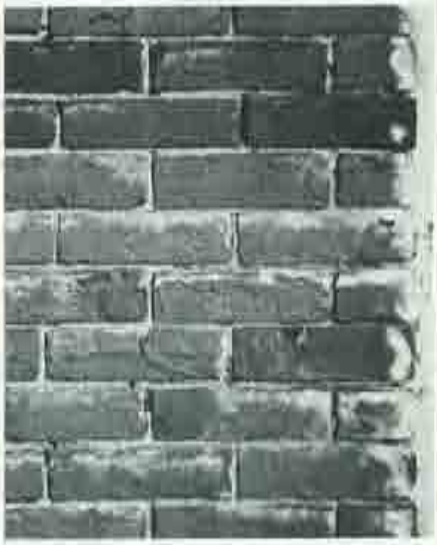
Creeper has blocked gutter and rainwater pipe, damming-up meltwater and leading to big ice buildup. Ice crusted creeper is very heavy and can pull off pipes and shutters.

More Ice Dam Problems

Heat leak caused by gap in roof insulation causes ice dams to form. Poor metal flashing detail (1) allows water to pour down face of brickwork where it turns to ice (2) and destroys the bricks.

Look for Brick Dust

When the snow is on the ground, a powdering of brick dust and flakes are clear clues to the destruction of the brickwork below caused by ice.

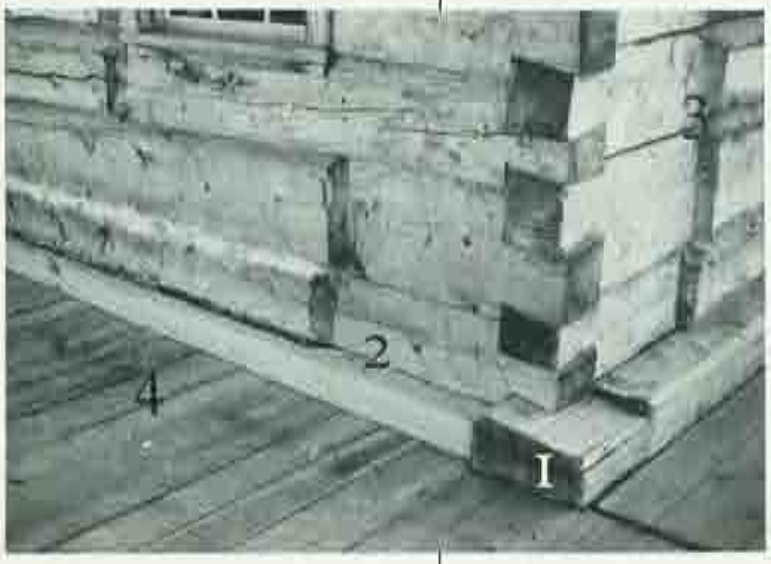


Poor Pointing Means Damaged Brickwork

Brickwork being destroyed by frost. The white frost shows up where the bricks were soaked because of poor pointing.

Peeling Paint and Falling Windows

An ice dam formed regularly in this corner but nothing was done about it. The leaking water washed out the mortar from the core of the wall, and ice smashed the soaked bricks. When the wet wooden lintel over the window rotted, the wall fell out (2). Peeling paint on brickwork was an early clue to damp trouble in wall (3).



A checklist for the Log House

This log house in B.C. shows typical problem areas: heavy timber "plate" (1) lies on wet ground and can rot-out on underside. Horizontal flat surfaces (2) catch water which runs back into wall. Chinking in joints (3) cracks and admits water which can be held in by oakum or moss packing until rot starts. Boardwalks are great for getting around when it's muddy but check underneath where they rot. (4) Unpainted windows with putty need constant checking because they lack protection of paint (5). A cracked sill admits water to hidden log joints (6). Trim covering ends of logs needs to be securely fixed, check the nails (7).

Column

Problems with a leaky basement? Here are some money-saving things you can do.

Martin Weaver/Advice

Heritage Canada gets a lot of letters asking for advice on how to deal with construction problems in old buildings. On this page Martin Weaver takes some typical recent questions and gives the answers.

We have heard that ordinary Portland Cement is not good for repairs to old brickwork and stonework. What should we use?

Ordinary Portland Cement and sand mixtures by themselves are usually too hard and too strong for old masonry repairs. The rule is to make the mortar slightly weaker than the bricks or stones of the masonry. If the masonry expands or contracts the mortar should be able to "give" and if the stress gets too big then the mortar should crack rather than the stones or bricks. For general work on historic masonry, a mixture of Portland Cement, lime, and sand gives good results. Mix 1 part by volume of *white* Portland Cement: 2 parts by volume of hydrated lime: 4 or 6 parts by volume of sand. The colours of the sand and/or special mortar dyes can be used to control the colour of the mortar. The size and shape of the sand grains control the texture.

We have recently had our clapboarded frame house insulated and now the paint has started to fall off the outside boarding. What is wrong?

Water is most likely to be at the root of this problem as it is in so many cases of deterioration in buildings. When your insulation was installed it was probably blown in through holes drilled in the boarding but no "vapour barrier" was installed on the warm or room side of the insulation. Moisture from the inside of the house, from bathrooms, kitchens, house-plants, humidifiers and the occupants, can then pass through the insulation or through gaps where the insulation doesn't quite fit. The insulation stops heat leaking through the wall and warming the back of the clapboarding. At certain times the boarding will be cold enough for the water vapour to condense on the back of the boards and because the backs of the boards are not painted the water soaks in. Paint won't stay on wet wood and so the paint blisters and peels off.

To help solve this problem one can do two things, install vents at the top and bottom of the wall on the outside to move the moist air out before it can cause condensation, and fit a vapour barrier to the interior. If you can't install a polyethylene sheet vapour barrier because you don't want to damage plasterwork or panelling, you can apply two coats of special aluminum paint to your interior wall surfaces, and then redecorate over them. Major paint manufacturers make this type of paint usi" "leafing aluminum pigment".

We want to insulate the walls of our basement. The stone walls leak water into the basement in some places when it rains. Can we solve these problems without spending too much money?

From the description which you have given it is possible that there may be a relatively cheap solution to the leak problem. Leaky basements can sometimes be very expensive to deal with, but in this case the wall only leaks at certain points when it rains and this may be the clue to the solution. If there are no obvious cracks or holes in the wall the thing to do is to go outside when it is raining and see if water from rainwater pipes concentrates at the foot of the wall in places matching the interior leak points. If the leaks and the rainwater pipe locations match, fit extensions to the ends of the pipes to take the water away from the building about six feet or more. General poor drainage around the outside of basement walls is usually best dealt with by trenching and backfilling with self-draining fill after installing a drain as shown in the accompanying sketch. Many people don't realize that insulation can be fitted to the outside of walls and this job can be done at the same time as the drainage trenching.

When trenching around buildings take care that trenches are adequately braced and that foundations are not undermined. Trenching is best done in short sections so that there is no risk of the basement walls being subjected to massive changes of soil support which could result in the walls falling into the trench. The sketch shows the most economic solution to this combination of problems of drainage and insulation. ■

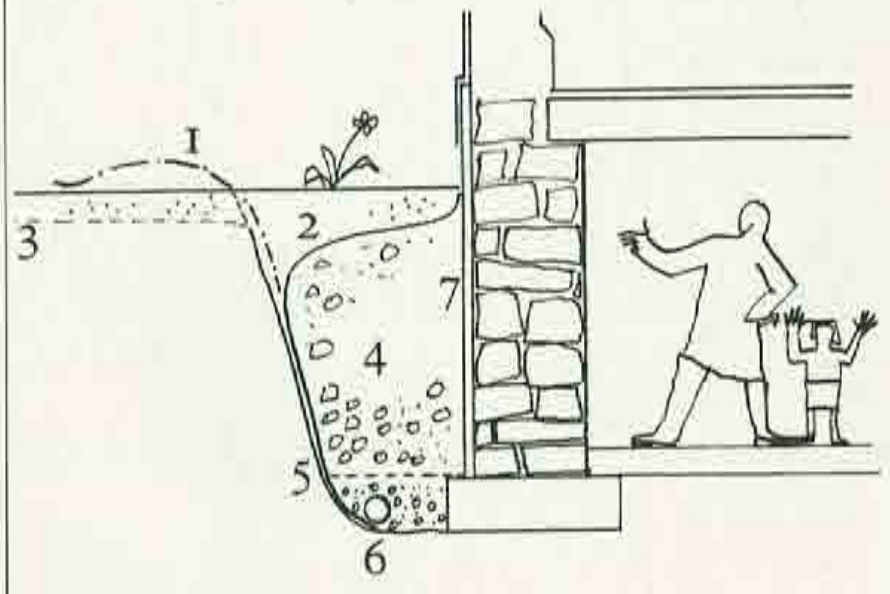


Illustration by Martin Weaver

Stopping leaks in a basement wall and adding insulation: 1. 6 mil polyethylene sheet folded back until excavated trench is refilled. 2. Polyethylene folded over fill. 3. Topsoil. This is replaced over polyethylene which should be deep enough to avoid normal gardening. 4. Clean, self-draining fill of stones and gravel. 5. If original soil is put back in trench instead of 4, a filter layer of mineral wool should be put in on this line. 6. Perimeter drain of perforated agricultural drainpipe laid to fall to soakaway or storm sewer. 7. Rigid sheet insulation of glass fibre or foam plastic say 2" thick.

NUTS AND BOLTS

Moisture and Older Buildings

Looking at a Common Problem

It doesn't matter whether you are conserving the contents of museums or conserving older buildings in Canada—too much or too little moisture is one of our basic problems.

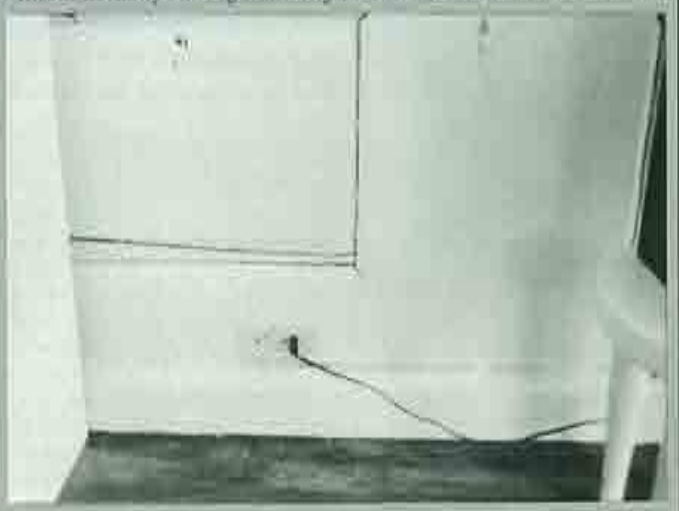
Wood, our commonest building material, is most susceptible to extremes of moisture or lack of moisture. Wood never stops taking up moisture or drying out again as it comes to a balance with its surrounding environment. This is known as "lashing equilibrium moisture content."

This massive beam snapped dramatically because the wood was desiccated not because it was burned.

If wood is subjected to heat for a long period its structure becomes degraded, it becomes more and more brittle until it will break under normal loading. The temperature does not have to be very high—certainly not to the point at which the wood would burn. The deterioration is controlled by both the temperature and the length of time that the wood is exposed to it. In Figure 1 the effect of the desiccation caused by thermal degradation is dramatically demonstrated. For many years a stove flue heated the wood of this beam in a Ukrainian log house in Alberta. The beam was even charred by the overheated flue (1) but the beam broke several inches away because of the cumulative effects of years of heat degradation (2).

Using microscope Martin Weaver locates paint failure culprit—crystalline/efflorescence deposits left by departing moisture.

Many of us have seen the effects of very low humidities in our homes during the winter. Curiously enough, the infuriating splits which occur in door or wall panels can frequently be avoided without actually raising humidity levels in the air in the house. The

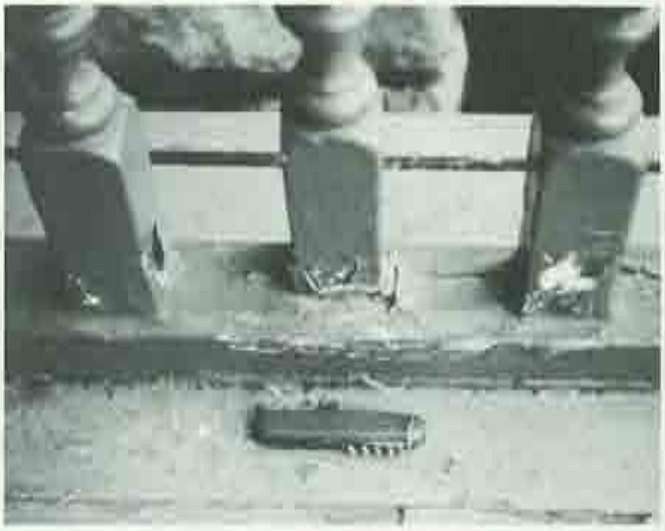


Stuck in heavy paint layers this panel tore itself apart in a New Brunswick home.

problem is usually the result of wooden panels having been held so rigidly in position that when they lose moisture and begin to contract, they are placed under great stress. Prevented from contracting they will actually tear themselves apart. The commonest cause of splitting in wooden panels is "painting-in". A heavy accumulation of paint acts like a glue and holds the panels tightly around the edges. (Figure 2) If the paint is removed from the edges of the panels they can be free to move in the grooves in the frames and can expand and contract without problems. Loose panels are frequently nailed or screwed into their frames in misguided attempts to "improve" matters—thus causing more problems.

moisture is public enemy No. 1 for the preservationist

If you get heavy condensation on your windows watch out for paint and wood deterioration.



This paint and wood deterioration was caused by snow shovels cutting into protective paint layer.

Humidity in excess leads to many more problems. Paint won't adhere to wet wood and it is usually peeling paint which tells us that the wood is getting wet. Worse problems are caused by rapid changes from wet to dry. Figure 3 shows the typical results of cycles of heavy condensation followed by hot sunshine on sash window frames, and of cracked and loose putty. The peeling paint and the damage to the wood can be avoided by double-glazing, proper maintenance of putty, and/or by lowering interior atmospheric humidity levels. Figure 4 shows damage to ballusters on a porch due to moisture which got into the wood via nicks in the paint film caused by snow shovels. In a cumulative process small nicks or breaks in the paint admit moisture. The paint layers start to fall-off admitting more moisture. Fungi attack the wet wood and fixing nails corrode leading to the eventual collapse of the ballustrade. The answer to this problem could be plastic snow shovels but is more likely to be spring or summer maintenance of the paint layers. If the damage is made good with fresh paint when the wood is dry the cycle of deterioration can be arrested. Brush applied wood preservatives of a type which can be painted-over would also help to prevent the rot problems. Too many people waste gallons of paint annually painting on wet wood or over improperly prepared surfaces. (See *Heritage Canada* Magazine February 1979 pp. 45-52).

Any surfaces which could have been affected by deposits from streetsalting need especially careful preparation before painting. Quantities of warm water and bristle brushing will remove the almost invisible deposits and will make it possible to paint over, providing all loose paint, dirt, and grease have been removed.

White or colourless powdery crystalline salt deposits are more frequently found on damp masonry and plaster. These deposits are called efflorescence. When they occur on the surface of masonry they are usually easy to remove with a brush. When they occur in and just below the masonry surface they are termed sub-fluorescence and cause far more serious problems.

To understand the problems of efflorescence and sub-florescence we must once again think about moisture moving in and out of building materials. In buildings, masonry materials such as brick and stone always have moisture in them to a certain extent. Moisture containing dissolved salts such as those originating from sea salt or road salt for example—sodium chloride and calcium chloride—will evaporate when it comes to the surface.

Damp marks and whitish crystalline efflorescence are clues to the cause of the brickwork disintegration.

However, the salts cannot leave the masonry with the evaporating moisture and are left behind on and in the surface. This process is called dehydration. The salt crystals thus deposited in the surface pores of the masonry may remain in place for a long time, hydrating as they take on moisture from the air and from the surrounding masonry and dehydrating as they lose moisture. Unfortunately this process of taking-up and losing moisture involves expansion and contraction. Although the forces involved are very small, once millions of crystals are involved the cumulative effect can be disastrous and the whole surface can be crumbled to powder or pushed-off in flaking layers particularly by sub-florescence. Figure 5 shows a typical case of destruction caused by salts and rising damp in the brickwork of a railroad station. For years the platforms were salted to prevent accidents. Moisture rising up the brickwork brings with it the salts in solution. A whole zone three or four feet above grade is flaking and powdering where the rising damp is evaporating. The pointing in the joints is clearly disintegrating and being pushed out in this same zone by the same salts.

millions of tiny salt crystals cause most masonry damage

How can this problem be solved? Obviously the problem has two components—moisture and salts. The moisture is often difficult to remove totally. This leaves the salts. One can stop salting and use sand or urea to stop people slipping on icy surfaces.

In some cases such large quantities of salts have been deposited in the masonry and in the ground beneath that it will be years before they are dissipated. Such deposits can be removed from walls by using leaching packs or poultices of a mixture of clean water and diatomaceous earth.*

Apply a layer of paste made of these two ingredients about a half inch thick—mixed to about the consistency of peanut butter. As the layer dries out, the salts are drawn out into the poultice. When dry, the poultice cracks and can be brushed off. Collect the powder on plastic sheets and dispose of it. If the salt-laden powder gets back to the ground the salts re-infest the soil and the cycle continues.

Figure 6 shows a combination of damage caused by salts and the freezing of moisture in brickwork. The moisture in this case came from a crack in the stone window sill and because there was no weathering groove or "drip" cut in the underside of the sill.

The missing groove can easily be cut in the sill using a carborundum disc. **Martin Weaver.**

**Diatomaceous earth can be obtained from swimming pool supply dealers as "swimming pool filter medium"—check your yellow pages.* ■

Cracked stone window sills are a common cause of damaging moisture penetration into masonry beneath.

For Further Reading

Harrity, M. H. and Hansen, J. L. ***Masonry Conservation Technology.*** *Massachusetts Masonry Institute—1976.*

Hutcheon, N. B. The stability and durability of masonry materials. ***Technical Paper No. 29.*** *National Research Council of Canada 1955.*

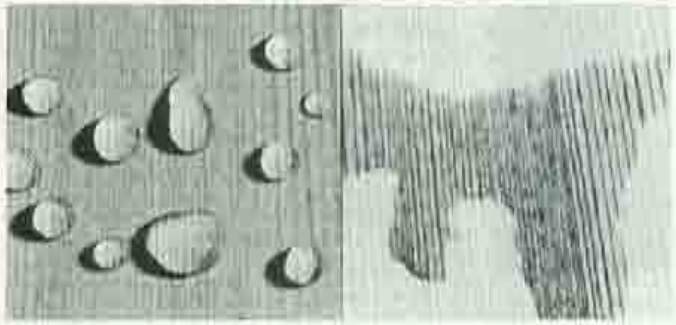
The Bulletin of the Association for Preservation Technology.

Vol. IX No. 4 1977. Winkler, Erhard M. The decay of building stones: a literature review.

Vol. X No. 1 1978. Weaver, M. E. A masonry deterioration case study: Holy Trinity Anglican Church, Hawkeshury, Ontario.

Vol. X No. 2 1978. Winkler, E. M. Stone preservation, the earth scientist's view.

Column



Water beads on WR treated surface on left but soaks into untreated wood on right.

We don't like the idea of using very dangerous chemicals to prevent rot in our log house, what should we use?

More and more concern is being expressed about the misuse of such dangerous chemicals as pentachlorophenol, P.C.P., or "penta" as it is often called. Recent articles following years of research by the Forest Products Laboratory, U.S. Department of Agriculture, demonstrate that far more use could be made of water repellents and water-repellent-preservative mixtures, usually known as WR's and WRP's.

These solutions contain waxlike substances and give wood the ability to repel liquid water. In repelling the water they resist decay and stain by denying the fungi that cause deterioration the moisture that they need to live.

By preventing a great deal of moisture from entering timbers, WR's and WRP's also substantially reduce warping, cracking and splitting.

Typical WR and WRP Solutions

WR and WRP solutions are widely made and distributed commercially and are available in most paint and lumber stores. For solution formula, see box.

Safety First

In mixing and applying WR or WRP, care should always be exercised. The safest place to do the mixing is outdoors. The solutions are volatile, flammable mixtures. Don't breathe their vapors or expose them to flame or sparks. It is wise to wear protective clothing on the hands and arms and to take care that the solution is not splashed in the eyes or on the face. Be especially careful using WRP, as these solutions contain toxic materials.

CAUTION: Wood preservatives (a type of pesticide) can be injurious to man, animals, and plants. Therefore, for safe and effective usage, it is essential to follow the directions and heed all precautions on the labels. Some wood preservatives are toxic to humans and animals and may be root poisons and defoliants for plants. It is, therefore, advisable to wear rubber gloves and protective masks (approved for use with pesticides) and to cover nearby plant life when using any material containing preservative chemicals. The application of preservatives using any spray method can be especially hazardous and extra precautions must be taken. Avoid spraying whenever possible. Use a brush to apply preservatives or dip wood in a tank.

DO NOT USE ANY PRESERVATIVES INDOORS UNLESS THEY HAVE BEEN SPECIFICALLY APPROVED AND RECOMMENDED FOR SUCH USE.

Store preservatives in original containers under lock and key—out of reach of children and pets—and away from foodstuff. Use all preservatives selectively and carefully. Follow recommended practices for the disposal of surplus preservatives and preservative containers.

Final caution

It must be clear by now that wood preservatives are dangerous chemicals but that with proper provisions for handling, application and disposal they can be used safely. If a rot attack has already started WR's will not kill the fungus responsible for the deterioration. Live fungus can only be killed by fungicidal chemicals which are in most cases best handled by trained operatives and specialists. The original question was—"to *prevent* rot"—the WR can do a lot for you without using hazardous chemicals. ■

A formula for large scale use by contractors and professionals who wish to avoid using commercially available WRP solutions which contain pentachlorophenol

Approximate quantities to make one gallon.

Ingredient	Water repellent (WR)	Water-repellent preservative (WRP)
Orthophenylphenol Dowicide 1*	None	1¾ to 2¾ cups (higher level in high risk areas)
Boiled linseed oil	1½ cups	1½ cups
Paraffin wax	1 oz.	1 oz.
Solvent (turpentine, mineral spirits or paint thinner)	Add to make up 1 gallon	Add to make up 1 gallon

*Dowicide 1 is available from Dow chemical agencies and from
S. F. Lawrason, 115 Cityview Drive, Rexdale, Ontario M9W 5A8

A 100 lb. drum costs about $250.00. The formula suggested above is a variation of one published by the U.S. Department of Agriculture. Orthophenylphenol (O.P.P.) has been substituted for pentachlorophenol concentrate. O.P.P. has a lower mammalian toxicity level and is therefore safer for general use.

Mixing: Melt the paraffin wax in the top unit of a double boiler or some other container heated by hot water.

DON'T USE A DIRECT FLAME OR HEAT NEAR A FLAME SUCH AS THE PILOT LIGHT ON A STOVE—THE PARAFFIN WAX WILL IGNITE.

Mix at room temperature (60° to 80° F). While vigorously stirring the solvent, slowly pour in the melted paraffin. After the paraffin wax and solvent are mixed, add—in order—linseed oil (and orthophenylphenol if WRP). Stir until the mixture is uniform.

The ingredients may separate if the solution is stored at low or freezing temperatures. If this happens, warm the solution to room temperature and stir to redissolve the ingredients. (DO NOT HEAT OVER A FLAME.)

NUTS AND BOLTS

GETTING THE BUGS OUT

Poisons, pesticides, and preservatives

Our heritage buildings, their contents, and the surrounding landscape and gardens are frequently occupied by unwelcome "visitors" which we call pests. The word pest comes from the Latin *pestis*—a plague or contagious disease.

To preserve our heritage we are often forced to use pesticides. The "cide" ending is derived from another Latin word meaning to kill or slaughter. Unfortunately such large quantities of pesticides are now in daily use that it is getting increasingly difficult to limit the slaughter to the target pests. Our domestic animals, our livestock, wild animals, desirable plants and ourselves are also being affected.

There are literally hundreds of pesticides now on the market designed to kill anything or everything from insects, rodents, fungi, trees and weeds, to slugs and barnacles. Pesticides can be described as either specific or broad-spectrum. The former are used to treat one species or type of pest e.g. Dicofol for mites which attack trees and shrubs. The latter, of which DDT is an example, will kill a large range of pests and may even kill you too if you are sufficiently exposed to them.

Today, all pesticides must be registered with, and approved by, government agencies at both federal and provincial levels. In Canada, pesticides must be registered with Agriculture Canada under the Pest Control Products Act. In the U.S.A., pesticides must be registered with, and approved by, the Environmental Protection Agency. In both countries the registration number must be shown on the product label. Provincial and local governments may also restrict or control the use of pesticides. Aldrin, for example, is registered in in Canada, only for restricted use for eradicating subterranean termite attacks. It may only be used by licensed pest control operators, and local authorities have to be consulted about use permits which may be required.

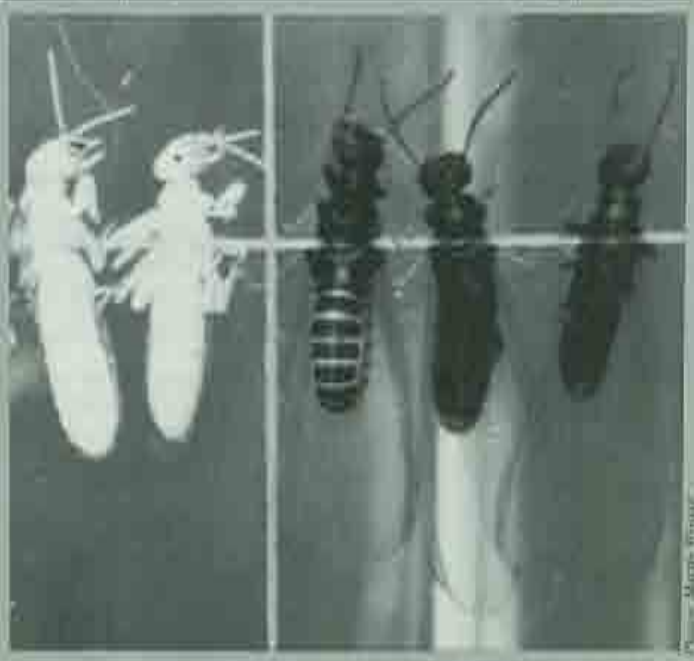


Photo: Mario Proulx

Subterranean termites are a pest in southern Ontario and in B.C. Termite attacks must be controlled by a professional exterminator.

How much protection does pesticide registration give you? Your greatest protection against accidental injury or poisoning is the label on the container of the pesticide which you are using. If you do not read, understand and closely follow the label information, do not use the product. Government regulation of registered pest control products ensures that the label gives the following types of information:

- Categorization: wood preservative, e.g. rodent repellent, insecticide.
- Guarantee in terms of percentages of ingredients e.g. technical chlordane, 45%.
- Marketing type: domestic, commercial, or restricted.
- Formulation e.g. solution, wettable powder, liquid.
- Cautions: e.g. keep out of reach of children. Poisonous if swallowed, inhaled or absorbed through skin. Do not contaminate feed or food. Do not contaminate any body of water, etc.
- Symptoms of poisoning: e.g. nausea, vomiting, hyperirritability and convulsions.
- First aid: e.g. call a doctor in case of accident. IF SWALLOWED, induce vomiting immediately by drinking warm soapy or salt water, or, do not induce vomiting, etc.
- Toxicological information: e.g. The administration of barbiturates is beneficial. Avoid adrenaline and morphine. Oxygen may be indicated.

▸ Decontamination and disposal: e.g. sweep up or vacuum after all spills. Respiratory protection required during sweeping etc.

▸ Uses: e.g. standing poles/posts: arrests insects, and internal decay, repels rodents. Details are given of methods of application, mixtures, preparation of surfaces and materials.

Practically every pesticide is either toxic to man or can cause harmful effects such as eczema or allergic reactions. Toxicity is the term for the ability of the chemical compound to cause injury. The likelihood of this injury occurring is termed the toxicity hazard. If label directions are followed, toxicity hazard to humans is slight or negligible but the hazard to the target pest is extreme.

All pesticides are given toxicity ratings. Obviously one can't test-rate unknown but potentially acutely poisonous substances on humans. Tests are carried out on large groups of laboratory animals, such as rats. When 50% of a group dies, the amount of the chemical producing this result is recorded; this data is known as the lethal dose 50%, or LD_{50}. The LD_{50} is expressed as milligrams of chemical per kilogram of the animal's body weight. An LD_{50} of more than 5000 mg/kg is considered relatively non-toxic. An LD_{50} of between 500 and 5000 mg/kg is slightly toxic. Between 50 and 500 mg/kg is moderately toxic and any LD_{50} less than 50 mg/kg is is very toxic.

In a recent issue of *Canadian Heritage* magazine I described a water repellent preservative for wood which used orthophenylphenol as the active ingredient instead of pentachlorophenol which is probably the most commonly used—and misused—wood preservative in Canada. It may be of interest to compare their LD_{50} figures. Orthophenylphenol is only slightly toxic at LD_{50} 2480 mg/kg (rats oral) while pentachlorophenol is very toxic at LD_{50} 50 mg/kg (rats oral).

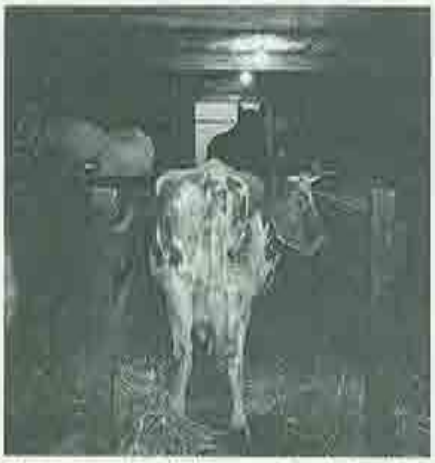
Complications arise—as if this was not complicated enough—when one dissolves the chemical in solvents or carriers such as methanol or methyl hydrate which also has an unsavory reputation as a poison.

Let us look at some commonly used pesticides and see what they are used for. Some brief guidance is also included on the recognition of poisoning symptoms.

The first group are sometimes called natural insecticides because they are made from plants. Of all the pesticides, these are the safest and most widely used. However, people who suffer from allergies should steer clear of them because they often cause reactions in sufferers from hay fever, asthma, and eczema. Pyrethrin is a good

Operatives wearing full protective clothing to apply orthophenylphenol and methanol as a fungicidal treatment.

A typical selection of pesticides on a hardware merchant's shelf. All carry appropriate warning labels under the Pest Control Products Act.



These wooden stalls were treated with a selected preservative of low-mammalian toxicity, to protect these historical breeds of cattle and horses at Old Fort William, Thunder Bay, Ontario.

Because this new timber in British Columbia was not treated with a preservative, it was attacked by a "dry-rot" fungus as soon as it got damp enough.

example of a "botanical" or natural insecticide. It was originally derived from the *Chrysanthemum cineraiaefolium*, but is now usually a synthetic product. Pyrethrin is slightly toxic with an LD_{50} of 1500 mg/kg. As far as its uses are concerned, pyrethrin is recommended for the treatment of infestations by bedbugs, batbugs, booklice, carpet beetle, drain flies, mosquitoes and ticks.

As a second group, we can examine the organochlorine compounds. These are broad spectrum pesticides which are very effective but have long lasting residual effects. They have entered our food chain and we are still discovering the horrific side effects of their use. Their use is now restricted and will probably be more heavily controlled in the future. In our context, their major applications are in wood preservation. These compounds commonly affect the central nervous system and short term poisoning symptoms often strongly resemble epileptic seizures. Symptoms include a wide range of neurological disorders, feelings of apprehension, tingling, numbness of the face, hands and feet, and convulsive movements. Not all of the organochlorine compounds are acutely toxic; methoxychlor is an example of a relatively non-toxic compound with an LD_{50} of 6000 mg/kg. It is used to treat attacks by the Smaller European Elm Bark Borer the insect responsible for introducing the fungus which causes Dutch Elm disease. Pentachlorophenol is another organochlorine compound most commonly used for wood preservation and as pesticide to kill fungal and insect attacks in wood. With its LD_{50} of 50 mg/kg "penta", or PCP as it is often called, is an extremely toxic material which has another lesser known and even nastier aspect to it.

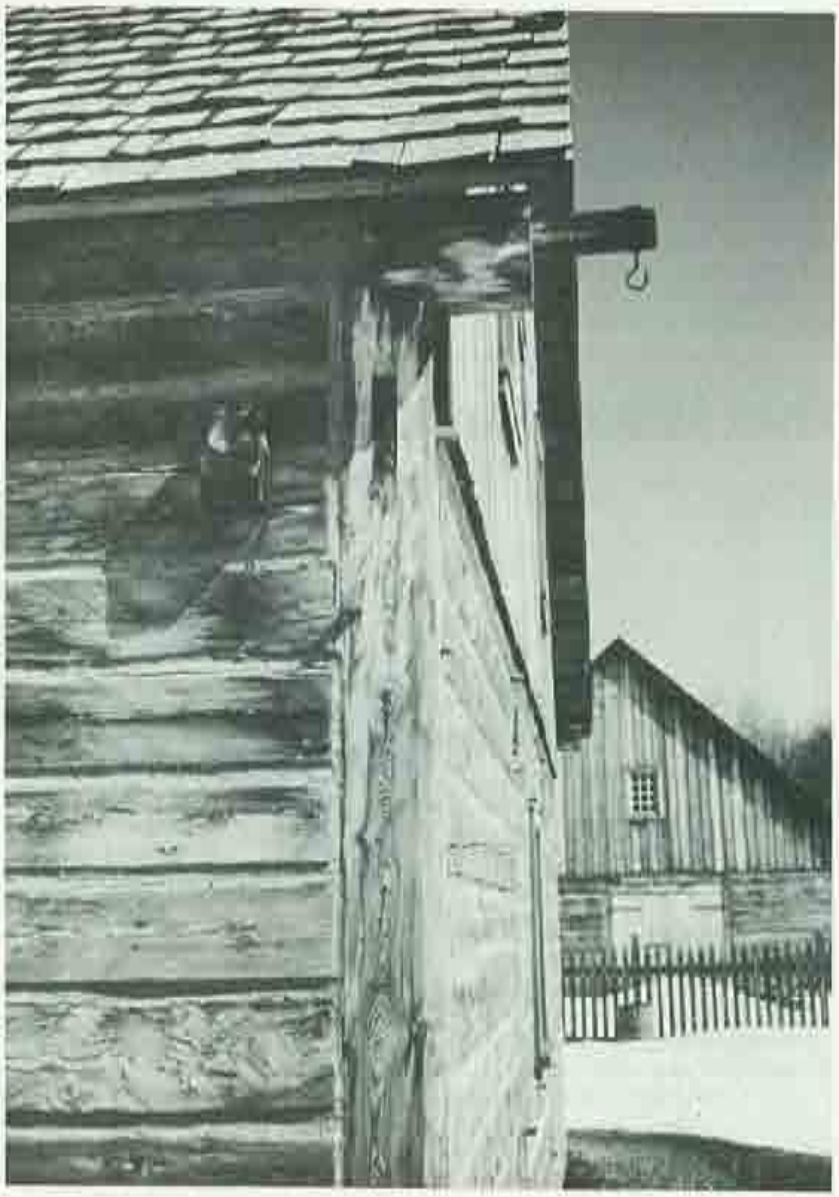
Penta, like 2,4,5-T (another organochlorine), contains small quantities of dioxin, the horrible poison involved in the 1976 Seveso disaster in Italy. "Acceptable" manufacturing levels of dioxin are now set at or below 0.1 mg/kg of organochlorine pesticides. However, dioxin is fat soluble and may be stored and concentrated in the body like DDT. A chemist who accidentally exposed himself to only milligram (1 mg) quantities in 1975 was severely poisoned with many distressing symptoms such as chloracne. This says nothing of birth deforming (teratogenic), carcinogenic, and spontaneous miscarriage effects. As mentioned earlier there is an increasing movement towards the use of orthophenylphenol instead of pentachlorophenol to avoid the dangers associated with both the short and long term use of the latter.

Practically every pesticide is either toxic to man or can cause harmful effects.

A third group of pesticides are the broad spectrum compounds known as carbamates. Poisoning symptoms include heavy sweating, salivation, tears, muscle spasms, nausea and vomiting, diarrhea, dizziness and psychotic behaviour. Diagnostic signs include pinpoint pupils and a very slow heart beat.

Propoxur is a carbamate which has an LD_{50} of 95 mg/kg and is therefore rated as moderately toxic. It is used to kill ants, carpet beetles, cockroaches, larder beetles, silverfish, spiders and weevils.

The fourth and last major group of pesticides are the organophosphate compounds. Pesticides in this group affect



An incorrect application resulted in the whitish green crystalline deposits on the surface of these timbers. The crystals are a lethal mixture of copper, chrome and arsenic salts (a). Such preservative compounds must be properly applied with the correct combination of controlled heat and pressure.

nerve function and may be very dangerous to the applicator. They should only be used with extreme care. Pesticides in this group include:
chlorpyrifos (LD_{50}: 163 mg/kg)
diazinon (LD_{50}: 350 mg/kg)
malathion (LD_{50}: 1375 mg/kg)
dichlorvos (LD_{50}: 56 mg/kg)

Of these malathion is probably the most widely used. It is about as toxic as aspirin and as biodegradable, breaking down into substances which do not cause environmental damage.

Pesticides in this group are largely used in the treatment of tree and shrub pests e.g. diazinon and malathion to treat spruce bud-worm and many varieties of aphid. Diazinon is very effective against carpet beetles, clothes moths, cockroaches, fleas, silverfish, ticks and weevils.

Dichlorvos can be used against most of the insects listed above with diazinon but is most commonly used for impregnated strips which can be hung in kitchens and near garbage cans. These are very effective in controlling flies. Note however, the relatively high concentrations of very toxic dichlorvos in two common examples. Vaporette Insect Strip® dichlorvos 18.6%; related compounds 1.4%; and Shell Vapona No Pest Strip® dichlorvos 19.2% related active ingredients 0.8%.

Poisonings resulting from pesticide applications are fortunately rare. The majority of poisonings are caused by accidental or deliberate swallowing of the chemical. We are becoming more aware of the effects of long term poisoning caused by pesticides which have got into the atmosphere, water supplies and the food chain. One common and easily avoidable cause of accidental poisoning is the storage of pesticides in unlabelled containers—or even worse—in old soft drink bottles which just invite children to come along and take a swig. All pesticides should be clearly labelled and stored out of children's reach.

We have discussed the LD_{50} toxicity rating system which is most important to us in assessing toxicity hazard; however, we should also note the concentration or amount of the pesticide actually recommended for use. A look at recommended treatments for cockroach infestations soon underlines this point; thus we find diazinon recommended as a 0.5-1% solution or as a 2% dust. Also recommended are rotenone 1%; propoxur 1%; lindane 0.5-1% and fenthion 0.5%.

Sometimes compounds are combined to increase the effectiveness of the main active pesticide. The added ingredients are called synergists. The pesticide Vaposector for example, contains two synergists as can be seen from this formula:

Ingredients:

N-octyl bicycloheptene dicarboximide	synergists	0.5%
Technical piperonyl butoxide	synergists	0.5%
Pyrethrins		0.4%
Inert ingredients (volatile petroleum distillate)		98.6%

With the exception of termite attacks which should only be treated by a licensed pest control operator, most household pests can be safely controlled by the layman if the actual pest has been correctly identified and its habits are understood, and if pesticides are used carefully and strictly according to the instructions on the label.

If you have a pest infestation and want to find out whether you can treat it yourself the following source lists may be useful.

Just remember to be careful. **Martin E. Weaver** ■

Where to get information

Booklets on wood destroying insects and other pests such as clothes moths and carpet beetles. Write for details to Agriculture Canada, Information Services, Ottawa, Ontario K1A 0C7 and the Forintek Canada Corp. Eastern Forest Products Laboratory, 800 Montreal Road, Ottawa, Ontario, K1G 3Z5.

Information on registered pesticides is also available from Agriculture Canada.

If you are in any doubt about the appropriateness of any pesticide or treatment ask your local Medical Health Officer or Workers' Compensation Board.

The Medical Health Officer will inform you of any local, municipal or provincial regulations which affect your case.

The Rentokil Library Series is one of the best sources in the world for authoritative information on pests and pesticidal treatments. The series can be obtained from Pest Control Magazine, Books Dept./ Fran Franzak, 9800 Detroit Avenue, Cleveland, Ohio, 44102.

Preservatives and pesticides.

A preservative is a substance which is applied to your cultural or natural resource to protect it from attack by pests.

A pesticide is a substance which is used to eradicate an attack by pests.

Some pesticides cannot be used as preservatives because they have very short lasting effects—pyrethrin's effectiveness lasts three hours or less.

What Makes An Ideal Insecticide?

The ideal insecticide

will:
1. be cheap
2. be safe to user
3. kill insect adults larvae and eggs
4. be fast working
5. retain killing power long enough to kill maximum number of insects
6. be easy to apply

won't:
1. leave or form dangerous residues
2. break down or lose its effectiveness in storage
3. be absorbed by and build up in animal or plant tissue
4. injure non-target animals or plants
5. corrode or damage building materials or equipment

IT DOES NOT EXIST

Column

Problems with paint chipping off your wood- or brickwork? Read on.

Martin Weaver

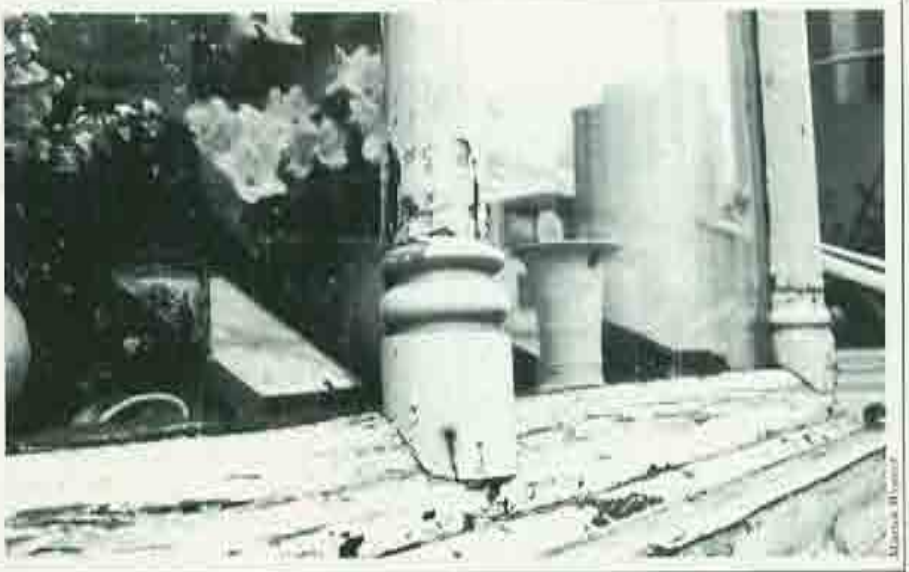
Heritage Canada's Director of Technical services takes a look at some recent letters and gives his answers.

Why is the paint falling off the woodwork of this fine Victorian shopfront in Toronto? What can be done about it?

The basic problem is a simple and obvious one. The paint is cracked and peeling and this condition is being made worse by saltsplash from the sidewalk and street. However, the cause of the cracking and peeling is almost certainly improper preparation of the surfaces when the front was last painted. The street salt and urban pollution leave fine crystalline deposits which must be scrubbed off with bristle brushes and plenty of water. If the deposits are not entirely removed, peeling and cracking ensue when new coats of paint are applied and cannot adhere to a firm surface.

The treatment which I would recommend is as follows:

- carefully sample paint layers to determine original colours and their distribution.
- carefully remove all traces of loose and flaking paint, rust, oil, grease and dirt using chemical paint remover (methylene chloride based, water rinse-off type) scrapers and detergents as necessary. Scrub all surfaces with household cleaner and water. Rinse thoroughly and allow to dry. Sand down all surfaces taking particular care to get down to fresh wood surfaces where wood is exposed.
- spot prime knots, sap streaks and all bare spots and areas to be puttied or caulked. Caulk nail heads, joints and checks or cracks as required.
- prime surface with one coat of long oil alkyd mildew resistant white undercoater as Sherwin Williams Hi-Level Exterior Undercoater B46 W31.
- apply two coats of oil base gloss exterior paint as Sherwin Williams Hi-Level Exterior Gloss Paint B46 W4. Allow two days or 48 hours between coats. Colours to match those established by paint layer investigations. *On no account* should a blow torch be used to remove paint from any woodwork.



Paint falling off a fine Victorian wooden shopfront in Toronto. The cause was a combination of salt splash from the street and poor surface preparation prior to painting.

Why is the paint falling off the exterior brickwork of our old market building only a few years after it was treated with special masonry paint?

It appears that in this case the failing paint film is a silicone-based coating formulated for masonry. Unlike pure or unpigmented silicones which are water-repellent, this coating is reported as being waterproof. Microscopic examination of tiny samples shows that the coating was applied over a thin layer of what appears to be a thin wash of lime and fine sand. From these data we can suggest that the reasons for the unsightly failure of the coating are as follows:

- any moisture penetrating into the brickwork from above e.g. from leaking roof or gutters, is trapped behind the waterproof coating.
- the trapped moisture and salts have caused a breakdown of the bond between the silicone-based coating and the underlying layer and between the latter and the brickworth beneath.
- once these bonds have failed the pressure of the trapped moisture is sufficient to push the coating off the wall.
- failure of the silicone-based coating may also have been due to the differences in thermal expansion and contraction between the two coatings.

The failing coatings should be removed and repairs should be made to eliminate any leaks or other sources of moisture.

Tests will have to be carried out in an unobtrusive spot to select an appropriate cleaning technique. I suspect that the only technique which will work without damaging the brickwork will be to use an industrial heavy duty paint stripper specially formulated to remove paint from masonry surfaces. The underlying layer or coating may have to be removed with an acidic chemical cleaner formulated specially for brickwork.

The strippers and cleaners are designed to be rinsed off with a jet of water. Don't let the pressure of the water jet become too high or it will damage the bricks and the pointing. Try a pressure of about 30-50 p.s.i. (pounds/square inch) to start with.

Under no circumstances should the brickwork be sandblasted. ■

NUTS AND BOLTS

BUILDINGS AND ACID RAIN

It's not just land and water the pollution destroys

In recent years popular and scientific writers have drawn attention to the dire effects of atmospheric pollution on some of the world's most famous heritage buildings. The Taj Mahal, the Acropolis and the great monuments of ancient Rome are all recent victims of our inability to control the emissions of our factories, our heating plants, our gasoline and diesel automotive exhausts, and our politicians.

The major victims of acid rains and the associated pollution products are—tragically enough—the very building stones which have become the byword of permanence in innumerable societies since the ancient Egyptians first built "for eternity."

Copper and copper alloys such as bronze—also long regarded as almost indestructible—are similarly victim of our increasingly corrosive atmosphere.

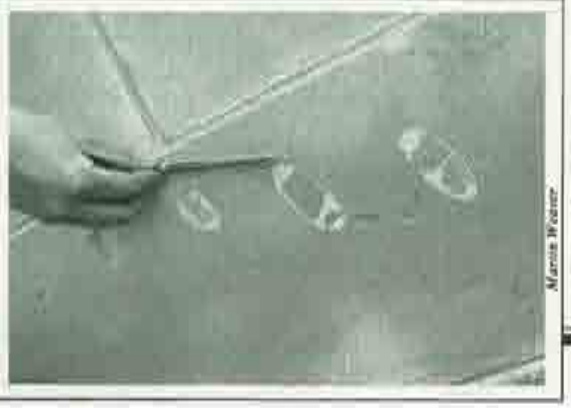
Is this problem really serious or are preservationists overreacting?

In 1956 Harold Plenderleith in *The Conservation of Antiquities and Works of Art* compared photographs of part of the west frieze of the Parthenon taken in-situ in 1938 and of plaster casts taken for Lord Elgin in 1802. A dramatic loss had demonstrably occurred in 136 years of exposure to the increasingly polluted atmosphere of Athens. In some areas centimetres of marble had literally disappeared. Since the relatively gentle conditions of 1938, the atmosphere of Athens has become much more hostile to a degree that has brought the marbles of the Acropolis to a point of crisis and a cause for international concern.

But all this is on the other side of the Atlantic and is surely not a cause for concern in Canada, apart, of course, from our concern for the imminent loss of our international heritage? Wrong—our buildings are in trouble! Recent observations on the buildings on Parliament Hill in Ottawa indicate that Canadians share the problems of the Athenians, but on an accelerated scale!

I first began to observe and photograph the buildings on Parliament Hill in 1975 in connection with my advisory work on the conservation of the East Block. In 1977, I reported on the conservation state of the stones of the East Block and drew attention to the effects of dilute sulphuric acid originating from atmospheric pollution. A number of most significant observations were made following scientific analyses of pollution deposits from the East Block conducted in the laboratories of the Conservation Division of Parks Canada and the laboratories of the Department of the Environment in the United Kingdom. Before we can appreciate the significance of these results we should perhaps first examine the nature of building stones and how they deteriorate.

Sulphuric acid in rain eats away marble in Halifax and limestone in Ottawa, where projecting resin provides clue.



We can picture building stones as being rather like fruit cake. Stones commonly consist of an aggregate and a binder—particles of various materials bound together by others—the currants, nuts and peel cemented together by cake mix. In stones, the equivalents of the harder bits in the cake mix are often sand or fragments of silica minerals. The equivalents of the cake mix in sandstones for example might be clay, chalk, iron compounds or silica, cementing together grains of sand.

Vast quantities of calcium carbonate originating from the skeletal remains of ancient sea creatures gave us many of our limestones. In some cases one can still see fossils of sponges and shellfish in a matrix of calcium or magnesium carbonates. Any building stones which are bound together by carbonates or which consist almost entirely of carbonates are liable to be dissolved by acids.

The presence of clays in limestones and sandstones can have a considerable effect on the durability of the stone in our built environment. Limestone varieties low in clay content take a good polish and are durable. Limestones with high clay content tend to be soft, and of low durability. Sandstones with clay binders or cements also make the least durable building stones.

The disintegration of clay binders or cements in either bands or zones is rapid in humid climates both by swelling action of the wetted clay minerals and by frost action and salt burst.

In limestones, clay lines or bands such as stylolites* tend to weather out rapidly. Acid rain then quickly widens the opening by solution.

To return for a moment to our model of the fruit cake, much of the total volume consists of gaps or spaces. Building stones contain two types of spaces or voids, those which are sealed off and those which are interlinked. This raises the phenomena of porosity and permeability. Lava in the form of pumice may be highly porous and have a high ratio of space to solid. It will float in water because the cavities are sealed off from one another and the stone is impermeable. In contrast, as much as 25% of the total volume of a block of sandstone may consist of empty spaces or pores which can be filled by water. The spaces are interconnected and the stone is highly permeable. Contrary to popular belief, dense rocks such as granite are porous and although the percentage of void to total volume is low (up to 1.5%) moisture can pass through granite.

Let us return to the problems of the building stones on Parliament Hill. The majority of the stones are sandstones—a local stone known as Nepean sandstone, and Ohio sandstones. Both of these types have silica as their major cementing material.

When the first tests were carried out on the polluted surfaces of the stones of the East Block, it was discovered that there were two types of deposits. A black deposit on many surfaces where the stone was generally in good condition proved to be almost pure carbon or soot. In areas where the stone was very obviously in trouble, however—with its surface disfigured by hard dark blistering and peeling crusts—tests revealed that 40% of these crusts consisted of calcium sulphate dihydrate and 2.5% was an organic material, probably carbon.

In simple terms, the latter stones were covered with a crust of gypsum or had much of their surfaces converted to gypsum. Why is this a problem? Gypsum is about 32 times more water soluble than calcite (calcium carbonate or lime). Gypsum or other sulphate crystals hydrating and dehydrating—taking on and losing water—can have an incredibly destructive effect if they are in the surface of a porous

Photos by Martin Weaver

Peeling crusts of sulphate and stone show under a moulding on the right of this detail on the Peace Tower, Parliament Hill, Ottawa.

Ottawa's acidic rain attacks bronze statues on Parliament Hill and removed more than 5 mm. from face of Tyndall limestone column on the Hunter Building.

**Stylolites are lines usually of darker colour than the surrounding stone. Caused by a combination of high pressure and solution, they contain concentrations of clay and/or organic material.*

and permeable stone exposed to moisture.

Gypsum crystals growing in the pores of stones can exert extraordinary pressures which will completely smash the structure of the stone from within. At 0-25°C these crystals can develop pressures of 1800 atmospheres which can be expressed as 26,452 pounds per square inch *(see also* Canadian Heritage, *June 1980)*. How and why did the gypsum crusts form? Although the sandstones of the East Block have a negligible natural calcium carbonate content, the acid rain attacks the lime mortar between the stones, dissolves out the calcium carbonate and redeposits it in and on the surface of the stones. This leaves the mortar weakened by the loss of its binder. The calcium carbonate then reacts chemically with the dilute sulphuric acid in the rain and forms calcium sulphate.

From observations on the East Block it was clear that where running rainwater could not flush away build-ups of sulphates—i.e. under drip-moulds and in other protected areas—disastrous results had occurred.

It was only later realized after complex analyses carried out early in 1980 that the sulphates flushed away from upper surfaces were in fact redeposited in the thickness of the masonry lower in the buildings. There these sulphates remained until recently, exactly like a time bomb. Unfortunately the time is now running out.

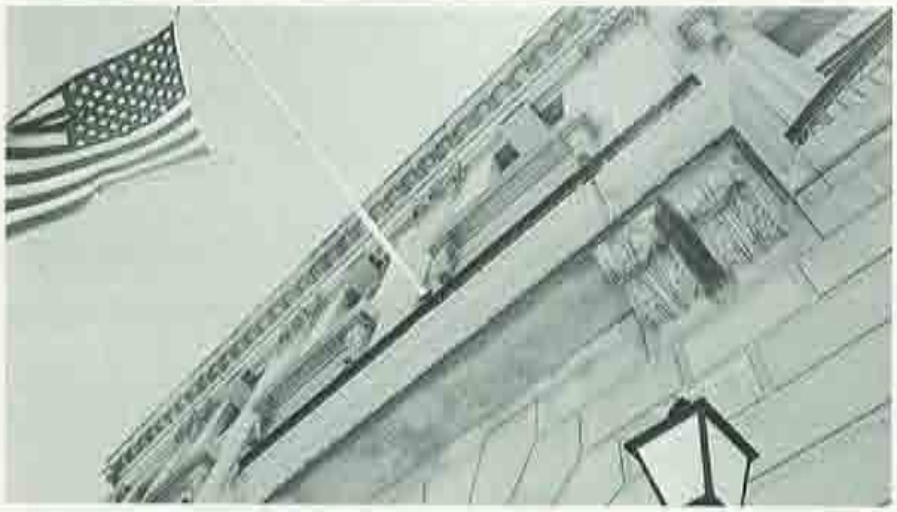
With the increased acidity of our rain (pH 4.0 in recent Ontario studies) the acids are able to penetrate more deeply into masonry and to bring long-hidden salts out to the surface. The results are dramatic and extraordinarily destructive as may be seen from the illustrations which accompany this article.

Ottawa, like many other Canadian cities has been doubly unfortunate in having had pulp mills in the vicinity. The fantastic sulphate pollution levels caused by pulp mills can be appreciated from the following table.

Sulphate Content of Various Atmospheres

Location	Micrograms/m³ ($\mu g/m^3$ as SO_3)
Rural England	55
Kansas City, Mo., annual average	5.7
New York City, annual average	486
New York City, 24 hour average	1085
London, killing fog 1952	3840
Pulp mill, surrounding New Hampshire	5720-37,200

(Extract from Winkler, E. M. Stone: Properties, Durability in Man's Environment. *Springer Verlag. New York. 1975)*



Pollution from northern U.S.A. acidifies Ottawa rain attacking U.S. embassy and Parliament Buildings indiscriminately.

Observations in May 1980 revealed an incredible picture of decay and deterioration on Parliament Hill—this is not a political comment—the stones are literally being eaten away by acids or are being blasted apart by concentrations of water soluble salts.

Just to the south of the West Block, a stone staircase was installed in 1978. The staircase was constructed of Indiana limestone which contained some surface flaws. Following normal practice, flawed areas were cut out and the holes were filled with epoxy or polyester resins. The surface was then dressed flat and smooth.

When this staircase was examined in May 1980, it was found that the resin adhesives—which are not affected by acids—stood above the adjacent stone surfaces, in some places the thin ribs of resin stood more than one millimetre above the surface of the stone. This shows that in less than two years more than one millimetre has been eroded away from the surface of the limestone. From this we might infer that the limestone has been eroded at the incredible rate of almost one millimetre per year. Although some of this damage might be due to calcium chloride from street salting operations, erosion is clearly taking place elsewhere in limestone where there is no such contamination (*see illustration, column on the Hunter Building, Ottawa*). If pollution of the atmosphere and associated acid rainfall continue at the present levels the staircase could literally be dissolved to collapse in 25 years. Similarly disastrous rates of destruction are visibly occurring as the result of heavy build-ups of soluble salts in and on the surface of the sandstone blocks in the East Block, the Centre Block and the West Block.

There is no magic plastic coating or "snake oil" to prevent this destruction of our heritage stonework. The only remedy is to stop the pollution.

It would be poetic justice if the very politicians who are dragging their feet on stopping pollution were flattened by falling masonry. If the deterioration caused by acid rain and air pollution continues at present rates, it could happen on Parliament Hill. **Martin E. Weaver** ■

For additional reading

Winkler, E. M. Stone: Properties, Durability in Man's Environment. *Second Revised Edition. Springer Verlag. New York, 1975. Springer Study Edition Paperback $14.80 (U.S.)*

Bates, Robert L. Geology of the Industrial Rocks and Minerals. *Dover Publications Inc. New York, 1969. Paperback $5.50 (U.S.)*

Sneyers R. V. and de Henan P. J. The Conservation of Stone. *The Conservation of Cultural Property Museums and Monuments Series XI UNESCO Paris 1968.*

Helping Antiques Through a Canadian Winter

Barbara Keyser

With the onset of frosty weather and the need to keep the furnace on at home, I have noticed that some wood carvings I bought this summer are cracking. Is there any material I can coat them with to stop this? They are sixty years old; I thought old, well-seasoned wood should not crack.

Please resist the impulse to apply any coatings to wooden objects other than those originally on them. Unfortunately, after the initial seasoning period when the sap which fills the cell cavities of green wood evaporates, all wood, regardless of age, is dimensionally unstable. That is, it shrinks and swells depending on the moisture content in the environment. Wood sculpture, paintings on wood, musical instruments, and furniture with complex inlay or veneer, are all very sensitive to atmospheric moisture. So are objects made of bone or ivory, and paintings on canvas.

The underlying cause of your problem is the low level of relative humidity inside your home during cold weather when the furnace is on. Objects preserved for centuries in European castles, churches, and museums without central heating often deteriorate when brought to Canada with its hot humid summers and severe winters. Here, the uncontrolled indoor climate of homes (and museums) undergoes changes as violent as those outside. In winter, with indoor temperatures as high as 25°C, relative humidity can drop to 10%. At the height of summer, it can go up to 95%. Every homeowner is familiar with the changes in woodwork that occur with the seasons, such as that door that sticks in summer but not in winter. The same changes occur within works of art and antiques.

Air contains invisible water vapour. The actual weight of water vapour present in a fixed volume of air is the absolute humidity. Given a constant absolute humidity, a fixed volume of air undergoes changes in relative humidity as the temperature changes, because the ability of air to support and contain water vapour varies with heat and cold. The warmer the air, the more water vapour it can contain, as everyone experiences on steaming summer days. Relative humidity is usually expressed as a percentage for a given temperature.

All this sounds very abstract. How does it work in practice? Wood changes in dimensions with its moisture content; its moisture content varies in proportion to that in the air. It is winter; the outdoor temperature is −10°C. At best, air at this temperature could contain 2.1 grams of water (100% RH). Bring this air indoors and heat it to 20°C—it still contains 2.1 g of water, but the relative humidity is now only 12%. Wood in the house loses moisture and shrinks. Sculptures crack and paintings flake. The more extreme the changes in relative humidity, and the more suddenly they occur, the greater is the possibility that sensitive objects will be damaged.

The degree to which wood shrinks and swells in response to changes in relative humidity depends on the way it is cut from the log and the way pieces are joined. Movement across the grain is much greater than that with the grain. Warpage is minimized when the grain is uniform, that is, radially cut (*see illustration*). Tangentially-cut boards move much more. Often panel paintings exhibit flaking in only one area; usually this area is tangentially cut. Good craftsmen were careful to choose radially-cut planks, but such wood is less common now because sawing an entire log radially leaves more waste. Cracking and warping are also more likely when wooden parts are closely joined, especially if their grains run contrary to each other at the joint; this is common in furniture.

Wood sculptures cut from a whole log nearly always check.

How can these problems be minimized in the home?

- Using home humidifiers, try to maintain a relative humidity level in the home of 30-35% in winter. Major museums try to maintain 50% the year around but this is simply impossible for either small museums or private collectors. However, it is important to note that maintaining a desirable relative humidity in the home is related to saving energy; it is easier if the thermostat is set at 18°C or even lower. Still, humidifying over 35% can be dangerous in a home, as the moisture passes through the exterior walls and freezes, damaging the walls.

With the changing of the seasons, try to keep the change of relative humidity within 5% a month. Dehumidifiers may be necessary in summer. It is probably not practical to control humidity of an entire home to this extent. A realistic goal may be to control one or two rooms, preferably those which have either no outside walls or effective insulation with vapour barriers, and keep the most sensitive objects in this area.

- Know what the relative humidity is in the area of the home where sensitive objects are kept. Home humidistats and coloured paper indicators (available from Fisher Scientific) are inexpensive and will give at least a "ball park" (± 10%) reading, which is much better than no reading at all. The collector who owns extremely valuable and sensitive objects might wish to invest in an electronic Beckman "Humi-Chek," available for about $200 from Beckman Instruments in Toronto.
- In summer, photograph any humidity-sensitive and valuable objects that you own. Watch the objects for changes and compare them with the photographs. This is the surest way to know which objects are sensitive and the extent to which they change (a good photographic record of valuable antiques is also a good reference for insurance purposes, or identification in case of loss or theft).
- Do not put sensitive objects in locations subject to frequent variations in tempera-

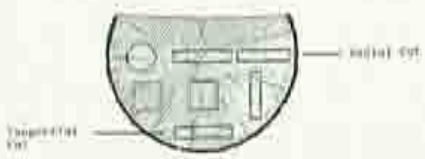
ture and/or relative humidity—that is, near radiators, forced-air heating outlets, working fireplaces or stoves, or where direct sunlight falls on them. Avoid hanging paintings on external walls. Do not use hot spotlights close to sensitive objects, or attach picture lights to the frames of paintings as these heat the surface unevenly.

▸ If a piece is warped, do not try to force it flat or mechanically restrain it in any way. The dimensional changes in wood exert powerful forces; if mechanical restraints are stronger than the forces and stresses within the wood, the wood will simply break.

In the past warped or flaking paintings on wooden panels were often forced flat and "cradled"—that is, battens were glued to the reverse. This treatment often increased the rate of flaking. A flaking picture should be stored flat and a competent conservator consulted; do not touch the blisters or flaking areas. Do not attempt to reglue veneers on furniture unless they return to their original position easily, without forcing.

▸ Sculptures incorporating an entire tree trunk will almost always have checks. Do not fill these with any hard material, as this can make the checks worse. It is best to accept the disfigurement of small checks, but if the appearance of the piece is unacceptable, the checks can be filled with a soft wax tinted to match the surrounding wood.

▸ Do not attempt to treat cracked ivory. This is a job for professionals. Special humidity-conditioned cases can be constructed for extremely rare and delicate objects. In any event, preventing damage to objects by providing a proper environment is preferable to repairing them after permanent damage has occurred.



Transverse section of a log showing the characteristic effect of growth ring direction of the shape of cut lumber after shrinkage.

The information given here is only the barest outline of a vast and complex subject. For those who would like more detailed material, the Canadian Conservation Institute in Ottawa publishes a series of authoritative technical bulletins. Topics include relative humidity, lighting, environmental monitoring devices, care of wooden objects, and care of musical instruments. They are available free of charge. Their address: The Canadian Conservation Institute, National Museums of Canada, 1030 Innes Rd., Ottawa, Ont. K1A 0M8.

NUTS AND BOLTS

SYNTHETIC SIDINGS

The pros and cons of the imitators.

In these days of plastic flowers, "authentic walnut" woodgrained plastic table tops, plastic "brick finishes," "authentic old-style adzed finish" styrofoam beams, and Astro-turf™ it is hardly surprising that we are also presented with imitations of wooden siding. It is currently possible to obtain synthetic siding made of aluminum, vinyl, steel and, most recently, masonite.

These modern industrial products are pressed upon the public with claims that they are "maintenance-free," have long-life "baked-on" or "integrated" colour finishes and even, in some cases that they save energy by providing added insulation.

How valid are these claims and why do preservationists start to foam at the mouth when the subject of synthetic or substitute siding arises?

Let us take a look at the latter question first. Synthetic siding changes the architectural quality of an existing building. There is a clear visual difference between wood siding and any of the synthetic products. The synthetic products have a regularity, sharpness and smoothness of finish which painted wood siding does not have. Despite attempts to produce "rough sawn" and "woodgrain" imitations in both vinyl and aluminum, they look like exactly what they are—blatant imitations. The "grain," aside from being a regular repeat pattern, is not characteristic of real wood finishes. The huge range of old siding forms provide rich and varied surface textures, which simply cannot be matched by standardized, machine-made, mass produced products.

A second major problem of synthetic siding lies in the fact that the vinyl, aluminum and other materials are in sheet form and no matter how clever you are with flashings and accessories, they won't follow all the decorative features, nail patterns, brackets, mouldings and finials which give many of our older buildings their character. In many cases original features may actually have to be removed to allow the synthetic products to be applied. At best the decorative details will be covered over and the architectural integrity of the building is compromised if not destroyed.

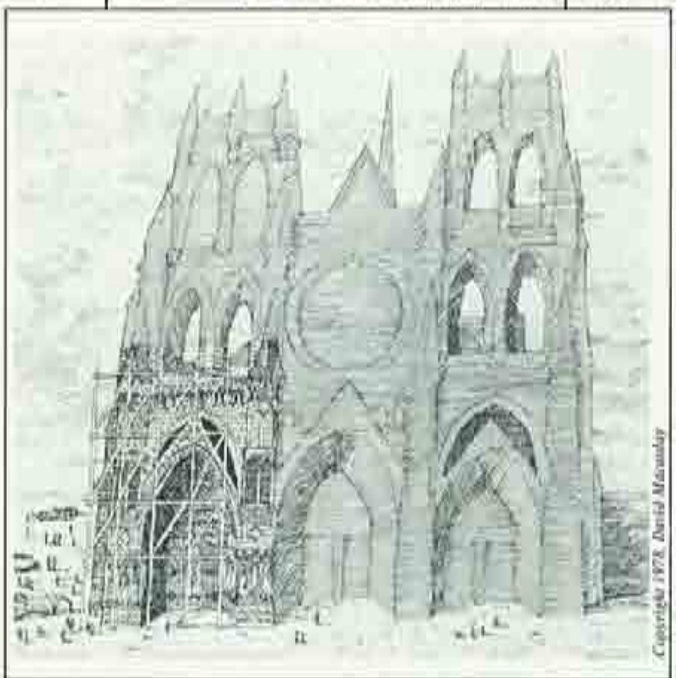
The character of original wood siding depends in part on the width of the boards or, more exactly, the widths of the exposed surfaces. There have been too many cases of synthetic siding being applied where the exposed surfaces are twice the width of the original boards. Once again the character building is considerably changed.

Remember those points:

- destruction or obliteration of decorative detail,
- total change in surface texture and finish,
- loss of architectural integrity.

Small wonder that those who know and appreciate the quality of our older buildings are being driven to distraction by the creeping tide of synthetic siding which suddenly appears whenever they turn their backs.

David Macaulay's witty drawings entitled "a tribute to vinyl siding" in his book *Great Moments in Architecture*[1] show us everything from a cathedral to an igloo being covered in vinyl siding. We can laugh at this but the reality is with us as can be seen from the distressing case of the once beautiful and finely decorated mid-nineteenth century church at Sackville, New Brunswick illustrated here. The effect is one of architectural emasculation.



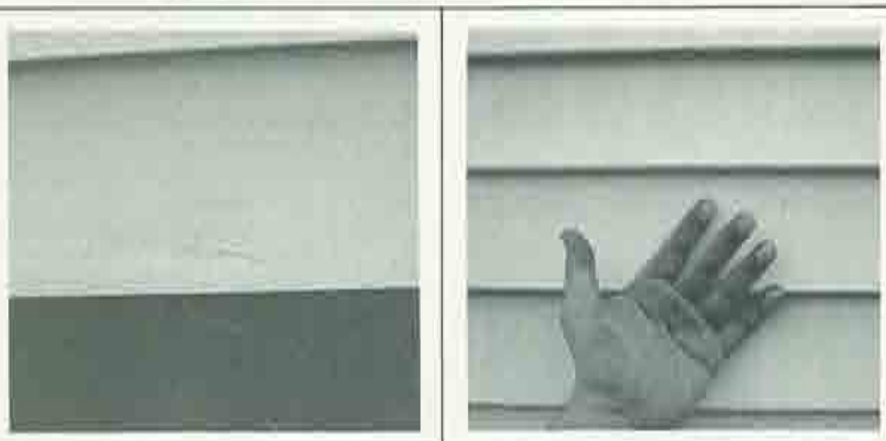
While David Macaulay's cartoon is amusing, its real-life counterpart in Sackville, N.B. (next page) is more sobering.

Why does synthetic siding provide such an apparently attractive substitute to apply over original wooden siding? The major attraction is supposed to be the elimination or substantial reduction of maintenance. The brochures carry strong marketing messages; "the beauty of wood

1. *Macaulay, David* Great Moments in Architecture *Houghton Mifflin Company. Boston 1978.*

Photos by Martin Weaver

Handsome survivor with wooden shingle siding in a district where all the neighbours have been obliterated by vinyl siding—including the house on the left.



Vinyl siding showing fake wood grain & impact damage *(l)*, and vinyl siding "chalking" *(r)*, evidence of surface breakdown and possibly of siding breakdown.

A mid-19th century church in Sackville, N.B. has been clad in vinyl siding, covering fine mouldings and destroying the original architectural character.

without its problems" . . . "no more peeling, blistering and flaking paint" . . . "no more painting" . . . "practically maintenance free."

Vinyl siding is frequently guaranteed not to dent, peel, blister, stain, chip, warp, rust, support combustion or absorb moisture. Various aluminum sidings are guaranteed not to rust—or red rust in some cases—peel, blister, flake, chip, split or check. This is often misleading advertising since these defects are not characteristic of the synthetic materials in question.

Some companies will offer 20 or even 40 years warranties which state that they will pay for the labour and materials if one of the above defects should appear. However, there is often more print further down the form. The first caveat is that the full 100% replacement cost is only assumed by the company for one year or perhaps five years after installation. A typical formula is that after one year at 100%, the percentage of the cost of replacement assumed by the company goes down by 5% per annum—until it's gone. In the case of aluminum and steel siding there are often warnings that the warranty does not cover chalking or colour fading—understandably because the siding does chalk and fade! One aluminum siding warranty states that it does not cover damages of any kind resulting from air pollution or "normal weathering of surfaces not resulting in conditions warranted against herein"—in other words, blistering, peeling, checking and flaking. This too is understandable in these days of acid rain!

The colours of aluminum and steel sidings will normally change within a few years. This can create a considerable problem if the siding gets damaged and parts have to be replaced. It is then virtually impossible to get a colour match between the old siding and the new. It can also be extremely difficult to paint over the weathered finish of synthetic siding if this should become necessary.

Now that we have raised the question of damage to synthetic siding we should examine the forms that this damage can take.

Aluminum and steel sidings are very susceptible to scratching and denting. If there is any likelihood of impact damage from such activities as children playing or people leaning bicycles against the siding, then the aluminum and steel are liable to be damaged. For some years the aluminum siding manufacturers have applied a compressed fibre or some other form of backing to their thin siding (typically 0.020 inch thick sheet aluminum). The original purpose of this backing was to reduce the hazard of denting but it is only partially effective. With the current emphasis on energy

conservation, this backing has been advertised as being good additional insulation. In practical terms aluminum and vinyl sidings are not good insulators because they are so thin. With a backing there is a marginal insulation effect which is a combination of the creation of an air space between the new and the original siding, and the reduction of air leakage into and out of the building due to the new impermeable skin. A Rhode Island study[2] recently determined that for a two-storey house, twenty-five feet square (1250 ft² area), the payback period for 23 storm windows, two storm doors and six inches of attic insulation was 4.4 years while the payback for aluminum siding with an R-factor of 2.5 was 29.96 years.

Many vinyl sidings have a tendency to become brittle when cold and to crack or shatter. On a recent tour of Canada and the Atlantic states of the U.S.A., I noted dozens of examples of new or relatively new vinyl siding which had cracked or had been punctured by impact. In one case, just outside Boston, vinyl siding on a church was chalking so badly that fingers lightly brushed across the surface were immediately covered in powder. At that rate of chalking the siding will have weathered right through in 25 years.

It is important to gain an accurate assessment of the true costs of synthetic siding installations as opposed to maintaining original materials. This can be a complex business but since the synthetic sidings are marketed as maintenance-free or as virtually maintenance-free we should compare life-cycle costing.

Let us assume that the synthetic siding is not damaged and it weathers and ages normally; there will be inevitable changes in colour and gloss. A synthetic siding job is likely to cost two or three times more than a good paint job on wood siding; if there are decorative elements to go around, it may cost four times as much as the paint job. At the least, the synthetic siding should last as long as two or three paint jobs before requiring maintenance. Two or three consecutive paint jobs on wood where the wood is properly prepared and the paint consists of two quality coats, properly applied, should last 15-21 years and could last 20-30 years. Can synthetic siding last for 15-30 years without requiring maintenance or painting? The answer from a large number of examples is no! Synthetic sidings often require painting after 10 years and some have required painting after as little as 5-7 years. Once painted, the synthetic siding needs to be repainted as often as wood.

In 1979 the U.S. Department of the Interior published some interesting details from a study carried out by a New England architectural firm. Although their study was on vinyl siding they established that aluminum siding costs were very similar. The firm compared the cost of a vinyl siding job with the cost of maintaining and repainting the original wood siding of a church. The vinyl was assigned a 20 year life—which was generous. They then assumed a six percent inflation rate, six percent interest on savings—both low figures—and a wood repainting cycle of 6-7 years. The cost of the vinyl siding job was assumed to be a total sum available for all options. Where painting and repair of original siding was cheaper than a synthetic siding job they invested the difference at six percent interest. Using surpluses and interest it was shown that if the original siding was repainted every 6-7 years then there would still be a surplus in the painting fund after 20 years—the lifetime of the vinyl siding. The need to replace the vinyl siding would then cause a further deficit (the higher initial expense of a synthetic siding job might also force a property owner to seek financing which would add substantial interest to the purchase price).

There are two further potential problems with synthetic siding. If synthetic siding is applied to an old uninsulated building, it can act as a vapour barrier and can cause condensation problems where they are hidden from view.[3] Early warning signs of deterioration, such as peeling paint or water staining on wooden boards, are hidden from sight behind the synthetic siding and the situation is worse because the property owner has been told that there is no need for maintenance. By the time problems become noticeable they may have reached very serious proportions.

Concern has been expressed about the performance of synthetic siding in fires.

Applying synthetic siding over original siding *(left)* causes problems around trim. *(Right)* Painting over deteriorated metal siding: like painting a car with a brush.

Martin Weaver and participants at Heritage Canada's Halifax Preservation Workshop examine the fine wooden siding and trim of Uniacke House, Nova Scotia, built in 1813-15.

2. See also: In the Bank . . . or up the Chimney? *Second Edition. Washington D.C. Department of Housing and Urban Development 1977.*

3. Vapour barriers should be fitted on the warm side of exterior walls.

Aluminum siding has been found to behave quite well in comparison to many other materials when tested for flame spread, flame penetration and smoke accumulation. When applied over original wood siding, lapped aluminum siding has even protected the original siding from flames pouring from window and door openings. Vinyl siding exposed to heat will first sag and then melt off the wall. The gases produced by melting and subsequently burning siding are on the outside of the building and are hence not really a problem to the escaping occupants. In a really "hot" fire aluminum siding will melt and flow. In the 1979 fire which destroyed the roof and interior of the historic Martineau Hotel in Ottawa, the aluminum screen doors melted and formed puddles in the street. About 100 ft away on the opposite side of the street plastic signs sagged and melted in the heat, just as vinyl siding would do.

In conclusion we should remember that it is usually more economical and always more appropriate to retain and maintain original materials when preserving our heritage buildings. **Martin E. Weaver** ■

Repainted aluminum siding shows a streaky appearance and is peeling where dented. Also evidence of warping in siding.

Where to get information

Aluminum and vinyl sidings on historic buildings. *John C. Myers, Preservation Brief No. 8, Heritage Conservation and Recreation Service, U.S. Dept. of the Interior. U.S. Government Printing Office; 1979-0-302-019.*

"The case against substitute siding" Brian D. Conway The Old House Journal *Vol. VIII, N. 4, April 1980.*

Compare Before You Buy

Costs and benefits of various sidings.

Sooner or later, among the most important questions home-renovators are likely to ask themselves is: what are the costs and benefits of the various kinds of material available for siding? To answer the question, Canadian Heritage *recently chose a typical turn-of-the-century Ottawa house and asked local contractors to suggest prices. Our report:*

The house is a single detached two-storey rectangular building (19 feet wide and 27 feet long) with a one story lean-to at the back (13 feet wide and 16 feet long). The house has a high gable front and a simple bargeboard that has lost most of its decorative elements. Twenty years ago the clapboard exterior was stuccoed over and the squared rubble stone foundation was covered with cement. The wood replacement for the original stucco-covered wooden window trim has been included in the following calculations. The house has an open porch and a stoop in front of the off-centre plain-trimmed entrance door. Because the porch should be replaced and its replacement estimates are not yet available, porch costs are not included in the calculations.

Technically the only solution is to remove the stucco with the probably rotted wood siding underneath and replace it with new siding, but for the purpose of this exercise we assume that the strapping will be fixed on top of the stucco before the new siding is applied. Only the curved stucco under the soffit must be removed and the replacement of the soffit with new material is accounted for.

The alternatives considered are wood siding and synthetic siding. The proposed wood siding is 6 inch feather-edge pine; the wood soffit is tongue and groove pine. One major advantage of wood siding is its flexibility of application and its adjustment to the deformation of an existing structure. There are two widths of synthetic siding available, 4 inch and 8 inch. Because of the uneven exterior it is better to use the more rigid 4" wide horizontal siding. The painting price was calculated using one coat of primer and two coats of exterior quality paint. ■

Material	Siding material installation (with strapping)	Soffit	Removal of Stucco Soffit	Total Cost	Guarantee (years)
Aluminum	$3990.	$362.	$200.	$4552.	25
Masonite	3870.	355.	200.	4452.	20
Steel	4788.	434.	200.	5422.	20
Vinyl	No breakdown available			3975.	40
Wood	4630.	472.	200.	5292.	100
Paint				1080.	

Advice

Yes, Virginia, there is a solution

Coming to grips with synthetic siding.

The Housing Authority here in Richmond, Virginia, will not make conservation loans for frame houses unless the borrowers will agree to install aluminum siding in lieu of painting the exterior frame portions of the houses. Their explanation is that non-lead paints will not adhere where lead-based paint was once used.

We would like to determine if this premise is accurate, and if so, whether some solution other than aluminum siding has been found by anyone involved in restoration. Is it possible that an intermediate coating might be used which would adhere to both the old lead-based paint and a new non-lead paint?

You have posed us a most interesting question. I have no idea where your Housing Authority got the idea that contemporary paints will not adhere to old lead-based paints, and as for making conservation loans available only if aluminum siding is installed over the original siding—I find this incredible.

Let us deal with the paint adhesion question first. New paint films may fail to adhere to, or may not be compatible with, old paint films on wood for the following reasons:

- old paint layer is peeling or loose;
- grease, oil or dirt are not cleaned off properly from old surface;
- old paint surface has mould on it, which should have been scrubbed off;
- old paint surface has crystalline efflorescence on it which should have been washed off;
- resin may have "bled" from knots and resin pockets which have not been properly sealed;
- old surfaces are generally lightly sanded down, to ensure a fresh surface and, as many believe, to provide a good "key"; failure to sand down may lead to poor adhesion of new paint.
- contemporary paints have various vehicles or binders e.g. alkyds; epoxy esters; latex emulsions—styrene, butadiene, polyvinylacetate, acrylics and vinyl acetate, oils—linseed oil, tung oil, soybean oil, safflower oil; phenolics; urethanes; vinyls—vinyl chloride and vinyl acetate. In certain cases these paints may contain strong solvents such as ketones or special additives to accelerate drying. These or the vehicle may soften or dissolve the vehicle or binder of the original paint and cause defects such as alligatoring, blistering, peeling or creeping. Such combinations are obviously incompatible. Old paints which employed water and perhaps glue size as a vehicle or binder e.g. whitewash, colour-wash, distemper or calcimine, and ceiling white usually cannot be painted over and have to be removed.

Old exterior house paints usually had linseed oil as a vehicle although fish oil was occasionally used. From all of the above information you will note that the pigment has not played a part in the causes of failure.

Paint peeling from wooden siding is caused by moisture from building interior—covering it only hides the problem.

In the case of old lead-based paints the commonest pigment is white lead also known as flake white or Cremnitz white. Chemically it is basic carbonate of lead $2PbCO_3.Pb(OH)_2$; ordinarily white lead contains about 70 per cent of lead carbonate and about 30 per cent of lead hydrate. To answer the Housing Authority in Richmond, I think we can do no better than to quote Rutherford J. Gettens and George L. Stout.* "The siccative or drying action of white lead upon oils is another reason for its being so widely used. Pure white lead in oil is (was) favoured as an outside white paint because it chalks on weathering, does not check or crack and *leaves a suitable surface for repainting.*" The conclusions which one must reach from all this is that there is nothing in lead-based paints which would prevent a modern paint from adhering to them, providing of course that the old paint surfaces are clean and properly prepared, and that the vehicles and solvents are compatible—which they are in the majority of cases. There is nothing special about this case since the above would be true of any old paint whether it contained lead pigments or not.

Finally I suspect that there may be some element of confusion behind the Housing Authority's edict. It is possible that recent U.S. legislation against the use of lead-based paints, and publicity concerning the dangerous effects of burning off old lead-based paints and inhaling toxic lead in the combustion products have given rise to the idea that lead-based paints should be covered up and not painted over.

I have discussed this problem with H.E. Ashton of the Division of Building Research, National Research Council. Mr. Ashton is probably Canada's leading expert on architectural paints and is the author of most of the National Research Council's publications on paints and paint failures.

He agrees with my statements that most failures originate from improper preparation, and from solvent or vehicle incompatibility. He also agrees that basic lead carbonate should not be regarded as the cause of any problems of paint films failing to adhere.

As a matter of interest he recalled that about ten years ago there were reports in the northeastern United States of some alkyd and "latex" paints failing when applied over old paints. It appears that at that time some reaction occurred between old and new paints which led to the formation of an impermeable film. When any water vapour passed through the substrate (e.g. the clapboarding underneath), the entire paint layer was forced off the surface. Strictly speaking, this was not a failure of the new paint to adhere to the old. It would seem that the modern paint formulations have changed in some essential aspect since then because we have heard no further reports in recent years.

I think our line should be that any reputable paint manufacturer can design a painting system to provide excellent results in such situations—a system in which original paint, new undercoat and new finishing coat are all compatible. **M.W.** ■

**Gettens, Rutherford J. and George L. Stout. Painting Materials, a Short encyclopedia. Dover Publications Inc. New York. 1966.*

This correspondence has been published in the Bulletin of the Association for Preservation Technology, Vol. XII, N. 1, 1980, pp. 11-14.

Advice

Framed and hung

T.L.C. for favourite paintings.

I have a number of old photographs and engravings that have been lying around for years. I would like to have them framed so I can display them in my home. How should they be framed and hung?

We are used to thinking of paper as cheap, available, and expendable. Yet almost everyone owns paper of value—whether images (prints, drawings, and photographs) or documents (books, maps, and letters). The need to preserve valuable paper is so widespread that it has given rise to an extensive science.

The principal enemies of paper are mould and insect damage; mechanical damage (creasing and tearing); acidity, whether inherent in the paper itself or absorbed from the environment; and damage from exposure to light. Now that works on paper can be valuable investments, spending time, care, and money on damage prevention is important for collectors.

Good housekeeping is the best prevention of mould and insect damage to paper. Do not store paper of value in damp and/or dirty places such as garages and basements. Hot, dry environments such as attics should also be avoided.

To prevent mechanical damage—and soiling as well—remember the following:

- Use clean hands to handle books and pictures.
- When lifting works on paper, use two hands to keep from bending, creasing, or tearing them.
- Unmatted pictures should never be stacked directly on top of each other but should be separated by a smooth, nonacid cover tissue.
- Be careful not to touch or drag anything across the surface of a picture. Charcoal or pastel drawings, silkscreen prints, and photographs are particularly vulnerable to surface damage.
- Open a mat by the outer edge, *not* by inserting a finger through the window and lifting the inner edge.
- Store works in mats or folders flat in metal drawers or special solander boxes.

Exposing the cellulose fibres of paper to acid speeds their discolouration, embrittlement, and eventual destruction. Some paper is acid because of its method of manufacture. Symptoms of acid deterioration are yellowing and brittleness. Measuring the degree of acidity, removing it (deacidification), and stabilizing (buffering) such papers are the tasks of professional paper conservators.

Most—though far from all—works of art, photographs, and any papers more than a hundred years old are not extremely acidic in themselves. However, proper framing, matting, and storage materials are extremely important: probably more works on paper have been damaged from being mounted and/or stored next to highly acid woods, cardboards, and cheap paper products than through inherent acidity. Inappropriate adhesives such as Scotch tape, masking tape, and rubber cement also produce unsightly stains that are very difficult to remove.

In addition, many collectors believe that once a work on paper has been commercially framed, it is safe forever. Unfortunately, this is seldom true. Many commercial framers, from lack of knowledge, negligence, or economy—sometimes due to consumer pressure to keep costs down—do not use proper materials. However attractive the final result, it's what is next to the paper that counts in providing a safe environment for valuable works. Consumers must insist that framers use archival, acid-free mat boards and paper hinges with water-soluble adhesives for adhering works to the mat rather than pressure-sensitive tapes (that means no Scotch, masking or magic mending tape).

It may be safest and most economical in the long run for collectors to buy a proven brand of acid-free board and take it to a frame shop for cutting than to rely on framers' own statements about the quality of their materials. This point cannot be stressed strongly enough, as works on paper kept in acidic mounts can absorb corrosive chemicals from cheap boards and discolour.

There are several other points to remember. First, never allow a framer to dry-mount or paste a work solidly down on a board; rather, it should hang freely from hinges at the top so that it can expand and contract freely with changes in atmospheric conditions. Also, the margins of a work should never be trimmed. To do so may damage its esthetic value, destroy evidence of authenticity, and diminish its monetary value.

Fortunately, prodding by conservators has begun to affect the custom framing industry. *Framer*, a trade journal, recently published a release form warning owners of the consequences of poor matting: "I (we) the undersigned having declined the recommendations of (the framer) concerning the proper framing of this piece of art to Museum Standards, do agree to release

Common causes of damage to paper: insect and mould injury *(left)* and discolouration from use of pressure-sensitive tapes *(right)*.

said gallery from any and all responsibility for any and all damage that may result from improper framing." Thus consumers as well as framers need to be knowledgeable about proper methods and materials.

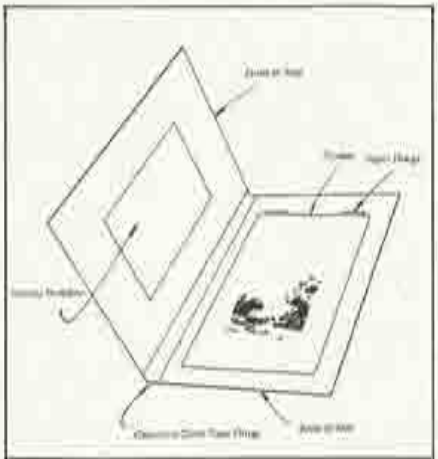
Basic matting and framing can even be done at home, given proper materials and some practice. The basic window mat consists simply of two pieces of mat board hinged together with a strip of gummed cloth tape. The essential tools for cutting a mat opening are a straightedge made of tough material, a Stanley knife, museum-quality mat board and a cardboard cutting surface. Do not try to cut through the board in one stroke. Use a light, even pressure and concentrate on keeping the angle of the knife constant. At first, three or four strokes may be necessary to cut through a four-ply thickness, but after some practice only two will be needed, one to make an initial scoring and another, firmer cut to finish. The knife should be held at an angle to make a bevelled edge around the opening; the bevelled edge will be sharp and should be lightly sanded with fine sandpaper to prevent possible damage to the picture.

Hold the picture in position in the mat by attaching it to the backboard with two hinges affixed to the upper edge of the reverse side of the picture. Never paste the corners of a picture directly to the backboard. Good quality gummed paper can be used. It may be cut in strips 1.5 cm wide, of whatever length is demanded by the size and weight of the picture to be supported. The strips are folded in half and applied first to the picture and then to the backboard. After attaching the hinges, cover them with blotting paper held down by a light weight for a few hours until they are dry.

When framing, never place a work directly against the glass, since glass easily condenses moisture and may cause mould growth. There is also a chance that the surface of the picture will stick to the glass. Plexiglass may also be used, it is unbreakable and is available with colourless additives that filter out harmful ultraviolet light. However, do not use it on charcoal or pastel drawings whose pigment particles may come away because of electrostatic attraction.

To protect a work from dust and dirt, use fluted plastic backing sheets. Seal the gap between the backboard and the frame with gummed wrapping tape. Last, when cleaning a framed picture, never spray the cleaning solution directly onto the surface of the glass, as the liquid may run down inside the frame. Apply the cleaner to the cloth instead.

Works on paper in North American galleries are normally matted in four standard dimensions: 35.5 x 46 cm (14" x 18"); 40.5 x 54.5 cm (16" x 21½"); 56 x 71 cm (22" x 28"); and 71 x 91.5 cm (28" x 36"). These can be stored in special acid-free boxes and folders made to accommodate these sizes and the same frames can be reused when selected works are displayed. Even if it is impossible for private owners to mat everything in their collections, all works should be stored flat in acid-free folders or interleaved with acid-free tissue paper in solander boxes (first choice) or enamelled metal map cabinets. Do not use wood, cardboard, or cheap paper containers.



The basic picture mat

Once works are properly framed, care must be taken in where and how they are displayed. Light speeds the deterioration of paper and fades impermanent colourants in watercolours, prints, felt-pen drawings, and colour photographs. While there must be enough light to see colours, an excess should be avoided. An optimum amount is 50 lux (five footcandles), which corresponds roughly to the output of a reading lamp at a distance of about one metre. Daylight illumination and fluorescent lights contain harmful ultraviolet rays and should be avoided.

Heat as well as light hastens deterioration of paper. Do not hang pictures over a radiator, heating register, or air duct (such locations also tend to be dusty). The enticing spot over the fireplace is doubly bad because of soot as well as heat and dirt.

A good policy is to change items on display every three to six months. This is easier to do if standard mat and frame sizes are used, and fragile works can spend half to three-quarters of their time in safe storage. If these measures seem troublesome, it is well to remember that with the soaring dollar values of many types of paper collectables and art works, the efforts required to protect an investment will be well worth while. **B.K.** ■

Where to get materials

Mat Board
An acid-free all-rag matting board of high quality, made expressly to National Gallery of Canada specifications, is called HARUMI board. It can be purchased from:
Buntin Gillies and Company Limited, 2730 Lancaster Road, Ottawa, Ontario. K1B 4S4.
Telephone: (613) 733-9006 Attention: Mr. J.S. Crawford

Gummed Linen Tape
A white linen tape with water-soluble gum on reverse. pH approximately neutral. For hinging mats.
Grameguild Mouldings, Toronto, Artistic Woodwork, Toronto.

Fluted Plastic Backing Sheets used in framing
Artistic Woodwork Co. Limited, 991 St. Vital Blvd., Montreal 459, Quebec. (Also in Toronto and Vancouver).

Interleaving tissue paper
Process Materials Corporation, 329 Veterans Boulevard, Carlstadt, New Jersey, 07072, U.S.A.

Acid-Free Folders and Envelopes for Storage
The Hollinger Corporation, 3810 South Four Mile Run Drive, Arlington, Virginia, 22206, U.S.A.

For further information:
The Care of Prints and Drawings with notes on matting, framing and storage, available free of charge from Restoration and Conservation Laboratory, National Gallery of Canada, Ottawa. K1A 0M8.
How to Care for Works of Art on Paper, by Francis W. Dolloff and Roy L. Perkinson, Museum of Fine Arts, Boston, Massachusetts. ■

Publications Available from The Heritage Canada Foundation

E — English
F — French
* — Indicates members' price
H.C. — Heritage Canada

AREA CONSERVATION

The Heritage Area Conservation Program of Heritage Canada, H.C. Ottawa, photocopy, 11 pages, free, E, F.
This is the statement of Heritage Canada's policy on area conservation. A copy of this is the prerequisite for any organization thinking of approaching Heritage Canada for help in setting up a conservation area. Students researching the subject will find this paper useful; anyone interested in the subject will find it informative.

Sheppard, Burt and Associates and Arends and Associates *St. John's Heritage Conservation Area Study: A Report on the Feasibility and Desirability of Establishing a Heritage Conservation Area in St. John's Newfoundland*, Newfoundland Historic Trust, St. John's, December 1976, maps, graphs and photos; paper, 217 pages, $7.00, E.
This feasibility study, well written and profusely illustrated, contains all the facts about the St. John's conservation area. It can, and has been used as a model for other studies. The St. John's Study is of value to planners, students and researchers.

Stephen Square: A Design Concept for an Historical District in Calgary, Society for the Preservation of Architectural Resources in Calgary and Heritage Canada, Calgary, October 1978, maps, line drawings, photos; paper, 108 pages, $5.00, E.
This well researched study presents proposals for the preservation of Calgary's downtown core.

Thompson, William et al, *Winnipeg's Historic Warehouse Area: Its Revitalization Through Conservation*, Manitoba Historical Society, Winnipeg, May 1976, maps, photos, building plans; paper, 112 pages, $6.00, $5.00*, E.
This study is intended to compliment the City Planning Department's *Historic Winnipeg Preservation Study*. It is a must for those researching the Winnipeg conservation area.

BIBLIOGRAPHIC

Richardson, Douglas (ed.) *Architecture in Ontario: A select Bibliography on Architectural Conservation and the History of Architecture with Special Reference to the Province of Ontario*, Heritage Administration Branch, Government of Ontario, Toronto, August 1976, paper, 140 pages, $3.50, $2.50*, E.
This unannotated bibliography was prepared for the symposium "New Life for Old Buildings" jointly sponsored by: The Frontenac Historic Foundation, Heritage Canada, and the Ontario Heritage Foundation, held in Kingston, Ontario during September of 1976. Because it ranges beyond the architecture of Ontario, it is useful for those researching other areas of Canada.

Bimonthly Indices (formerly *Quarterly/Newsletter Indices*) 1974 — H.C., Ottawa; paper, paging varies with index, $1.50, E, F.
Until 1978 a detailed index was prepared for the issues of *Heritage Canada* and *Heritage Conversation* (publication discontinued after Winter 1978). The English version of the index for any year is of the English sections of the magazine, and the French for the French sections. An order is filled by shipping both for any specific year if available. The latest English index is 1977; the latest French is 1976.
These indices are valuable for libraries, and anyone wishing to check a specific reference in one of Heritage Canada's magazines.

DO-IT-YOURSELF

Phillips, R.A.J. *Moving and Erection of Log Buildings*, H.C., Ottawa, November 1976, photocopy, 18 pages/*The Re-Use of Log Structures*, H.C., Ottawa, September 1977, photocopy, 9 pages, $.60, E.
These papers by R.A.J. Phillips are based on his experience with moving and assembling log structures on his property in Quebec. They are anecdotal in nature but contain some useful information for the log building afficionado who wants to save a piece of rustic heritage. These papers are sold as a single publication.

McGregor, James and Richard Morrison, *Renovating Your House*, Le/Conseil de Developpement du Logement Communautaire, Montreal, 2nd rev. ed., 1977, illus.; paper, 40 pages, $1.50, $1.00*, F, E.
If you are hiring an architect, the information contained here will help the two of you to communicate. If you want to do it yourself but don't have the basic knowledge, this book gives an outline and also provides a short bibliography and a list of useful contacts.

GENERAL

Denhez, Marc *Heritage Fights Back*, H.C. and Fitzhenry and Whiteside, Ottawa and Toronto, 1978, illustrated, index; paper, 286 pages, $9.95, E.
This is an overview of the techniques used by Canadians to protect the buildings and neighbourhoods which represent Canada's architectural heritage. It is a valuable handbook containing an introduction to Canadian heritage legislation, tax rules, building codes, and financial support. It includes a survey of the criteria used to determine a heritage building, and emphasizes public participation and its techniques.

HERITAGE CANADA

Bylaws of Heritage Canada, revised edition, photocopy, $1.00, Free*, F, E.

Annual Report, paper, $.75, Free* (one copy only), F, E.
All yearly reports are still available.

Weston, Julia "Heritage Canada has a new face", *Habitat*, Ottawa, offprint, Free, E.
New directions for Heritage Canada, including an extensive education program, formulated by Jacques Dalibard.

The Papineau Chapel: Heritage Canada Property Series no. 1, H.C., Ottawa, 1975, paper, 8 pages, $1.00, $.60*, F, E.
The history of the Papineau Chapel, Heritage Canada's first acquisition, donated by the Papineau family.

LEGISLATION

Denhez, Marc *Protecting the Built Environment, Part I*, H.C. Ottawa, second ed., 1978, includes summary, charts; paper, 24 pages, $3.00, $2.00*, E.
The subtitle of this report, "A Survey of Legal Techniques at the International and National Level for the Protection of Architecture and Historic Sites" describes its contents. Both parts of the *Built Environment* will constitute a new edition of Heritage Canada's legislation series. Part II, when published, will discuss the law at

provincial (or territorial) and municipal levels, as well as covering private contracts for the protection of property. Part I, a must for anyone studying Canada's heritage legislation, helps to put it in an international and national context.

SYMPOSIA

Fraser, Mary (ed.) *New Life for Old Buildings: Proceedings of the Symposium at Kingston, Ontario, 9, 10, 11 September 1976*, Frontenac Historic Foundation, H.C., Ontario Heritage Foundation, Toronto, paper, 102 pages, $3.50, E.

This symposium was organized to provide "information, ideas and suggestions which those already converted to the movement could use to increase public understanding and support for conservation in their own communities." This volume consists of reports of the workshop discussions and précis of the papers delivered.

Laidler, K.J. (ed.) *Preserving the Canadian Heritage: October 7-8, 1975*, Royal Society, Ottawa, paper, 188 pages, $7.00, $4.00*, E.

This symposium attempted to survey all aspects of heritage — historical, technical, visual, native. Through these collected papers, it provides an introduction to the subject "heritage".

Recycling Industrial Buildings for Residential Use: Proceedings of the Heritage Canada Symposium Held October 18, 19, 1976, H.C. Ottawa, 1977, photocopy, 73 pages, $3.00, $2.00*, E.

The facts and figures of adaptive re-use presented in the words of several experts in the field (Dr. J.M. Hengeveld of the Netherlands, Claude Gagnon, Montreal, Jack Diamond, Toronto, et al). Useful, particularly for potential developers, and researchers (including university students) and of interest to anyone wishing information on the subject.

A.J. Diamond Associates, *The Conversion of Industrial Buildings: Feasibility and Practice: A Study prepared for the Heritage Canada Symposium, October 18, 19, 1976*, Diamond Associates, Toronto, 1976, paper, unpaginated, $6.00, $5.00*, E.

As stated in the title, this document was prepared for use at the October '76 symposium. More facts and figures with some charts and line drawings. Useful to the same group.

TECHNICAL

Weaver, Martin "Still in doubt about removing old paint? Read on", "Blast it?", *Heritage Canada*, February and May, 1979, Ottawa, offprint, $.50, E.

Technical notes, including illustrations, about how to remove paint, why masonry should not be sandblasted and appropriate cleaning methods.

UP THE STREETS . . .

Phillips, R.A.J. *Up the Streets of Ontario*, H.C., Ottawa, 1976, sketches; paper, 32 pages, $1.00, $.75*, E, F. (photocopie)

A layman's guide to the architecture of Ontario

Phillips, R.A.J. and Alan Gowans, *Up the Streets of British Columbia*, H.C., Ottawa, 1978, sketches; paper, 32 pages, $1.00, $.75*, E.

Professor Gowans adapted Mr. Phillips' Ontario study for British Columbia.

Recent Publications

Benn, Bruce and Deepak Kamra, Marc Denhez (ed.) *How to Plan for Renovations: Canadian Case Studies*, Heritage Canada, Ottawa, paper, 137 pages, $2.75, E.

This book takes the reader through the renovation process in easy-to-follow stages. Readers may find the most useful part of the book is the cost breakdowns for nearly forty actual jobs. The figures can be used as a "cost yardstick" in planning renovations.

Downs/Archambault, Architects, *Park Site 19: a Feasibility Study*, Heritage Canada, Vancouver, paper, 50 pages, $5.00, E.

This study was commissioned to develop a new park concept. By retaining many of the original structures, and combining them with public open space and community services, Vancouver's West End can have the first "Live in Park".