The Griffin

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HERITAGE RESTORATION SEMINAR -- JUNE 16, 1990

Heritage Starts at Home

The following articles have been reprinted with permission from various issues of the Heritage Canada magazine Canadian Heritage. We hope the selected topics will be useful to those who are embarking on a restoration project.

We thank the Nova Scotia Museum for printing this special edition of The Griffin.

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Complying with codes

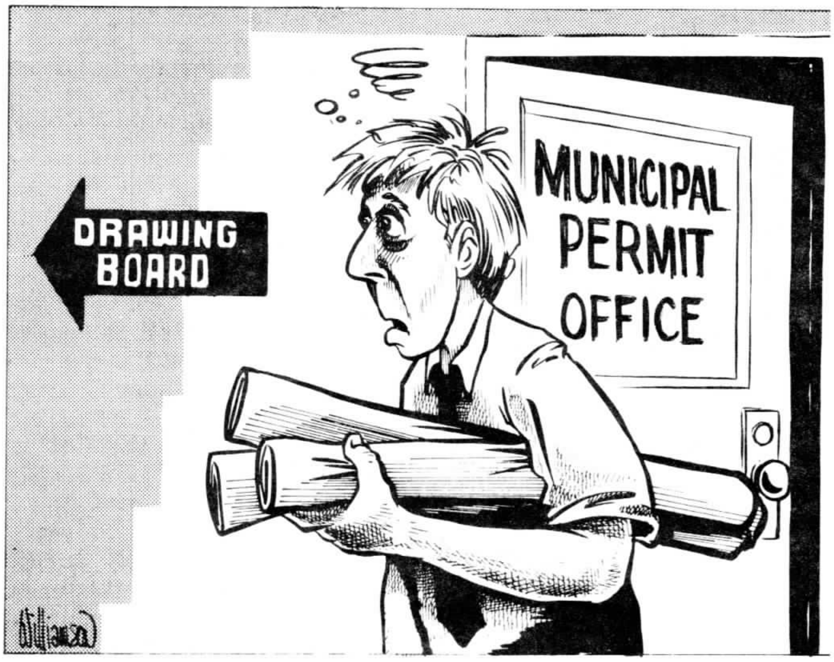
Q – I'd like to renovate my heritage home, but I'm afraid to face the inevitable hassle of dealing with the building code inspectors. What can I do to minimize my expected pain?

P.N.
Ottawa, Ontario

A – It's an all-too-familiar scene in municipal permit offices: The owner of a heritage home, elaborate renovation plans in hand, stands dumbfounded at the news that basic code requirements have been ignored and it's back to the drawing board. Such pain, however, is not inevitable. Planning and building inspectors are increasingly prepared to offer advice before plans are drawn, and in Ontario they can now allow alternative compliance methods that were previously off limits. Says Ottawa planning inspector Neil Dillon: "We prefer to discuss a project before drawings are complete. We can familiarize people with zoning and code requirements before they hire a draftsman."

Copies of the National Building Code are available for $19 (make cheque or money order payable to the National Research Council) from: Publications Section, Building R88, National Research Council, Ottawa, Ontario. For information on compliance alternatives, contact: Robert Kearney, Secretary, Associate Committee on the National Building Code, Building Research Division, Montreal Road, Ottawa, Ontario K1A OR6.

Gail Sussman/Ken Desson



Product/Tip: Insul-Aid

If your building has no vapour barrier and if a fine interior prevents you cutting into the walls to install the normal polyethylene membrane, this latex product may be painted on interior walls. It makes a good alternative in heritage homes or historic house museums with their accompanying high humidity levels. Having a low permeability rating of 0.6, Insul-Aid prevents water vapour from moving through the wall to a cold zone where it condenses. The resultant moisture will damage the insulation, the wall, and any paint on interior or exterior surfaces. Insul-Aid can also be used on ceilings.

This product is easy to use. Apply it as a primer for wallboard or plaster, or over previously-painted surfaces. Cover it with a finish coat of alkyd or latex paint.

Check the insulation in your attic now. If you have no vapour barrier and you detect condensation, this product may offer a solution. It should, however, be applied only if you do not have a vapour barrier in place.

Insul-Aid, manufactured by the Glidden Company can be purchased at your local building supply store. Price: approximately $25.00/4 litres.

– G.S.

KEEPING IT TOGETHER

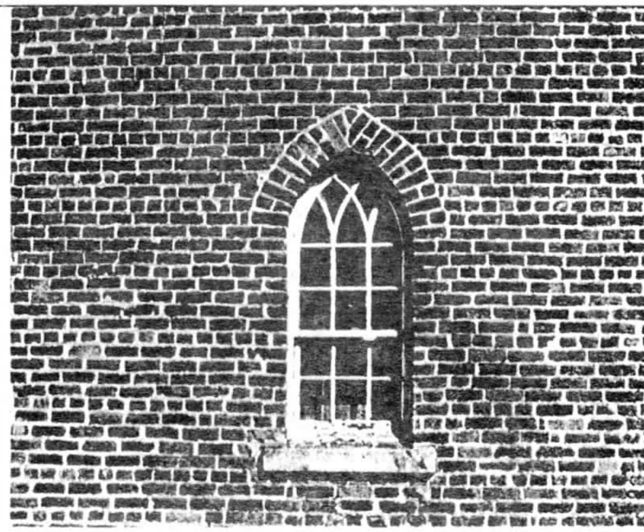
Mortars in old buildings.

When we look at an old stone or brick wall, among the first things we notice are the joints between the masonry units. Bricks and stones are laid in mortar and so arranged and overlapped that the wall is strong and resistant to weathering. The various ways of arranging bricks or stones to provide single or double skins or simply to provide strength and durability are collectively termed "bonds" or "bonding" and "coursing."

Certain bonds and coursing patterns and the profiles of the joints are characteristic of the masonry of specific periods and regions. A series of typical Canadian masonry bonds and the profiles of the pointing are illustrated in this article.

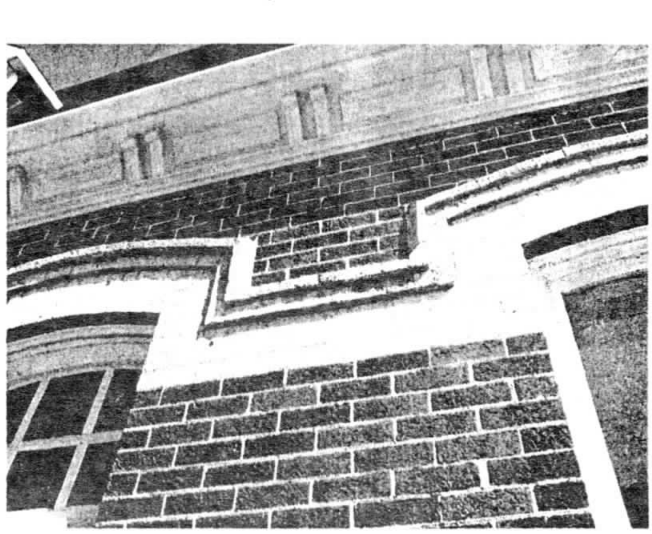
The actual appearance of the joint itself is determined by its colour, texture, and profile. Colour and texture are controlled by the mortar material used in the joint, while the profile depends on a number of other factors such as the need to waterproof the joints and a desire on the part of the builder or the designer to produce decorative effects.

What we actually see in the joint in old masonry is frequently not the mortar in which the bricks or stones are set or bedded, but a secondary application of mortar known as "pointing". (It may sometimes also be incorrectly termed "tuck-pointing" — see below). The derivation of the term "pointing" is obscure but one may speculate that the neat finishing of the mortar in the joints was usually executed with the point of a trowel or some other pointed tool.



Photographs by Martin Weaver and Richard O. Byrne

American bond with flush joint; Halifax, Nova Scotia ca. 1830-40.



Stretcher or common bond with bastard tuck or beaded joint. Kingston, Ontario ca. 1830.

In some cases the external appearance of the masonry was "improved" when, for example, inferior brickwork was "tuck-pointed" and made to resemble higher quality work. English brickmasons used the term "tuck-pointing" in the 18th and 19th centuries specifically to describe a joint where, following normal pointing, a second fine fillet or bead of pointing was tucked into a raked slot in the first layer of pointing. This gave the appearance of a finer, slightly raised joint particularly when paint was used to colour in the coarse joint up to the fine line of the second pointing. Tuck-pointing was frequently replaced by "bastard tuck-pointing" when the expensive double pointing was reduced to one operation carried out with a single slotted pointing tool. At a superficial glance the results looked similar.

In some cases, hand-made or irregular machine-made bricks were laid roughly and then the exterior wall face was painted and fine lines were painted-on in a contrasting colour to create an illusion of finely laid brickwork. This process was known as "striping" and "stripers" as tradesmen could be found in Canadian city and trade directories until the 1920s. A striped or painted-on joint pattern could very well be the authentic finish for an historic building and because of the intensive handwork required can be very expensive to reproduce today.

Mortar in old buildings can be characterized by three main ingredients: lime, aggregate (sand of varying grain sizes, forms and colours), and hydraulic elements (which may or may not be present). (See below for more information on mortar materials.) Some historical Canadian mortar mixes are:

*"two measures fresh well burnt lime to five measures of sand" (The Parliamentary Library Buildings barrack Hill, City of Ottawa, July 1870);

*1 part lime: 2.2 parts sand; mid-18th century mortar, Redoute Dauphine, Artillery Park, Quebec.

*1 part lime: 2 parts sand; Halifax Citadel, N.S. early 19th century;

*1 part lime; 2 parts sand; Lower Fort Garry, Manitoba ca. 1831-39.

In the 1870 specifications of the mortar for the Parliamentary Library Buildings, the lime was described as being "best fresh burnt brown lime" to be mixed with three parts of "clean sharp pit sand, and the whole to be properly mixed together dry, and a sufficient quantity of water being added, the whole to be ground under edge runners or in pug-mills". The specified pointing mortar was different and was "to be composed of one part best brown lime, one part sharp forge ashes, and one part iron scales mixed and ground under the edge runner to a fine paste as required for immediate use". The possible final appearance of such mixes often leaves the modern restoration architect in a dilemma. One has no idea of the colour of "best brown lime", let alone a mixture of this with forge ashes and iron scales. The resultant mix could range from grey to black or brown. As a further problem the specification makes no reference to the profile of the pointing.

While historic mortar mixes may be established by modern analyses (*see notes*) it is often academic and even inadvisable to use such mixes in repointing or repairing masonry which has sur-

Severely damaged English bond brickwork, George Island, Halifax, N.S. ca. 1886. Note how mortar is standing up to ice damage better than the bricks.

	INTERNAL WALLS	EXTERNAL WALLS: Sheltered Exposure	EXTERNAL WALLS: Moderate Exposure	EXTERNAL WALLS: Severe or Marine Exposure	PAVING	
HIGHLY DURABLE EG: Granite Basalt Fully vitrified	v vi vii	v vi	iv v	iii iv	ii iii	increase in durability and exposure
MODERATELY DURABLE EG: Many building limestones and sandstones Well-fired brick	v vi vii viii ix	v vi vii viii	iv v vi vii	iii iv v	iii iv	increase in durability and exposure
POORLY DURABLE EG: Some calcareous sandstones Some microporous limestone Underfired brick	vii viii ix x	vii viii ix	vi vii viii	v vi	v vi	increase in durability and exposure

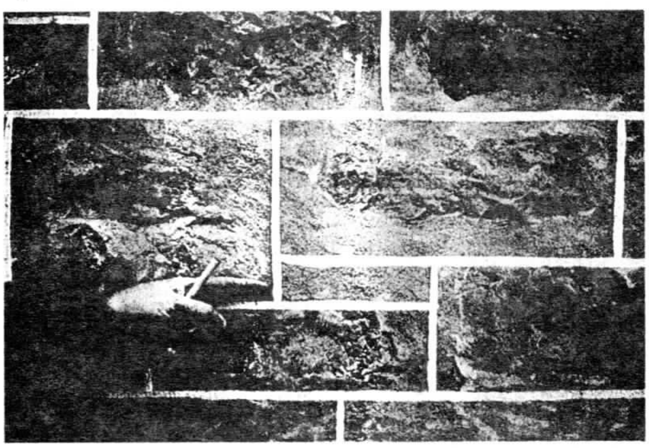
RECOMMENDED MORTAR MIXES
The numbers i to xi refer to mortar designations given in table of mortar types

CANADIAN MODERN CEMENT-LIME MORTARS ON THE BASIS OF COMPOSITION

	Parts by Volume of		
Designation of Mortar	Portland Cement	Hydrated Lime or Lime Putty	Aggregate, Measured in a Damp, Loose Condition
M	1	¼	for all mortars
S	1	over ¼ to ½	not less than 2¼
N	1	over ½ to 1¼	nor more than 3 x.
O	1	over 1¼ to 2½	the volumes of
K	1	over 2½ to 4	cement and lime

Sources: ASTM Specification C-270, CSA Standard 179M-1976

Stretcher or common bond with very narrow slightly concave joints. Halifax, N.S. ca. 1892. Note apalling disfigurement caused by silicone treatment.



"Striped" joints painted on over mortar in rough random ashlar stonework. Merrickville, Ontario ca. 1870.

Poor feather-edge repointing in brittle cement and sand mortar cracks away to reveal original lime mortar in very narrow joint. Quebec City Original ca. 1830.

vived the ravages of time and the environment in a weakened or deteriorated condition.

Mortar and pointing mixes for the repair and maintenance of old masonry are described in the accompanying tables which are derived from similar tables prepared by J. Ashurst in 1979.

The final appearance of the selected modern mix can be adjusted to match the original by careful selection of aggregate particle sizes, configurations, and colours — possibly assisted by the addition of permanent mortar colours. Original aggregate particle size distributions can be matched by sieve analysis. Aggregate particle forms or configurations and colours are conveniently matched by examination of original particles under a binocular microscope at a magnification of between X20 and X40. Good overall colour and texture matches can be achieved by using Morgan W. Phillips' method (1978) (*see sources.*) A basic principle to keep in mind is that the mortar should not be stronger than the stone, brick, or terracotta with which it is used.

There has for many years been a tendency among contractors, tradesmen, and laymen to assume that a hard inflexible mortar such as that produced by mixtures of Portland Cement and sand will produce a durable mortar. This is not the case for work on old buildings. The addition of lime to mortars increases their flexibility, reduces damage to masonry units, and thus generally increases durability.

It is hoped that with these charts and explanations the reader will be able to select mortars for repairs and maintenance on Canada's old buildings. **Martin Weaver** ■

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Mortar materials and terminology

Confused by mortar materials and terminology? The Heritage Canada Foundation's Martin Weaver offers this primer:

ASTM: references such as "ASTM C595-76" refer to a standard of the American Society for Testing and Materials.

COMMON LINE: produced by burning relatively pure limestone ($CACO^3$ + clay compounds etc.) at less than 1000°C. The product slakes* when mixed with water and possesses no hydraulic** qualities.
There are three classes based on limestone composition:
High-calcium, less than 5% $MgCO^3$ (magnesium carbonate)
Magnesium, from 5% – 35% $MgCO^3$
Dolomitic, from 35% – 46% $MgCO^3$
(See: CSA Standard A82.42M-1978; A82.43M-1978)

CSA STANDARD: references such as "CSA Standard A179M-1976" refer to standards of the Canadian Standards Association.

HYDRAULIC**: the term hydraulic when applied to a mortar material signifies that mortar possesses the quality of setting under water to a greater or lesser degree depending on its composition i.e. a semi-hydraulic lime will not set completely under water whereas a hydraulic cement will.

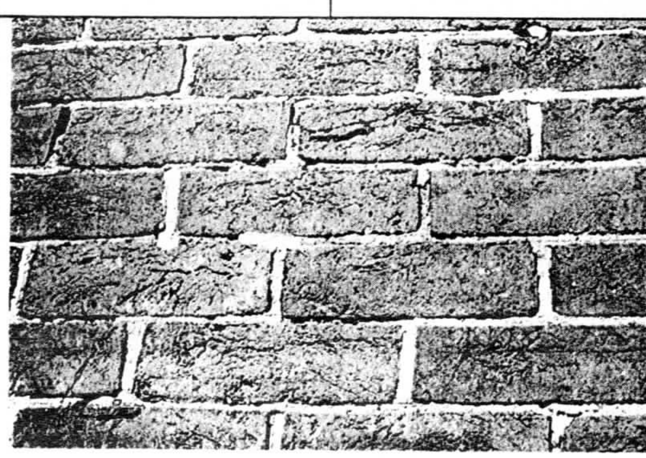
HYDRAULIC LIME: produced from burning slightly argillaceous (clay-like) limestone containing 16-26% silica and no more than 12% alumina, at temperature less than 1000°C. The product will slake slowly and is feebly hydraulic. Two classes: High calcium, less than 5% MgO (magnesium oxide) and Magnesium, more than 5% MgO.

MASONRY CEMENT: is a hydraulic cement for use in mortars, containing one or more of the following materials: portland cement, portland blast-furnace slag cement, portland-pozzolan cement, natural cement, slag cement, or hydraulic lime; and in addition usually containing one or more materials such as hydrated lime, limestone, chalk, calcareous shell, talc, slag, or clay, as prepared for this purpose.

NATURAL CEMENT: produced from burning distinctly argillaceous limestone at a temperature exceeding 1000°C. When ground the product has hydraulic qualities and like all true cements can not be slaked.

PORTLAND BLAST-FURNACE SLAG CEMENT: is a hydraulic cement consisting of an interground mixture of portland-cement clinker and granulated blast-furnace slag or an intimate and uniform blend of portland cement and fine granulated blast-furnace slag in which the amount of slag constituent is within specified limits (see ASTM C595-76).

PORTLAND CEMENT: produced by burning an artificial mixture of lime, silica, alumina, and iron components at temperatures of 1400°C – 1650°C. The resulting clinker is pulverized to give portland cement which possesses marked hydraulic and cementitious properties.



Stretcher or common bond with ruled joints. Kingston, Ontario late 19th century. Note damage to surface and pointing caused by sandblasting.

PORTLAND-POZZOLAN CEMENT: is a hydraulic cement consisting of an intimate and uniform blend of portland cement or portland blast-furnace slag cement and fine pozzolan produced by intergrinding portland cement clinker and pozzolan, or a combination of intergrinding and blending, in which the amount of the pozzolan constituent is within specified limits (see ASTM C595-76)

POZZOLAN: a volcanic material containing silica or a combination of silica and alumina, which in itself possesses little cementitious value but which will in pulverized form and in the presence of moisture chemically react with slaked lime (calcium hydroxide) at ordinary temperatures to form compounds possessing cementitious properties.

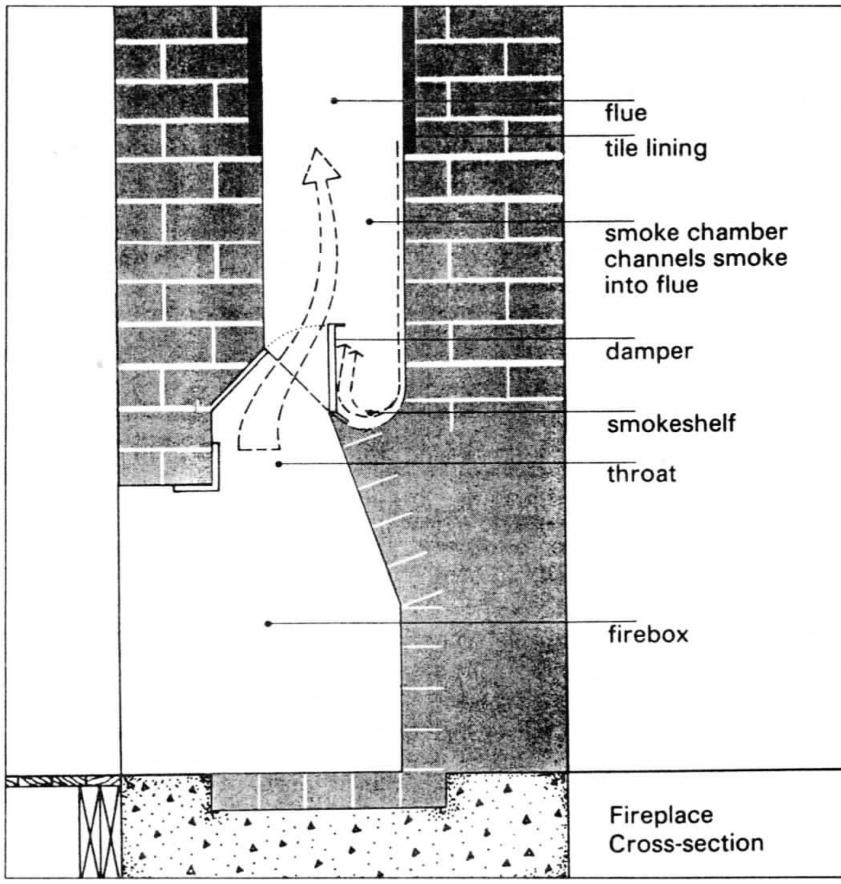
PULVERIZED FUEL ASH: also known as pulverized fly ash or P.F.A.; a finely divided pozzolanic material which may be combined with slaked lime and sand to produce mortars for use with less durable stones or bricks in sheltered environments.

SLAG CEMENT: produced from a blend of granulated blast furnace slag and hydrated lime in which the slag constituent is more than a specified minimum amount. (see ASTM C595-76)

SLAKING*: the process of adding water to calcium oxide (quicklime) to produce calcium hydroxide (slaked lime) producing considerable heat in this process of hydration. If the only water present after hydration or slaking is that which is chemically combined with the lime, the hydroxide or slaked lime is a dry powder. Hydrated lime is commercially manufactured and packaged in bags as a dry powder. The manufacture involves the careful calculation of the exact amount of water required to achieve hydration without adding too much and thus initiating carbonation. (see *Canadian Heritage*, "Nuts & Bolts", August/September 1981 p. 34-36).

The Chimney Check

If you plan to use your chimney this winter, it's wise to follow these safety precautions



The economic recession and the rising cost of fuel have caused many people to reconsider using a solid fuel such as wood in stoves and fireplaces. When using a fireplace it is important to understand how its components work. The fire's gentle crackle can quickly turn into a roaring chimney fire that might burn down your house. So before you light that match there are some safety precautions which should be considered.

Inspection

It is important to inspect the condition of your fireplace and chimney at the end of each heating season. The creosote buildup is easier to remove then and you will have the summer to make necessary repairs. If you did not inspect the chimney last spring, do it now.

The types of chimneys commonly found in buildings are unlined brick or stone masonry, masonry chimneys with liners, concrete block construction, prefabricated metal chimneys, and even ethnic chimneys built from wood lined with mud and cow dung. Although chimneys and flues are covered under section 9.2 of the National Building Code, they are frequently overlooked during an inspection.

Begin with the flue. Is it clear? If the chimney has not been used for years, check whether electrical wires and pipes have been run through the flue. If the flue is straight, a mirror held above the damper will pick up obstructions. To check a slanted flue, stuff a burlap bag with paper and weights and lower it by a strong rope. If there is a blockage, the length of the rope let out will indicate how far down it is. As the mortar deteriorates in unlined masonry chimneys, bricks may have fallen out and blocked the flue. Iron window weights suspended by a strong rope may be all that is necessary to break up the obstruction. In some cases it may be necessary to open up the chimney. This is a job for a mason.

To inspect the integrity of the flue, seal all known openings. Place a smoke bomb in the fireplace and note where the smoke escapes (the attic, interior, exterior). Smoke bombs are inexpensive and can be purchased from heating and airconditioning companies or hardware stores. Now you know where the cracks are.

Repairing the flue: It is possible to repair small cracks in a flue. Tightly stuff and weight a burlap bag so that it exactly fits the flue. Suspend the bag by a strong rope just below the crack. A fluid cement slurry poured down the chimney is then forced into the cracks by the upward movement of the bag.

Relining a Flue: A flue liner prevents the disintegration of the bricks and mortar by combustion gases. There are several methods to reline a flue:

Ceramic tile is the traditional liner used by masons. The tiles should be at least 5/8 inch thick and the joints filled with air-setting refractory mortar. It is difficult and expensive to reline a chimney with ceramic tile for often a large part of the chimney must be opened.

Galvanized steel is relatively inexpensive and should be considered a temporary measure. It can rust out in three years. One metre sections riveted together can be lowered from the top. The soupy concrete mixes which are poured around the galvanized pipe to stabilize it can shrink in curing. The cavities produced will trap moisture and in freeze-thaw cycles the expanding ice will damage the chimney.

Stainless steel liners must be used for gas furnaces. The exhaust gases will corrode ordinary metals. Stainless steel liners can be made in a sheet metal shop to fit straight flues. Metal liners stay warmer at the top resulting in less condensation. Retrofitted metal liners, however, reduce the cross section of the flue and thus can weaken the draft.

Poured liners, originally developed in England, are an easy way to line most straight or angled flues. An inflated rubber tube is placed down the flue. Concrete is then poured around the tube. When it cures, the tube is deflated and withdrawn. This results in a solid flue with no joints.

Prefabricated metal chimneys have standardized the installation process. Providing the detailed instructions are followed, there is less room for human error. Existing masonry chimneys vary considerably depending on the mason and the materials used. Thus some existing masonry chimneys do not meet the building code.

There are two types of metal chimneys: one piece continuous flexible steel and double-walled rigid units which are sold in sections. The flexible steel pipe has single wall construction. From a safety point of view there is nothing to come apart. Any space around the flexible unit is filled with vermiculite to reduce heat build-up in adjacent combustible areas.

The rigid units are six to eight inches round and three feet long. The two steel walls are separated by insulation. The sections are screwed or snapped together. Never install dented sections since they lower the insulating value.

Class A metal chimneys are certified to 1000°F for one half hour. Because chimney fires can reach temperatures of 2500°F, manufacturers are being pressured to increase the temperature ratings for metal chimneys.

Each fireplace and heating appliance requires its own flue. There is a danger when fireplaces and furnaces are used at the same time. The two units are competing for combustion air in air-tight homes that have vapour barriers, calking, and weather stripping. The furnace flue becomes the source of combustible air for the fireplace. Furnace fumes are drawn back down the flue and can asphyxiate residents. The solution is to supply air through a vent in the firebox. The mild disadvantage is that this accelerates the wood consumption.

Firebox: Check for any cracks in the firebox. The joints should be as small as possible. Point cracks with fireclay. Heat will erode portland cement within a year.

Damper: The damper prevents cold winds from coming down the chimney when the fire is not lit. Carefully check to see if the damper will move freely. It will be brittle from being repeatedly heated and cooled. Weathered mortar deposits, sand, and lime can accumulate on top of the damper. If the damper will not move, drill, as a last resort, a few 1/2 inch holes in it. A thin rod poked through the holes can wiggle deposits loose. Fill the holes with bolts and washers.

Floor joists: Check that no floor joists tie in to the chimney. A separation of at least two inches is required between the masonry and the joists. If beams must be supported by the chimney, the masonry must be at least 12 inches thick.

Stove pipes: Old openings in the chimney for stovepipes may only be covered with drywall. Brick them.

Exterior Inspection

Footings: The chimney should extend three feet above the roof and two feet above any projection within 10 feet of the chimney. This reduces eddies and downdrafts.

Efflorescence: This is a white powdery crust and it's a sign of wet bricks. Disintegration of masonry near the top is not always caused by a faulty cap. Warm, moist air escaping from a faulty joint in the liner can condense under the cap and wet the brick. Seal the joint. The moisture will damage the bricks in a freeze-thaw cycle.

Flashing: A saddle flashing is necessary to deflect rain and snow away from the chimney. The flashing should be properly tucked into the chimney's face.

Mortar: Cracks in the mortar will appear dark from escaping smoke. Probe the mortar to see if it flakes, crumbles, or breaks away in chunks. Repoint small cracks. The mortar must be specially prepared to expand and contract as the chimney heats and cools. A recommended recipe is one part portland cement, one part hydrated lime, and six parts clean sand. Carefully remove the old mortar with a cold chisel to a depth of one inch. Apply the new mortar with a trowel. Smooth off excess, smooth and point with a finishing tool, taking care not to leave "feather edges" of mortar spread over the edges of the bricks or stones.

Cap: Check that the chimney cap is sound. It prevents downdrafts and moisture penetration into the masonry walls of the chimney. The cap should extend beyond the chimney by two inches on all sides.

Leaning chimney: Moisture combined with the gases of combustion produce reactions which cause the mortar joints to expand on the windward (and therefore wetter) side of the chimney. If badly damaged, the chimney should be rebuilt from the roof line, using a liner to protect the mortar.

Fuel: Never use flammable liquids to start a fire. To limit the amount of creosote produced, burn only seasoned hardwood. Softwoods such as pine and spruce have more than a 50 per cent higher moisture content. More than 20 percent of the energy is consumed to evaporate the water before combustion can begin. This moisture condenses in the chimney.

A fireplace is not a safe method for the disposal of trash. Polyethylene wrappings and styrofoam vaporize before they burn, condense in the chimney, and can be ignited by sparks. Recycle newspapers rather than burn them in the fireplace. Large paper fires can send flames high up the flue easily igniting creosote and resulting in a chimney fire. Do not break man-made logs apart—they may explode. Be careful when burning coal and charcoal; they can produce lethal quantities of carbon monoxide.

There is a great deal of controversy over the chemicals that are advertised for preventing chimney fires. Sprinkling these powders on coals develops a false security that a chimney fire will not occur.

Chimney fires: Fires are the result of dirty chimneys. The flue becomes saturated with the hard, flaky, highly flammable tar residue called creosote. A spark can ignite it. Creosote moves from a gaseous to a liquid state at temperatures below 550°F. Deposits become quite heavy when the flue gas is cooled below 250°F. Excessive creosote is also produced when a fire is starved for oxygen. Hot fires should burn with the damper open.

If your chimney catches fire, call the fire department. Do not throw water on the flames. The steam produced could crack the flue liner. Throw rock salt on the floor of the fireplace and cover the opening with a wet blanket. Flare-type extinguishers thrown into the chimney also reduce the oxygen level.

The first chimney fire can cause tile linings to crack and mortar to melt or crumble. A second fire penetrates these openings and can ignite the rest of the house.

Cleaning the Chimney

Cleaning the chimney yourself is a fairly straightforward procedure. It can also save money. The average price charged by the many chimney sweep companies which have sprung up recently is $50.00. Assemble the following equipment:

Brushes: These can be purchased from a local building supply store or Canadian Tire for $15.00 to $20.00. Examine the quality and density of the brushes and quality of the wire. There are two types of brushes, exact fit and universal.

Exact fit brushes are stiff. They require a heavier weight to lower them into the chimney but require fewer strokes to clean the flue. Exact fit brushes are made of low grade round steel wire. They are easy to trim, cost little, do a good scraping job, but bend out of shape and rust easily.

Universal brushes are more flexible. They are made of flat wire steel, do an excellent job, last longer, are less likely to get stuck in the chimney, but are more expensive.

Protective equipment: A face mask and goggles are necessary to protect your lungs and eyes. Drop cloths, a tarp, and tape are needed to cover carpets and to seal the fireplace opening. Buckets, double paper grocery bags, and a broom are necessary to clean up the mess that will come down the chimney. Plastic garbage bags generally do not stand up to this use. An industrial or shop vacuum is more convenient.

Procedure: Protect floors and carpets with drop cloths. Seal the fireplace opening with the tarp.

Investigate the condition of the chimney before putting stress on it. Securely tie off a 28 foot extension ladder. On steeply pitched roofs use a safety line. Stand up wind to avoid soot blowing toward you. Lower the weights and brushes completely to the bottom of the chimney. Raise and lower the weights six to 10 times. Most of the accumulation of creosote will be near the top of the flue where it condensed.

Inside, remove the tarp from the fireplace and clean out the deposits that have fallen down the chimney. Do not forget to clean the smoke shelf. While you are still dirty remove the ashes from the clean-out trap. Clean yourself thoroughly. Skin cancer is a hazard for professional chimney sweeps.

ON THE ROOF

How to inspect and maintain it.

A roof is the first line of defense against water entering a building. The roof, along with its gutters, downspouts, and flashings drain water down and *away* from a structure. A simple concept but one that is often ignored until too late. Left to deteriorate, leaky roofs allow rot to develop throughout a structure and also allow masonry walls to suffer frost and other damage.

If a roof's gutter/downspout system is not designed and maintained well, water that has run off the roof may still enter the building either through foundation cracks or as rising damp. Hence it is important to have a well defined inspection and maintenance program to insure the structure is indeed shedding water.

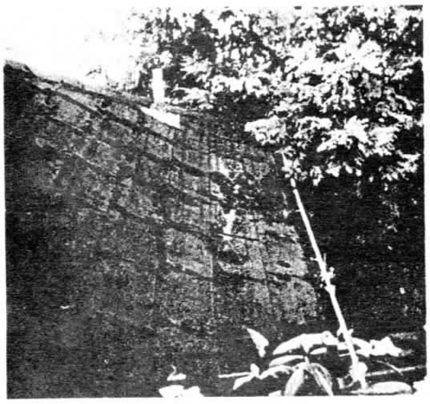
Inspections should always have a reason behind them. Regular inspections should be part of the maintenance of the building. Depending on the condition of the roof one may want a full inspection every 3 years for a new roof to every year for an older roof. Small mini-inspections may be needed after severe storms or in areas where many trees shed leaves and plug gutters. One may also need a full inspection prior to buying a building, or an inspection may be called for because a leak has been discovered.

Roof inspections should be of two kinds: ''wet'' and ''dry''. The wet inspection is the one often forgotten, yet it is the one that tests the whole roof system in terms of its ability to shed water.

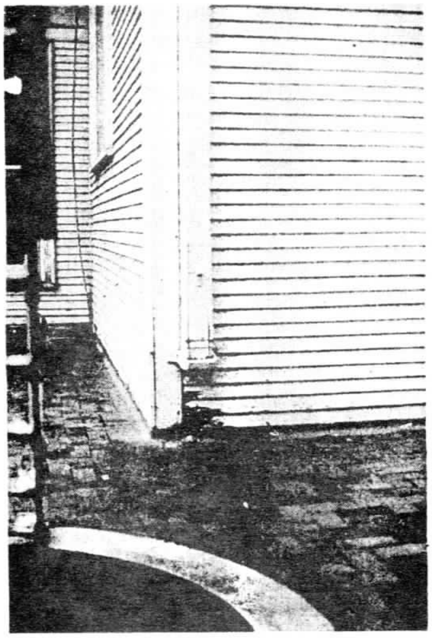
A wet inspection is normally carried out from the ground and in the attic. (Unless one has special safety equipment the average roof is too dangerous to climb on while wet). Points to observe are the following:

1. Are tree limbs banging against the roof in high winds? If so, they should be cut away.
2. Are the gutters spilling over? It may mean they are full of trash, set too low, or too small for the amount of water they have to carry. Proper gutter size can be determined using formulas that account for the area of the roof, and the expected levels of rainfall for a given geographic area.
3. Are roof areas flooding with excess water draining from other areas? One should inspect the underside of these areas more closely in the attic during the storm, and again when the roof is dry.
4. Check the downspouts to insure they function properly. Often downspouts are fixed to the building with clamps that cannot be opened. The result is the downspout is painted on its frontside, but never on its rear. Then the rear rusts through and floods the wall with water. The simple way to observe a leak like this is during a rain storm.

5. Check to insure the discharge from the downspouts, or roof drip, is drained away from the building. As houses age, soils build up near the foundations and change the intended drainage pattern. Leader pipes at the bottom of downspouts are also often mis-directed or knocked off or splash plates rendered useless, and water that once was carried away from the building now runs against it.
6. Observe the entire drainage pattern of the grounds to insure positive drainage is taking place.
7. Finally, while outside in the rain, look at the walls of the structure to see if water is flushing from the roof directly against them. This may be due to wind, bad design, or plugged gutters.
8. After making an external wet inspection of the roof system, go to the attic and inspect for damp spots and dripping water. Wear a hard hat to protect your head from overhead nails. With a good light look for old or new water stains and bracks of efflorescence on masonry. Use your sense of touch to feel suspect damp areas. Follow the dampness up to its highest point to determine its point of entry. Feel along walls and chimneys for dampness. Damp walls may indicate faulty flashing. Record where you find damp. To do this, take measurements so that the same spot can be located outside.



Heavy vegetation by and on the roof lead to rapid roof failure.



missing leader pipe has caused the corner of this house to rot.

These eight steps must be taken during a rain storm. Also keep in mind that roofs may leak under other conditions such as when snow is blown under shingles, or driving rain may enter areas that a straight downpour might not. There have been cases where one meter of snow blew into an attic under the gaps of a tile roof. The melting snow then caused extensive damage to plaster, paint and furnishings.

The "dry" inspection of a roofing system has to be approached with care. Roofs can be very dangerous and one must insure proper safety equipment and footing conditions are present. The best time to inspect a roof system is right after a rain when the roof surface is dry, yet soon enough that water may still be present where it shouldn't be. Never go on a wet, damp or frosted pitched roof. And watch out for wet spots caused by leaves or moss. Wear shoes with high traction soles.

Getting onto the roof is the first consideration once you think the roof is safe underfoot. If you use a ladder insure that it is not going to crush the leading edge of the roof or the gutter. The edge of the roof should never be damaged while climbing up to look for damage. Special brackets may have to be built to hold the ladder out and away from the gutter on the roof edge. Get someone to hold the bottom of the ladder or tie or stake it in place, and you may also have to secure it at the top.

Before climbing up the ladder go around the structure and look for signs of peeling paint and water stains under the soffit and along the fascia. These signs might tell you where leaks have developed. With your ladder properly secured, climb to the leading edge of the roof. Here one can look for the following:

1. Is the leading edge of the roof wet on its underside? A wet edge, or underside may indicate that a redesign of the roof's edge is needed. Perhaps a sheet metal drip edge needs to be installed.
2. Are there any signs of moss or fungi present? If there are, one must suspect excessive wetting.
3. Look at the gutters for ponding and for trash build-up. Trash should be cleaned out. Gutter screens should be considered with care in areas with many trees. One should also remember that though the screens keep trash out, they also make the gutters much more difficult to clean. Gutters can be flushed clean with a garden hose. This should be planned for on a regular basis depending on the amount of leaves in the area.

   Ponding in gutters may be caused by heavy snow and ice loads bending the gutters, or by ladders pushing the gutters down to the point where proper "fall" does not exist. If gutter ponding exists it should be corrected, or the life span of the gutters will be greatly shortened. Ponding also reduces the capacity of the gutter to carry water and may result in spill-over and damage to exterior walls.
4. Gutter joints should be inspected. Many modern "snap" together gutters are subject to opening up and leaking, while soldered gutters may show excess corrosion at their joints.
5. Downspouts should be lifted a couple of inches out from the structure from time to time and their backs should be inspected. This means having holding clamps that can be opened up. Unfortunately few houses have proper clamps on them. While the downspouts are free one should consider painting their backs if needed.

At this point in time one is ready to step onto the roof—well almost. A few considerations about safety and your footing.

1. The roof must be dry. This includes no frost.
2. You have high traction shoes on.
3. Proper life lines, safety harness, etc. are in place.
4. *Determine if the material you step on will break under your weight.* Ceramic tile and slate break very easily and must never be walked on without first putting duct boards down to distribute your weight. Wood shingles can be walked on under most circumstances but extreme cold can make them brittle. Asphalt shingles can be walked on except when they are very hot (they tear) or very cold (they shatter). Metal roofs can be walked on but can be very slippery even when dry. Common sense is your best guide plus caution with every step.

WHAT TO LOOK FOR

Knowing what to look for on a roof means knowing about the roofing materials. Let's start with wood shingles.

1. Look for moss growth, particularly under shady areas by trees where saps drip on a roof or where the roof never completely dries. Heavy moss build-up should be scraped off. Clean and then scrape the area with a strong solution of household laundry bleach and water. The area should be noted as a high maintenance area for the future with repeat cleaning and scrubbing needed.
2. Look for shingles that are pulling loose. Wooden shingles that have been laid too close together will pull themselves loose. This is because as a wet shingle swells it does not have enough expansion room and buckles-up pulling its nails with it. If severe enough the only remedy is to re-roof the structure.
3. Wooden shingles abrade over time until they are worn away. This is a natural process of wood fibres being eroded away by water, wind blown grit, and the breakdown of the wood's structure under intense sunlight.
4. Wooden shingles that do not have proper lap may leak. Shingles that were lapped correctly may not work later if they crack directly over a gap below. This can happen in two common ways; one, from people walking on the roof; or two, from excessive shrinkage of the shingle. The stress across a shrinking shingle held rigid by two nails may be too great and the shingle may crack. This should be looked for in very wide wooden shingles (20 to 35 cm) that have the greatest amount of expansion/contraction to contend with.

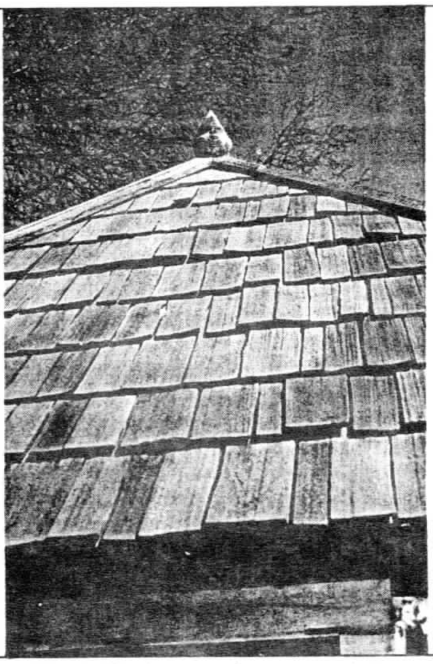
The next common problem area to look at is roof nails.

1. Slates may let go and fall if the nails holding them in place rust through. Hence if one slate is loose look for others that are ready to slide off because of rusted nails.
2. Copper roofs and gutters are often badly repaired, (and sometimes constructed) with iron nails. When this happens rapid rusting of the nail occurs due to the cathodic protection principle of metals. Look for rust stains bleeding down the roof. It may mean your copper roof or flashings will be breaking loose soon.
3. Nails that poke through into the attic act as cold sinks that condense moisture and hasten the nails' corrosion.

Slate roofs have a very long life span. Common problems to look for are:

1. Rusting nails.
2. Spalling and flaking of the slate due to frost damage.
3. Broken slates caused either by careless workmen or their being struck by tree limbs etc.
4. Check the flashing with extra care on all slate roofs as the slates may well outlive the metals used.

There are relatively few ceramic tile roofs in Canada. If faced with inspecting such a roof, look for frost damage and cracking similar to that found in slate roofs. Because ceramic tiles allow considerable air flow under them, one should randomly lift a few tiles to see if wet dirt has piled up under any of them. The wet dirt could start a fungal outbreak. Depending on the amount of dirt present, one may have to lift all the tiles and sweep the roof clean. Slate and tile roofs can both support lichen which in turn may give off acid substances that will etch and destroy metal flashings below.



Wood shingles must have space between them to allow proper expansion and contraction.

Loose slates indicate that roof nails are badly rusted. Major repairs are indicated.

Metal roofs have several unique problems besides corrosion. To discuss them all here is impossible. But briefly one should observe the following:

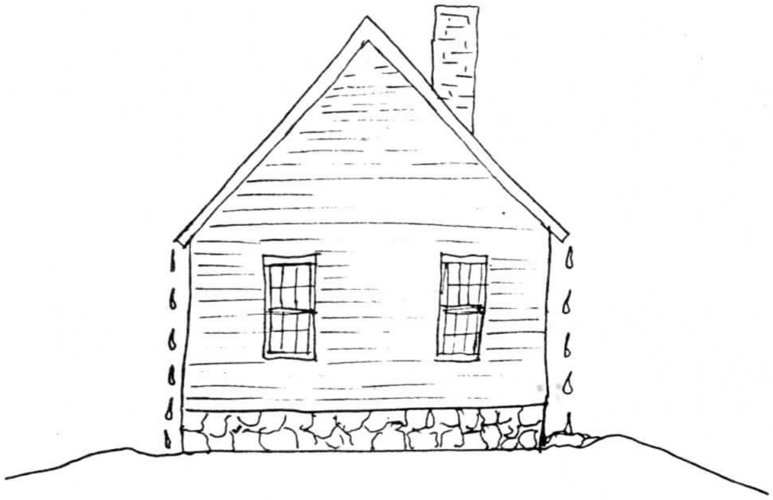
1. Look at the leading edges of metal where water can wick up on its underside (i.e. the edge of roofs). One will find the most extensive corrosion here as corrosion can penetrate from both sides.
2. Look at flashings with great care. What may appear to be sound metal in open exposed areas may not be sound up under shingles where moisture has collected and corrosion has developed.
3. Look for metal fatigue. Copper and sheet iron may turn brittle and crack following years of constant expansion/contraction in the hot sun and bitter cold.
4. Paint films on metals should be inspected with an eye to their renewal. It is best to renew them sooner than later. If you wait to the "later" end of when they need painting you risk the problem of extensive corrosion and the need for its removal before repainting.

Asphalt shingled roofs have several common problems.

1. General wear and abrasion. This will be greatest on the south and west side where the sun's heat has been the greatest.
2. Torn shingles from wind storms.
3. Mechanical damage from workmen on too hot or too cold roofs.
4. Abrasion from roosting birds, particularly pigeons.

On any roof one should closely inspect any place where TV towers, cable eyelets, lightning rods etc. puncture the roof surface and have been sealed with tar or other mastic. These are high risk areas where leaks often develop. Finally as you climb down from the roof remember your careful efforts by making a record of the conditions you found and determine when prudence would indicate the next general or local inspection. **Richard Byrne** ■

Richard Byrne is a member of the Heritage Canada Foundation's education department.



Drainage systems should drain water *from* the structure. Soil build-up could interfere.

Reference Shelf: Wallpaper

Where do you start if you want to research historic Canadian wallpaper? As with many other preservation subjects, you begin with American sources. In *At Home in Upper Canada* Jeanne Minhinnick says, "as yet no exhaustive study has been made of the fascinating papers which lined the rooms of Upper Canada." This is just as true now as it was in 1970 when Minhinnick's book appeared. In fact, the statement can be applied to all of Canada. What follows is a brief, annotated list of sources to consult on historic wallpapers.

Wallpaper in America: From the Seventeenth Century to World War I.
by Catherine Lynn, New York City: Barra Foundation, W.W. Norton and Company, 1980.

Lynn, who has also written under the name Catherine Lynn Frangiamore, is the most prolific writer on wallpaper in North America. *Americana* called this book ". . . the first comprehensive study of the subject in 50 years."

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

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

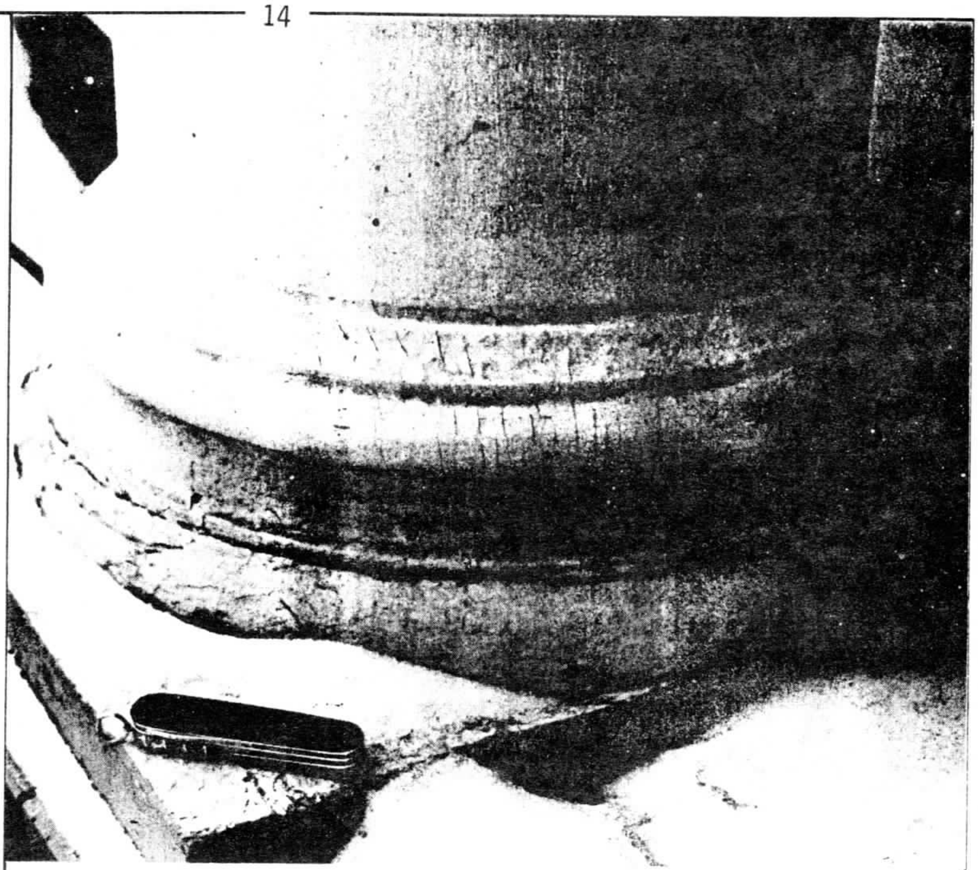
latest finishing coat. Alligatored paint should be removed to sound layers, sanded and repainted.
- Chalking describes the phenomenon of a powdery surface which rubs off on your hand. Such surfaces should be washed with water, dried, and then painted over.
- Dirt, soot and pollution should be removed 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.

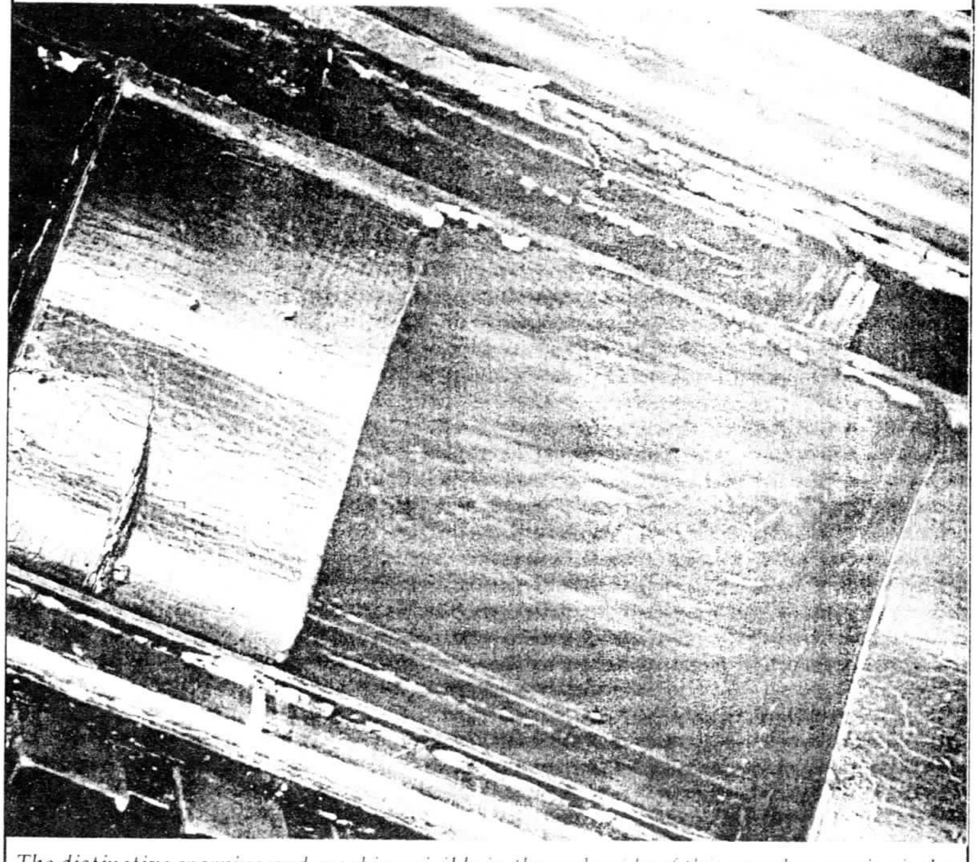
Paint removal techniques are of four basic types:
- softening and raising paint layers by applying heat;
- softening paint with chemical solvents or "strippers";
- paint removal using various types of abrasion;
- combination techniques using some or all of the above techniques.

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.

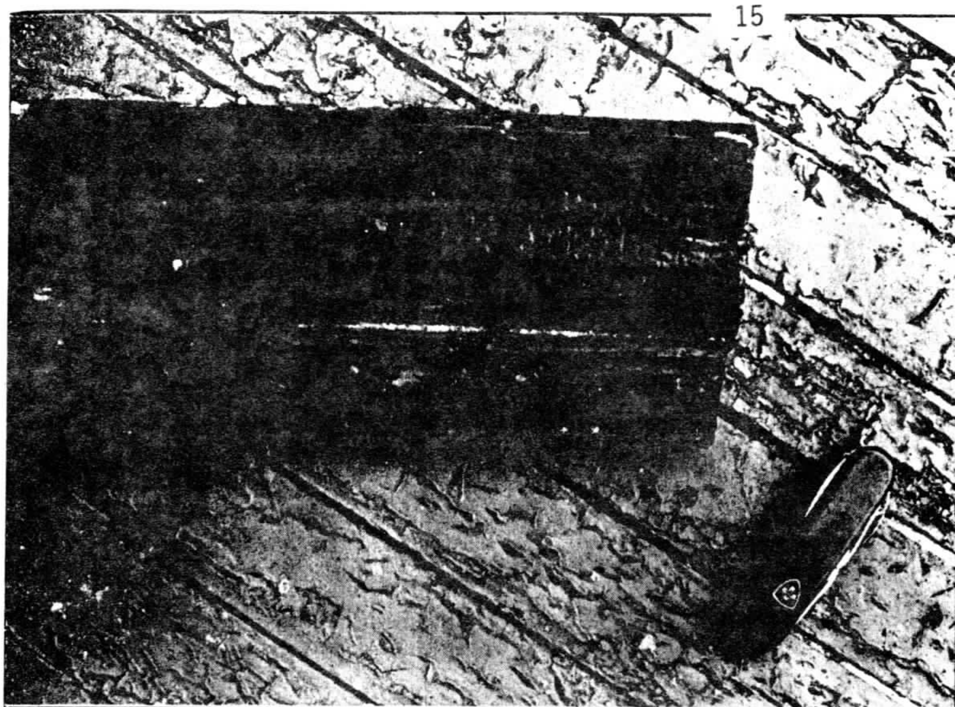
Probably the best removers using heat are the electric heat guns which work on the same principle as a hair dryer (See sources list at end of article). One can also use infra-red lamps, special heat pads, and "hot wire" paint removers. All these devices use electricity and can cause fires if left on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

FIXING PLASTER

Repairs and replacements.

Structural cracks in plaster can be repaired in three ways. If the crack is very fine, a fairly liquid mix of plaster of Paris can be pressed into the crack with a broad-bladed wallpaper stripping knife (remember to grind-off the sharp corners of the knife). Sometimes the hole is just too large, or the surrounding plasterwork is still moving because of vibrations or seasonal movements of the structure. In such cases one can use a cloth or paper tape system as is used when finishing the joints of a normal modern gypsum plasterboard drywall system.

To patch this type of crack, remove all loose material with a vacuum cleaner, wet the old plaster then apply a thin layer of joint compound for about eight centimetres or three inches on either side of the crack. Centre the reinforcing tape over the crack and press the tape firmly down into the wet plaster with a broad (5-6 in., 12-15 cm) joint knife taking care to leave some compound under the tape. Wipe off excess compound with the joint knife. As soon as the tape is firmly bedded apply a second thin coat of plaster joint compound making it as smooth as possible with the joint knife. When the first repair is dry—this usually takes about 24 hours—rub down the surface with a damp sponge or a coarse cloth wrapped round a handy wooden block. When the surface is smooth, apply a second thin coat of joint compound feathering-off the edges about three centimetres or an inch beyond the first coat. Once this second coat has dried use the damp sponge to "wet sand" or smooth the surface and then apply a final thin finishing coat. This coat may also require a light "wet sanding".

The third type of repair is used for wide cracks and holes. The edges of the hole should be undercut with a knife or a beer can opener. Vacuum out loose particles, wet the old plaster and fill the void with plaster of Paris, "spackle", or a modern cellulose filler such as Polyfilla.[R]

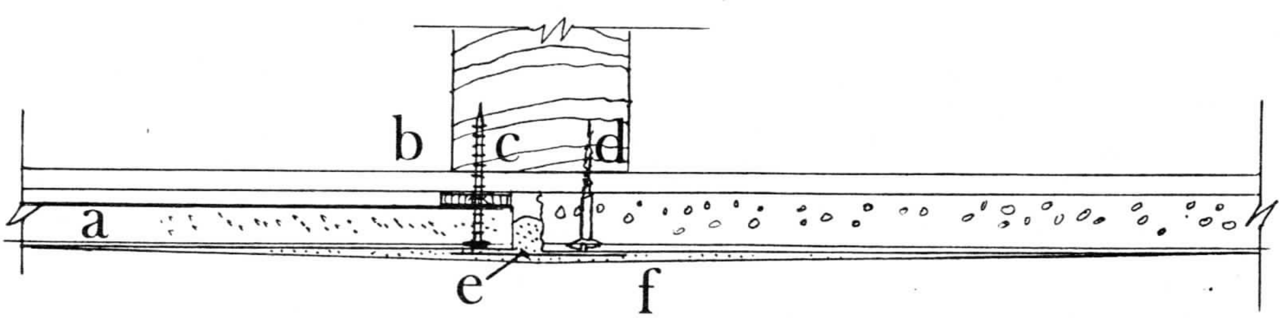
When the patch is dry, sand down the surface, dust-off and apply a thin finishing coat. If the hole is a deep one build up a series of layers and finish with one coat no more than 1/8 inch or 3 mm thick. If there is no suitable lath or support immediately behind the hole the new plaster will keep falling into the gap. To avoid this problem wad newspaper and force it into the hole. This will provide a good temporary support for the plaster patch.

A small sheet of gypsum plasterboard may also be cut to use as a patch, the hole being squared up roughly to match. The patch should be nailed firmly to studs or joists and will then require the joints to be finished with joint compound and tape as described earlier.

Failures of keys and/or latch systems can be repaired in two ways. The first or traditional method uses plaster of Paris and jute scrim. The second method is one recently invented by Morgan Phillips of the Society for the Preservation of New England Antiquities. This method uses a mix of acrylic resins, "fluid petroleum coke", and inert fillers such as powdered chalk, fumed silica and glass microbeads or microballoons. The traditional method quite frequently does not work if there are gaps between the faces of the laths and the back of the plaster, and if the spaces between the laths are narrow. The traditional method can't be used if you can't get at the back of the laths.

If you can get at the back of the laths the method works as follows:

▶ support the face of the plaster and gently press the sagging ceiling or bulging



Cracks and junctions between plasterboard patches can be refinished with a broad feathered plaster repair. The plasterboard (a) may require levelling on battens (b). The joint is taped (e) after the board has been nailed (c) and the loose lath has been screwed (d) back in position. Note that the final feathered patch should be about 15"-18" wide (f).

wall back into position or as far as it will go. The problem here is that loose material falls into the voids which open up when the plaster sags or moves away from the laths. If the plaster is forced back it will crack across these little piles of sand or lumps of plaster.

▶ once the plaster is supported remove all loose and broken keys. Test all keys with your fingers to see if they are sound. Vacuum out all dust and loose material.

▶ mix up a batch of plaster of Paris to a creamy consistency and apply it across the back of the laths so that it runs down into the gaps and thoroughly "wets" the back of the remaining sound plaster. Pump the backs of the laths with your finger tips to work the liquid plaster into the gaps between the faces of the laths and the back of the plaster.

▶ while this first plaster is still damp, mix a second batch of less liquid plaster. Soak strips of jute scrim in the plaster and apply them across the back of the laths pressing them down firmly into contact with the first coat of plaster.

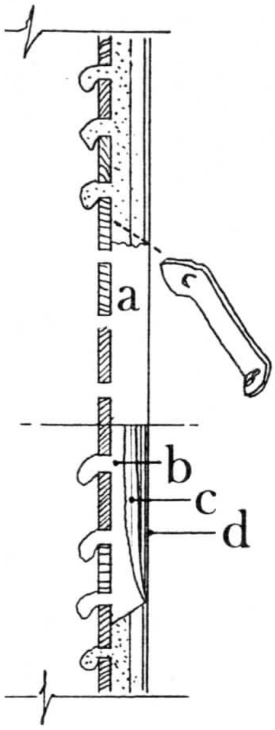
▶ a third batch of plaster is sometimes mixed and applied but this is a waste of time and labour. It also adds useless weight which can be a problem in ceilings.

The system basically consists of trying to bond new plaster to the backs of the old broken keys and then linking all the keys and laths by a coat of reinforced plaster. Frequently the plaster fails to penetrate all the gaps and make a good bond to the old plaster. Usually contact is made here and there and the scrim reinforced backing carries the load over the poor areas.

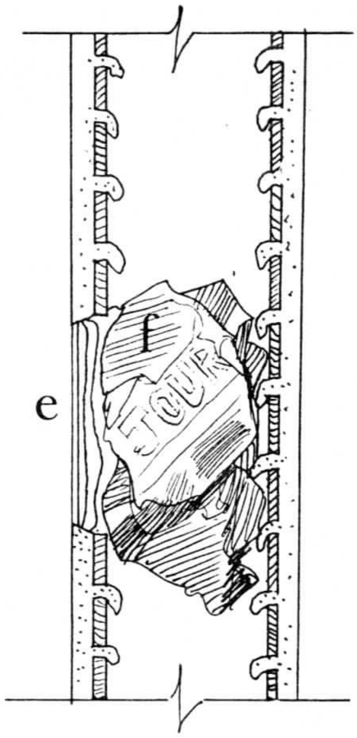
The Morgan Phillips technique is explained in detail in an article which Phillips wrote in the *Bulletin of the Association for Preservation Technology*. Vol. XII No. 2 1980, see *Adhesives for the reattachment of loose plaster* pp. 37-63.

In its essentials the process is as follows: support plaster; clean away loose material; drill holes in lath at about 6" or 15 cm intervals; inject "pre-wet" mixture of water, alochol and small quantity of acrylic resin; inject expanding thixotropic mixture of water, acrylic resin, "fluid petroleum coke" and fillers.

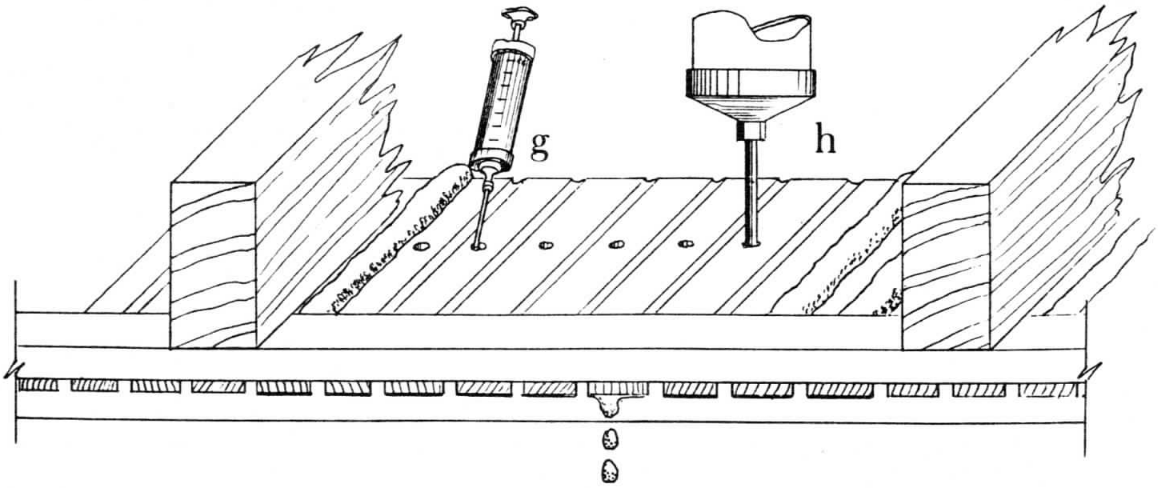
This method ensures excellent consolidation of the plasterwork because the mixture penetrates into all small cracks and voids filling them and then setting to firmly bond plaster to plaster and to wood laths. The method can even be used for "blind" repair work where you can't get to the back of the wall or ceiling to reach the laths. In such cases injection holes are drilled through the plaster from the face.



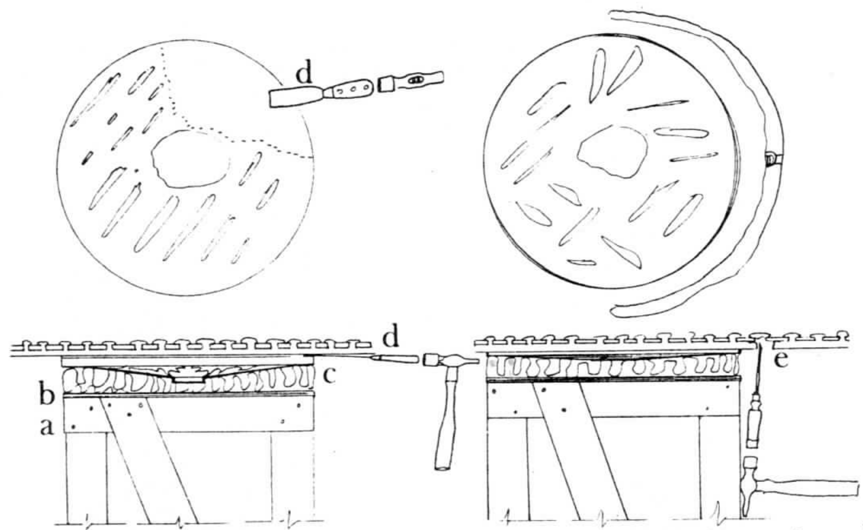
A large hole in plasterwork with the laths intact is undercut with a beer can opener (a). A patch is built up in three layers b, c, d.



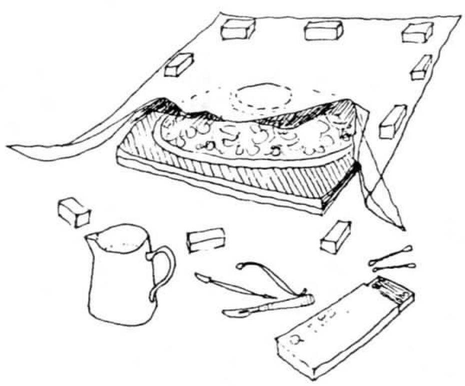
A large hole in plasterwork with no laths is filled with a wadded newspaper. Successive layers of plaster are then built up to restore surface.



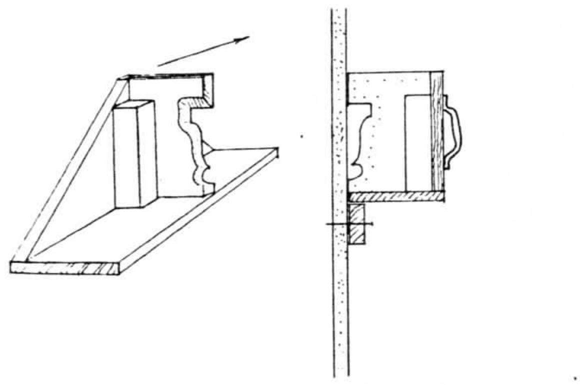
The Morgan Phillips method for reattachment of loose plaster involves injecting first a "pre-wet" mixture (g) then a fluid petroleum coke and acrylic resin mixture using a bulk loading gun (h).



Taking down a plaster ceiling medallion: temporary support (a) holds up plywood sheet (b) and foam plastic padding (c). Sound medallions can be split off ceiling plaster by driving a putty knife into the plaster "slip" coat (d) note that knife is driven tangentially not towards centre. Delicate medallions are cut away with their backing plaster (e); the backing plaster is then carefully split or shaved off on a bench.



Water soluble paint layers are removed by placing medallion face up on a thick absorbent pad. The pad is wetted and then pad and medallion are covered with a sheet of polyethylene. After 24 hours the paint is softened and is more easily removed with scrapers and scalpels.



A plasterer's "horse" or template for running mouldings. The template runs in the direction shown by the arrow. It runs on a temporary guide rail which is nailed to the wall. The cutting edge of the template is formed of zinc sheet which is pinned to a support board. Note that the edge of the board is chamfered up to the profile of the moulding.

Drilling ceases when lath is encountered. The pre-wet injection and consolidant mixture injection are then carried out from the face.

Moulded plasterwork such as ceiling rosettes or medallions are frequently found to be clogged with a heavy build-up of old paint and to have some features broken-off or missing. It is best to take the detail down to clean it and to mould the missing portions.

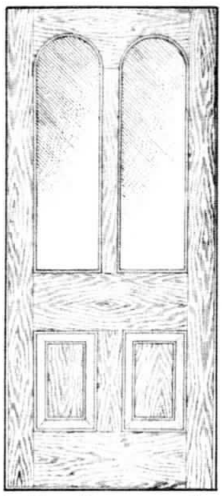
It may be helpful to take a medallion as an example and to go through the process of taking it down, cleaning it, repairing it and replacing it. The process goes this way:

1. record the exact position and orientation of the medallion on the ceiling so that you can get it back in place correctly.
2. support the medallion with 2″ or 5 cm thick foam plastic sheet over 1/2 inch or 12 mm plywood. The plywood is temporarily supported on braced 2″ × 4″ props. (45 × 95 cm).
3. either crack the medallion off the ceiling by tapping a thin broad knife into the slip coat; this can be done if you are dealing with a one-piece relatively thick medallion, or
4. cut the medallion and its plaster backing away from the surrounding plaster using a light hammer and an old chisel or screwdriver.
5. gently pry the medallion and its backing plaster away from the laths so that the keys are broke; the prying should be very carefully done with a stiff broad bladed knife.
6. use a thin bladed knife to separate medallion and backing plaster.
7. examine the paint accumulations and find out if the medallion was originally tinted or gilded. Find out if the paints are oil based or water based.
8. depending on result of examination you may either use a methylene chloride based paint remover like Polystrippa^R for oil based paints or you may wet the medallion with warm water to remove distempers. A good collection of knives, dental picks, and moulding or sculpting tools will be found helpful in removing the clogged paint from the plaster detail.
9. when paint has been removed and medallion is dry, repair all scratches and holes and remodel or cast missing pieces using plaster of Paris.
10. seal front surface—not back—with shellac and then give the medallion its appropriately coloured paint finish.
11. refix the medallion to the repaired ceiling using either the traditional plaster of Paris slip, or white glue (P.V.A.) or the mastic used for setting ceramic tiles. Use the original support system to hold the medallion up while the adhesive sets.

Martin Weaver ■

Fixing the Front Door

Front doors are one of the focal points of our homes. Studded with brass knockers, flanked with real or imitation coach lights, or radiant with decorative glass panels, they say something about the people behind them. But front doors are subject to considerable abuse from the elements, from day-to-day usage, and from our urge to "improve."



Most older doors are made of solid wood while modern ones are often hollow honeycomb affairs covered with wood or metal veneers. If it is a wooden door, regardless of its age, it has two certain features: its wood will absorb moisture into its cellular structure and it will be subject to dimensional change either through swelling and shrinkage or through planing and cutting.

Most home owners ignore the fact that paint does not stick to water. Paint is often applied purely as a cosmetic coating to keep a door looking good, yet in the one place that a door most needs paint it is rarely applied — on its bottom edge. It is here that the end-grain of open wood cells is exposed. This allows the wood to wick-up water which in turn not only allows rot to set in but also forces the paint to peel off. A small mirror can be used to inspect the bottom edge of a door to tell if it has been painted. Though a mirror may give you the proof of poor painting practices, other indications abound. The fact that paint is peeling off the bottom of a door or that veneers are coming loose from hollow core doors is evidence that a door's bottom is wicking-up water.

Another problem with finishes on exterior doors is the failure of clear finishes. Ultraviolet light passes through the clear finish, breaks down the bond between the cellulose and the lining in the outermost surface layers of the wood, and destroys the bond the finish had with the wood's cellular structure. Hence the finish starts to pull loose, it begins to crack, moisture enters, and the finish deteriorates rapidly. Most clear finishes stand up less than two months in strong sunlight before damage can be noticed. Ultraviolet inhibitors are available in some clear finishes, but none is very effective over a long period of time.

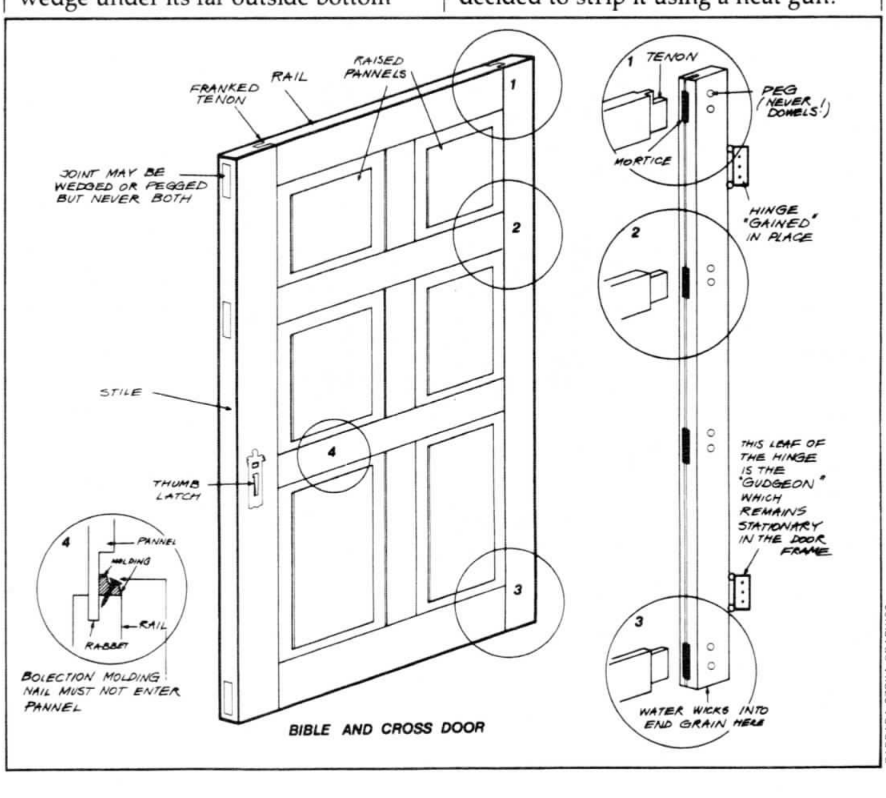
Another common problem is whether to fix an existing original front door or to find a suitable replacement. Historic replacement doors are often found in shops that sell bits and pieces of our architectural heritage. It is difficult to find one that is both the right size and that is in keeping with the style of a house. When found, you should examine the door to see if it is free of warps or twists. You should add on to its base cost the cost of having it refinished and repaired. Hence, a salvaged door might cost $100-150, and the cleaning and repair may run $100 to $400. A custom-made new door might be cheaper.

An actual case history of an old door being repaired will give you some ideas of the problems involved. The door in question has been in service since 1840.

First it had to be carefully taken off its hinges. This is done when the door is open, and supported by a wedge under its far outside bottom corner. This support takes the stress off the hinges and helps with control. It also helps if you have a second person to steady the door. Next the screw heads and slots were cleaned of paint. This should be carefully done and followed by the selection of a screwdriver that fits the slot perfectly. Otherwise you may find the head of the screw torn up, and you won't be able to get it out. The paint seal around the edge of the hinge also had to be carefully cut and chipped clean so that when the hinge came free it didn't cause a lot of damage.

Once the hinges were removed the other hardware could be worked with the door on saw horses. Several sets of hardware outlines were found where old locks had been: evidence could be found of a thumb latch followed by a cast iron Victorian lock, then a reversal of the door with the Victorian lock on the other side, and then a cheap 1950s lock. Surprisingly, the key hole escutcheon of the Victorian lock was still in place under the face plate of the 1950 lock. But an even greater surprise was in store when it was discovered that the original 1850 thumb latch was still in service on a wood shed door. It matches the paint outline in the smallest detail.

Since the door was heavily encrusted with layers of paint it was decided to strip it using a heat gun.



BIBLE AND CROSS DOOR

REPRINTED FROM UNIVERSAL DESIGN BOOK, SHATTOCK & MCKAY PUBLISHERS, 1983, P. 71

Seven hours and a 20 pound pile of paint chips later, the door was back to where it had been when first installed in 1840. The vertical rails had shrunk in width and no longer butted up against the shoulder of the cross rails. This 1/8" gap allows the door to sag out of square. (Hence before taking an old door and cutting away wood to fit a door jamb that is no longer square, you might wish to check if it is the door that has moved — and not the house.) Other interesting bits of information turned up while repairing this door: the exterior colour scheme became apparent — black frame and mustard panels. Also the door showed (along with the jamb) the scars of an unhappy puppy wanting to get in. Not too big a dog at that and one could rule out a cat from the type of scratches. As a final bit of information two old pieces of felt-like fabric came out of an old hinge gain where they had acted as filler under a piece of cardboard. (Gains are the carefully-cut recesses in door and frame which receive the plates of the hinge and which allow the hinge to sit flush with the surface.)

Now that the door is clean it will have to have its nicks and bangs repaired following the rule "repair the abuse and leave the signs of use." The door will have to be taken apart and then pulled back together so that the joints are snug again. What is the cost of this repaired door? Seven hours of stripping paint at $6 an hour and five hours of repair time at $20 an hour bring the entire turn-around cost to $142. You would be hard pressed to find a two-inch thick solid wood door, new or used, at this price.

With the door repaired and the hinges oiled you can only hope the neighbours enjoy it as much as the owner did restoring it.

Recycling bricks

I plan to use some old "recycled" bricks in a renovation project on my home but I have heard that there may be problems. Can you tell me more about this subject?

Recycled or salvaged bricks usually have an attractive combination of warm red-orange colours, pleasant texture, and a slight irregularity often associated with hand-manufacture.

Unfortunately, salvaged bricks can suffer from two problems. When old bricks were manufactured they were subject to a wide range of firing temperatures: some were over-fired and partially melted to form a glass-like surface (known as clinkers); others were under-fired and remained soft and very porous (known as salmons). The third-rate salmons could be used in the interiors of walls and in interior partitions where no damp could

Martin Weaver

This load of bricks awaits recycling in a renovation job. Bricks from interiors and exteriors are mixed together.

reach them to cause fast deterioration.

Today, when we get a batch of salvaged bricks, the good and the inferior quality bricks may be mixed together. If a salmon or soft brick is placed in an exterior wall, particularly in a position of severe exposure to wetting and freeze-thaw cycles such as in a planter, chimney, parapet, or coping, the brick will rapidly spall or crumble into powder.

The other major problem of salvaged bricks is that they may have become contaminated with water soluble salts. These salts will move in solution to the surface of the bricks if they are continuously wetted and dried. The evaporation of the moisture leaves the salts behind as crystalline efflorescence or subflorescence. The latter particularly will cause bricks to spall and crumble.

To avoid problems with salvaged bricks the following points should be remembered:

1. Always use lime and sand mortars with salvaged bricks. Such mortars are more elastic than Portland Cement mortars, contain less salts that cause efflorescence, and will achieve a good bond.
2. Never use salvaged bricks in positions of severe exposure to moisture e.g. chimneys, planters, paving, copings, sills, parapets, and patios.
3. If it is necessary to use salvaged bricks out-of-doors give them as much protection as possible against rain, soil-moisture, and water vapour.
4. If you have the facilities, the sodium sulphate crystallization test may help to establish the comparative resistance of salvaged bricks to both subflorescence and freeze-thaw damage. The test consists of drying the bricks at 103 + 2°C, then immersing them in a saturated solution of sodium sulphate decahydrate at 20 + 0.5°C for two hours. The bricks are then heated back to 103 + 2°C at high relative humidity for 10 to 15 hours. After 16 hours more in the oven, the bricks are allowed to cool and the process is repeated up to 15 times (unless the bricks break up). Compare the performance of salvaged bricks with new ones under this punishing test.

Martin Weaver ■

The Case of the Red-faced Building

"Then the building turned red," said a witness in a court case heard in Kitchener in December, 1983. The case centered on a dispute between a contractor and a local authority over a masonry cleaning job that somehow went wrong.

The victim was a venerable courthouse constructed about 1892. The building's late Victorian Romanesque Revival style resembles Queen's Park and the Old City Hall in Toronto. The courthouse stonework is finely executed in red-brown and buff or "grey" coloured Medina sandstones with some polished red granite.

The original specification for the cleaning work went this way: "All exterior stone areas . . . to be cleaned using hydro chemical method. Cleaning chemical to be brushed on (no strong acid solutions are to be used) and rinsed thoroughly by high pressure water spray. All glass, shrubs, slate roofing, sidewalks etc. shall be protected from damage. Heavy (sic) stained areas that will not come clean by washing may be spot cleaned by sand-blasting providing approval has been given by County personnel."

But some specifics are conspicuously absent: no actual chemical or compound is mentioned; no trade name, manufacturer, or distributor is mentioned; no strength of solution is given; no definition of "strong acid" is given; no description of the brush is given (that is, natural fibre not wire); no "dwell time" is given (the length of time for the cleaning solution to remain on the wall prior to rinse off); no water pressure is given nor is any flow rate (severe damage can be caused by the abrasive effects of 1000 p.s.i. water jets); no tests are specified and there is no definition of what is to be cleaned off; no definition of "clean" is supplied and since there are no test samples, client and contractor may disagree; no indication is given of how glass, shrubs, and so on should be protected; nor is there any indication of what they should be protected against.

The cleaning chemical used was ammonium bifluoride mixed with clean water in ratios of both 1:10 (one part by volume of the former to 10 parts by volume of the latter) and 1:15. This gives pH measurements of about 1.8 to 2.8. The contractor selected this compound because it had been used successfully at these concentrations on such stones in the past. The choice of this weak acidic solution was reasonable because the cement which holds the sand grains together in the stone is largely calcareous (that is, consisting of, or containing, calcium carbonate) and is dissolved by stronger acids of pH 1.0 or less. Alkali cleaners such as sodium or potassium hydroxide cannot be used because there is a risk of rusty coloured staining when the hydroxides react with soluble ferrous oxide in the stone to create ferric hydroxide.

The chemical solution was applied by bristle brush, allowed to rest on the surface for about three minutes and was then washed off with a spray jet of water at about 800 pounds per square inch.

During and shortly after the cleaning operations there was a period of unusually heavy rainfall which saturated the surface of the stone. Then, two weeks after the cleaning had been finished, apparently satisfactorily, some parts of the stonework suddenly developed a red rusty stain.

What went wrong may never be known but the saga was not over. The County insisted that the contractor sandblast the offending stains. The contractor suggested that they wait for the stains to fade. Since he wished to continue to work on heritage buildings in Ontario, he refused to sandblast — a process which he knew was officially frowned upon by preservation specialists both in the Government of Ontario and nationally.

The stains, however, failed to fade and the County called in another contractor, had the sandblasting carried out, and sent the bill to the first contractor. The County also refused to pay the first contractor for his work. The original contractor therefore took the County to court.

In his decision, the judge found that "the building does now appear to be clean . . . and it is generally agreed that some damage does occur to any stone that has been sandblasted as in this case." He ruled that the original contractor should be paid for his work — minus the cost of sandblasting.

The judge's final paragraph is significant: "it must not be forgotten that this company advertised itself to be experts in restoration work such as was contemplated in this case. When they undertook the chemical wash of the stone, they might well have consulted an expert in the field to determine if the strength of the solution was proper. They might also have tested the solution on portions of the building to determine if there would be any damage by way of discolouration. In the end result, the County was forced to proceed with the sandblasting operation and, for that portion of the work, they are entitled to be reimbursed."

In some circumstances the chemical, the solution strength, and the rinse-off pressures were as would be recommended, but as no special tests had been carried out under controlled conditions prior to cleaning no one had any way of knowing what would happen.

It is possible that the saturation of the stones by the possibly acidic rain combined with the acid cleaning solution may have transported soluble iron compounds from deep within the stone to the surface. It is also possible that iron dust from steel works in Hamilton about 80 kilometres away may have blown in with the rain: iron dust from both railway yards and iron and steel works causes rust coloured-staining on building stone.

In the final event, even if the stain did result from "an act of God," the contractor was unable to prove that the staining did not result from his failure to do all that could be expected of an expert in restoration work.

Although the specification did not call for tests and a prior agreement on what "clean" stonework would look like, the contractor should have made the tests and secured agreement on the sample. If he had, he could have saved himself a lot of trouble and quite a lot of money.

— *Martin E. Weaver*

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