Solvent extractable components of oil paint films
Sutherland, K.R.

Citation for published version (APA):
Sutherland, K. R. (2001). Solvent extractable components of oil paint films

General rights
It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

Disclaimer/Complaints regulations
If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: http://uba.uva.nl/en/contact, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.
1. Cleaning, controversy and research

Abstract

The process of cleaning paintings using organic solvents is outlined from a technical point of view, and a survey is given of some aspects of the recurrent controversies which have been provoked by cleaning treatments, specifically those issues relating to painting materials and methods used for cleaning. The extent to which results from scientific studies of solvent effects have been incorporated into the debate are also considered, and some general comments are made about attitudes to scientific research in conservation.

1.1. Introduction

Paintings have traditionally been coated with varnishes composed of natural resins which, because of their inherent chemical instability, will gradually develop a yellow or brown discolouration. They can also become crazed and opaque, as a consequence of oxidation and increased brittleness. The deteriorated varnish, along with accumulated surface dirt, and old retouchings which also have a tendency to darken and discolour, obscure the painted image and make it necessary to periodically clean the painting. A variety of methods and materials are employed in cleaning, but the most widely used techniques – particularly with regard to the removal of varnish and retouchings – involve the use of organic solvents. (The term cleaning is used in its broadest sense to describe the combined removal of surface dirt, varnish and retouchings, although it is often used specifically to refer to varnish removal.)

Cleaning a painting can dramatically alter its appearance, and so it is understandable that such treatments have often aroused comment, sometimes to commend or often to condemn the results. Controversies have long been associated with the cleaning of paintings, with well documented examples existing from the eighteenth through to the twentieth century [1]. A complaint has even been cited
Chapter 1

from antiquity, of a painting by the Greek artist Aristiedes of Thebes having been "ruined" by cleaning [1, p. 73], a sentiment which has been recurrent in cleaning debates up to the present day.

Generally, the controversies can be considered either in terms of aesthetic issues, concerning the appearance and presentation of the picture, or from a material point of view, concerned with the painting's physical condition. These aspects can be closely related, but the distinction is helpful for the purpose of discussion.

The aesthetic issues relate to the different approaches which can be taken in cleaning a painting. A conservator can attempt to remove all non-original, discoloured varnish and retouching prior to "restoration" (i.e. the application of new retouchings and varnish), or to reduce the varnish to leave a uniformly thin layer across the painting. Alternatively the varnish can be removed to varying extents in different areas of the picture, according to the state of preservation of these different areas, with the aim of retaining more of a tonal balance in the painted image. These three approaches – which have been termed "total", "partial" and "selective" cleaning, will produce different appearances in a cleaned painting, since a residual, coloured varnish layer will influence the colour and tonal relationships in the picture. They have therefore been the subject of much debate, both inside and outside the conservation field. The rationale behind the different approaches, and their relative advantages and disadvantages, have been described in detail by Gerry Hedley [2].

The other aspect of the debate concerns the possibility of material damage to the painting during cleaning. Cleaning treatments, especially high profile treatments of well known paintings, have repeatedly provoked allegations that original paint has been removed along with varnish and surface dirt. The more sensational descriptions of paintings having been "flayed", "scraped" or "scoured" were a prominent feature of the controversies in the nineteenth century [1, 3], and similar accusations have been repeated in subsequent debates.

In his discussion, which was originally presented as a pair of lectures in 1985, Hedley optimistically suggested that the focus of the controversies since the 1950s had shifted to aesthetic considerations, stating that

"Nowadays, it is reasonable to demand of the trained conservator that he or she should, on no account, remove original paint and ought to be capable of discerning the difference between varnish and glazes." [2, p. 153]

Some critics evidently do not agree, however, and these alarming accusations of damage persist. The vocabulary used is often an echo of the
nineteenth century polemics: William Hood, for example, is quoted in a 1998 article, speaking of encountering favourite paintings

"...flayed, literally skinned alive, by the restorers."

and elaborates

"It used to bother me that the Louvre Titians were so yellow. But now I see it this way: better to be in a coma than dead. At least the original's still buried in there somewhere" [4, p. 45]

Central to accusations of this type is the perception that the fine, upper paint layers often found in oil painting techniques – particularly transparent toning layers known as glazes – are inherently vulnerable and prone to indiscriminate removal by the solvents used for cleaning. With this perception, it is inevitable that museums in Britain and the United States have frequently been the target of criticism, since the approach of “total” cleaning – which in principle involves the most direct exposure of the original paint surface to solvents – has been widely adopted in these countries. This is in contrast to other European countries such as France and Italy, where “partial” cleaning approaches are more common. This distinction was taken to an extreme by a journalist for The Guardian, who wrote

"Restorers are scraping old masters. The worst offenders are the museums and collectors of the United States and Britain." [5]

Elsewhere, commentators have used expressions such as “drastic” or “radical” cleaning to refer to total cleaning, reflecting a similar attitude.

In the 1950s and 60s, a number of scientific studies of the effects of solvents on varnish and oil paint films were carried out, with a view to gaining a more precise understanding of the mechanisms and effects of cleaning. This research was being carried out shortly after another period of controversy in London, which occurred following the return of pictures to the National Gallery after the Second World War, some of which had been cleaned during the period of storage. One of the researchers, Ian Graham, who was working on a scholarship in the Scientific Department of the National Gallery, reasonably observed

"No claim is made that the work we are doing will settle all the controversies, or provide any new techniques for the restorer, but at least some of the processes he uses, being better understood, will become more controllable, and some criticisms answerable." [6, p. 500]

The results of these studies were incorporated to some extent into subsequent episodes of the cleaning debate, but differences in opinion about how to interpret the new data appeared to add an extra element of confusion to the discussions.
Chapter 1

This chapter will examine some of the criticisms of cleaning treatments from a technical point of view, to put them in the context of the physical and chemical properties of painting materials, and the techniques used for cleaning. The discussion will focus on the use of volatile organic solvents, which remain the most important and commonly used cleaning agents, and which are the focus of the research presented in this thesis. Alternative cleaning systems such as gelled and aqueous cleaning formulations will not be addressed, although these are subject to many of the same principles and concerns.

The extent to which scientific studies of solvent action have influenced the controversy, and the various interpretations of the research expressed in the debate, will also be discussed. Firstly, though, it will be useful to review some of the technical information relevant to solvent cleaning methods.

1.2. A technical description of cleaning

In principle, cleaning a painting is made feasible by fundamental differences between the paint and varnish layers, arising from their different chemistry and drying mechanisms. The traditional, natural resins such as dammar and mastic are applied to a painting as a solution in an organic solvent, or mixture of solvents, and dry to form a solid film by the evaporation of these solvents. The resins are largely composed of small molecules which do not cross-link to a substantial degree with ageing, and it is therefore possible to return the varnish film to solution at a later date by the application of solvent, as in cleaning. The main change in the solubility properties of natural resins is a consequence of oxidation of the component molecules – part of a complex ageing process which results in the discoloration and embrittlement mentioned above – and this means that although the varnish will remain soluble, solvents of increasing polarity are needed to remove older, more oxidised varnishes.

The “drying” of oil paint takes place by polymerisation of the triglyceride molecules which constitute the oil, a process which results in the formation of a three dimensional polymer, in which the pigment particles are embedded. Ionic interactions between pigments and acid groups formed by hydrolysis of the triglyceride molecules can also occur, contributing to the formation of a rigid, cross-linked structure. These drying reactions of oil will be described in more detail in Chapter 3. Under suitable drying conditions, a paint structure is thus formed which, although it can theoretically swell to some extent from the absorption of solvent, is resistant to disruption and dispersion by neutral organic solvents (i.e. those which are not acidic or basic).
The properties of tempera paint, which was also widely used in traditional painting techniques, particularly before the sixteenth century, are outside the scope of this discussion, but the principle is essentially the same. Egg tempera dries initially by the evaporation of water, followed by a gradual hardening of the film resulting from a combination of covalent and noncovalent bonding between the protein and lipid components of the egg yolk, as well as interactions with pigments [7]. This forms a rigid paint film which is similarly resistant to disruption by neutral organic solvents.

In the case of oil paintings, an ideal cleaning situation might therefore be represented by a rigid, extensively cross-linked oil paint film coated with a pure, moderately oxidised resin varnish. This is not uncommon in paintings made using conventional techniques, and such cases present a relatively straightforward scenario for cleaning, in which paint and varnish layers can be readily differentiated on the basis of solubility. Many deviations from this ideal exist, however, relating to the composition of both paint and varnish. These introduce varying degrees of risk to the process, and require careful discrimination and selectivity in the cleaning techniques.

Paint films formulated with certain pigments and media can show sensitivity to solvents. Some pigments, including carbon blacks and the organic earth pigment Vandyke brown, inhibit the drying of oil. This is a consequence of minor components of these pigments having antioxidant properties, which interfere with the oxidative polymerisation of the oil [8, p. 39]. Other pigments, including vermilion (mercuric sulphide), have a catalytic effect on the oxidative degradation of the oil polymer [9]. Both of these effects will prevent the formation of an extensively cross-linked polymer, and will produce a paint film which may remain vulnerable indefinitely to disruption by solvents. Another factor is the proportion of pigment to medium: paints formulated with a very low medium content may show the same problems of solvent sensitivity.

Additives to the oil medium, such as wax and natural resins, will also prevent extensive polymerisation of the oil if present in large enough amounts. Additives such as these became common in painting techniques during the eighteenth and nineteenth centuries [10], and paintings from these periods often exhibit solubility problems.

Varnishes are sometimes encountered which are oil and resin mixtures, rather than pure resin. Oil-resin varnishes were widely used before the seventeenth century, and were still in use as late as the nineteenth century [11], although by this time they had generally been replaced by "spirit varnishes", i.e. resins dissolved in volatile solvents [12]. If a large proportion of oil has been used in the varnish, it may polymerise to produce an insoluble film. This is particularly true in cases
where “hard resins”, such as copal or amber, were used in place of the “soft resins” such as dammar and mastic, since the former are themselves much less readily soluble in organic solvents [13, pp. 51-56]. Even pure resin varnishes of considerable age can become oxidised and hardened to the point that they are effectively insoluble in the commonly used cleaning solvents: this is sometimes a problem with residues of varnish left by a previous, partial cleaning treatment.

Similar solubility problems are encountered with retouchings, particularly those of significant age, which are more likely to have been carried out in a medium similar to that of the original paint. Aged, oil paint retouchings can be very difficult to remove because of their close similarity, in physical and chemical properties, to the underlying paint layers.

More recently, synthetic resins have been investigated as replacements for the unstable, natural resin varnishes [14, 15]. Occasionally, ignorance of the properties of modern resins has led to paintings being coated with inappropriate materials: resins such as polyurethanes, durable and chemical resistant polymers more commonly used for applications such as coatings for aircraft, have sometimes been encountered as varnishes on paintings [16].

Because of these numerous factors, paint and varnish layers often do not present such clear differences in their solubility behaviour, and more subtle differences in material properties must be exploited to separate varnish and retouchings from the underlying, original paint. Solubility properties are the dominant factor, but the differences are relative rather than absolute: each material exhibits solubility in a specific range of solvents, according to its precise chemical composition, and solvents or solvent mixtures are selected which are effective in dissolving varnish with minimal softening or swelling of the paint layer. These principles of solvent selection have been described by Hedley [17]. Mechanical properties are also exploited, in combination with solvent action: a varnish which is insoluble in a given solvent may swell and soften sufficiently that it can be safely fragmented and “rubbed” from the paint surface. Even in cases where a varnish is effectively soluble, a certain degree of mechanical action is often necessary to remove the dispersed material from the paint surface. In some instances, cleaning can be done by mechanical action alone, without the use of solvents. This can only be achieved in certain circumstances, for example where an extremely oxidised, brittle varnish is present over a smooth, well preserved paint layer. In this case the varnish can be effectively pulverised and reduced to powder by a gentle rubbing action. Because of the relative lack of control in this method, however, it is rarely used as an overall cleaning treatment [18, p. 202], although localised areas of hardened, insoluble varnish sometimes require mechanical removal. A scalpel blade can be used to gently break and cleave varnish fragments.
from the paint surface, although this is a painstaking process, and must be carried out with the aid of a microscope.

Aside from material differences in the painting, the action of solvents can also be manipulated by the technique of the conservator. Precise control of factors such as the amount of solvent used in a cleaning swab, the time of application to the paint area, the solvents' evaporation characteristics, as well as alternative cleaning methods such as the use of gelled solvents or aqueous formulations, allow a high degree of precision in cleaning even the more solvent sensitive paint layers. Where multiple layers of varnish, repaint and/or grime are present, a selective and sequential removal of the different materials is generally necessary for controlled cleaning.

The ability to selectively remove varnish and overpaint is of course meaningless without first being able unequivocally to distinguish these additions from original layers. This is more of an issue for overpaint, although local varnish residues can sometimes be confused with original glazes. A large number of criteria are used to identify non-original material, and for a large part these are empirical, relying on the experience and judgement of the conservator. The decisions require an understanding of the artist's technique and the properties of the materials used, as well as close examination of the visual and material properties of specific areas of paint. In cases where there is uncertainty, scientific techniques such as pigment analysis and the examination of paint cross sections can be used to clarify the paint structure.

Attempts have been made to summarise the criteria used to identify additions [19, 20]. An unambiguous distinction cannot be made in all cases, however, and if there is any doubt as to the originality of a passage of paint it should clearly be left intact.

Despite the versatility of solvent cleaning methods, there are still situations in which the physical properties of paint and varnish are such that cleaning is impossible without loss to the original paint layers. If this is found to be the case from initial cleaning tests, cleaning should not be attempted. Some periods and schools of painting, particularly of the eighteenth and nineteenth centuries when there was a great deal of experimentation in the use of paint materials, frequently present problems in cleaning. Examples of uncleanable paintings by Stubbs and Reynolds have been described [21, 22]. In addition, paintings are occasionally encountered in which the artist has reworked areas of the picture over a varnish layer. Delacroix and Turner are among the artists known to have employed such practices [23]. Complete cleaning of paintings by these artists may also be problematic or impossible.
1.3. An examination of some criticisms

In the light of this information, although there are clearly numerous risks associated with cleaning, it is evident that some of the more recurrent and generalised criticisms are based on oversimplified and artificial concepts of the cleaning process. In particular, routine use of the terms "skinning", "scouring", etc. – sometimes described in the less sensational but more ambiguous term "overcleaning" – portray cleaning as an indiscriminate procedure. Discrimination is the essential feature in the process of separating non-original from original material: without the ability to selectively and controllably remove varnish or overpaint, cleaning is not feasible. Much depends on the skill of the conservator, and it is of course possible to damage a vulnerable painting through insensitive treatment, but the removal of surface paint layers is not an inherent and unavoidable consequence of solvent cleaning as implied by the more enthusiastic critics.

Of the more specific criticisms, some are also based on fundamental misunderstandings of painting materials and conservation techniques. Brian Sewell, art critic for London’s Evening Standard, commented on the cleaning of Canaletto’s Stonemason’s Yard at the National Gallery

_The nation no doubt assumes that its treasured heritage of masterpieces is and always has been treated with the greatest care, that work on them is undertaken only when essential, and that it is then executed to the highest aesthetic and technical standards. Those working on the Canaletto in 1989, however, commented on the work of their predecessors in 1955 that their varnish was significantly discoloured, their ultramarine retouchings were a mismatch for the painter’s original Prussian blue...[24, p. 17]

with the implication that the varnish and retouchings had been applied in a discoloured state, rather than this discolouration having occurred subsequent to the 1955 treatment. Sewell also asks

_How is it that a painting housed for 35 years in perfectly conditioned air, controlled humidity and temperature, never exposed to the condensation of bath water, nor to the fumes of tobacco and the open fireplace, can in so short a time require a second major restoration?

failing to recognise that conservation materials such as varnish will discolour and deteriorate naturally, without the adverse factors he describes, so that even paintings kept in “perfect” environmental conditions will require periodic retreatments.
Incidentally, many of the paintings described in these examples are in the collection of London’s National Gallery. This is not because the Gallery’s conservation practices or policies are extraordinary, but because the institution has, for somewhat arbitrary historical reasons, been the focus of a number of well-documented controversies. These have become an informative source of the diverse opinions about conservation.

Michael Daley, director in the UK of the organisation ArtWatch International, was given access to several of the National Gallery’s conservation records, including that of Michelangelo’s *Entombment*. He reported that

...photographs in both of the two (sic) dossiers I have examined indicate solvent inflicted injuries. One in the ‘Entombment’ dossier shows the effect of a test patch of solvent on one of the painting’s figures. A pencilled note from the restorer, Helmut Ruhemann, observes that ‘the cleaned strip here looks more unfinished than the uncleaned parts’ – which is true: the cleaned section has a reduced tonal and colour range, not an enhanced one as would be expected with dirt removal. [25, p. 57]

Aside from the confusion of varnish and dirt removal, this comment illustrates a misconception relating to the removal of overpaint. Paintings, particularly unfinished pictures – such as the *Entombment*, or those painted in an rough and sketchy manner, have frequently been overpainted in the past by overenthusiastic restorers in order to make them appear more “finished”. Ruhemann mentions the overpainting of the Michelangelo in his description of the 1970 conservation treatment [26, p. 29]. The removal of overpaint in subsequent cleaning treatments to reveal a painting which is more sketchy or unfinished in appearance is often interpreted as damage by viewers who are familiar with the embellished version of the painting. Rembrandt’s *A Woman Bathing in a Stream* was also cleaned by Ruhemann at the National Gallery, in 1946, and provoked similar accusations, particularly in response to the uncovering of the roughly painted hand and wrist of the figure from beneath a heavy layer of overpaint [18, pp. 82-84, 89]. A number of criticisms of this treatment appeared in the letters page of *The Times* [27, p. 115].

The perception of solvent cleaning as harmful is exacerbated by the fact that many paintings are in a poor state of preservation, often as a result of older conservation treatments. Before the eighteenth century, cleaning methods employed a variety of harsh materials, as diverse as potash (potassium hydroxide), smalt (a type of pulverised glass) and even urine [28]. Caustic and abrasive agents such as these undoubtedly caused considerable damage to paint layers. The important distinction between caustic (acidic or alkaline) reagents and solvents is
that the former act by chemically disintegrating varnish – and, unless used with extreme care, paint – whereas solvents act by a physical swelling and dissolution, specific to certain materials, as described above.

Any existing damages in a painting are revealed by the removal of varnish and overpaint in subsequent treatments and, as one conservator remarked

...the last person to work on the surface of a picture is apt to be blamed for its final state. [29, p. 80]

A conspicuous example is Leonardo’s Last Supper, a painting which is in an extremely poor state of preservation, in this case largely as a result of the artist’s use of techniques unsuited to mural painting [30]. The recent conservation of the Last Supper, revealing the extensive damage, inevitably brought criticisms that the treatment had been destructive [31].

Another recurrent feature in cleaning debates is a concern for the vulnerability of glazes. The technique of glazing is widespread in traditional painting techniques, and in its most commonly used sense refers to the localised use of transparent paint layers to modify the tone of the opaque, underlying colours. The concern for glazes can be illustrated with a few examples, again from the National Gallery’s collection. Morris Moore, in 1846, commented on the cleaning of Rubens’ Peace and War:

The ‘Peace and War’, so preeminently rich and harmonious in colour, is now almost as remarkably crude and discordant. With characteristic ignorance the fine rich glazings have been scoured off... [1, p. 75]

Andrew Forge, in 1961, on Titian’s Noli me Tangere and Virgin and Child with Saint John the Baptist and Female Saint:

Do we have to take it on trust that the National Gallery cleaners have not removed any original glazes from the surface of these Titians? [32]

Michael Daley, in 1993, on Titian’s Bacchus and Ariadne:

The Gallery’s own restorers in the 19th century and again in the 1960s have, to the great consternation of artists and critics, contributed to [the] deterioration of the original condition ... With every cleaning and consequent loss of glazing, the sky has emerged stronger. [33]

The attitude represented by these criticisms is put concisely by Richard Boston:

Whenever a great painting is cleaned there are those who will argue that what was removed was not a discoloured varnish but the painter’s original glaze. [5]
Cleaning, controversy and research

Given the frequency of accusations of this type, and the absence of supporting technical evidence, some of the more aggressive claims appear to be simply a dramatic attempt to rationalise the altered appearance of a painting from cleaning. The pronounced colour contrasts which often emerge in a cleaned picture may be interpreted by some to be the result of the loss of glazes applied by the artist to “harmonise” the colours, rather than the loss of an obscuring (and, in a sense, “harmonising”) varnish.

There also seems to be an instinctive correlation made between the aesthetic effects of glazes and their physical properties, or as one commentary put it

...the widespread belief that because glazes produce a delicate visual effect they are ipso facto chemically delicate and therefore very sensitive to the solvents normally used in cleaning. [34, p. 190]

This belief is typified in a comment by Jacques Franck, relating to the feasibility of cleaning Leonardo’s Mona Lisa

...the glazes in areas of paint where Leonardo was depicting flesh are extremely thin and, in all probability, porous, friable and powdery ... Any attempt to remove and replace [the varnish] by solvents or scalpels could seriously endanger Leonardo’s own work. [35]

Of interest are the characteristics Franck speculatively attributes to the glazes – in particular, such layers are typically medium-rich, and unlikely to be “powdery”.

Often, the vulnerability of glazes is attributed more specifically to the medium used for these layers. Handbooks of artists’ materials, in particular the influential manual by Max Doerner, first published in 1921, promoted the idea that the old masters achieved their effects by the extensive use of resinous or oil-resin media, especially in glazes [36]. This belief was pervasive: a century earlier, the painting manual by Mérimée was endorsing similar views [37], and British instruction books of the nineteenth century also recommended a variety of resinous or otherwise solvent-sensitive media to emulate old master techniques [10].

Rembrandt is one of the artists Doerner believed to have used resinous paint media, and he warns

...paintings of the Rembrandt school can be easily cleaned down to the ground in a few minutes, particularly in the often very thinly painted shadow parts. [36, p. 394]

In a review of Doerner’s book, Ruhemann suggests that these beliefs are based partly on experiments Doerner and his students carried out to achieve the
same visual effects as the old masters [38]. The addition of resin to oil paint may indeed have given a translucency similar to that found in old paintings, but it is now known that an important factor in the translucent appearance of old paint is the change in refractive index which oil undergoes as a result of chemical changes on ageing [39]. Because of such long term changes in the paint medium, Doerner would have found difficulty producing the desired effects even using precisely the same materials as the masters.

Before scientific methods had been adapted and widely applied to the analysis of painting materials, it is understandable that the opinions of artists and copyists on the materials used by old masters had a greater authority. Many artists in the early part of the twentieth century would have been influenced by manuals such as Doerner’s, not to mention the notoriously impermanent techniques of artists such as Reynolds. Comments made in an editorial in The Connoisseur criticising the cleaning in 1936 of Velazquez’ Philip IV of Spain in Brown and Silver at the National Gallery illustrate this deference to artists’ views

...is not the opinion of Mr. Reginald Eves, A.R.A., who has made many admirable copies after Velazquez, and who asserts that ‘the picture’s subtle finish has been wiped away’, worthy of attention? [40, p. 95]

Statements from the National Gallery in response to criticisms such as those quoted have referred to practical, historical and scientific evidence on the properties of glazes. In a response to a questionnaire sent to the Gallery following the Exhibition of Cleaned Pictures in 1947-8, the point was made that

The brilliant and well preserved glazes which are found on many thoroughly cleaned pictures contradict the belief that glazes are exceptionally susceptible to damage during cleaning. [41, p. 245]

At the other extreme, Ruhemann mentions examples of glazed vermilion paint in which the glaze layers are far more solvent resistant than the underlying paint [18, p. 191].

On the issue of the perceived delicacy of glaze layers, Joyce Plesters points out

The essential characteristic of a glaze is its transparency and not (as is sometimes said) the thinness of the layer. [42, p. 458]

In the same article, Plesters quotes historical recipes for glazes which suggest that oil was commonly used as a medium, with small additions of resin sometimes made to improve the drying and visual properties [42, p. 459].

These observations have been borne out by subsequent research carried out at the Gallery: systematic medium analyses have been carried out on samples from
a wide range of paintings, and the results support Plesters' ideas, with samples from glaze layers of paintings from before the eighteenth century generally found to be oil based, sometimes with small additions of resin [43].

The concern for glazes has a rational basis in that they are surface layers, and hence more directly susceptible to any solvent effects in cleaning, but technical and practical evidence does not support the idea of these layers in general possessing an inherent solvent sensitivity. This is not to say that glazes cannot present risks in cleaning, or that resinous media have not been used – certain combinations of pigment and medium can exhibit solubility problems, as has been described – but rather that the attention paid in the controversies to this subject has been disproportionate. Conservators must be cautious of potential solubility problems with glazes as they must with other types of paint.

Another, related source of controversy is the concept of patina. Applied to paintings, this term is used in its most general sense to describe the positive qualities imparted to the picture with time. Most people would agree that this definition includes the craquelure of a paint film, and perhaps other factors such as the increased translucency of paint layers, but the extent to which discoloured varnish contributes to patina has been much debated [34, 42, 44, 45]. This is largely an aesthetic issue, related to the different approaches to cleaning outlined in the introduction, and therefore outside the scope of this discussion. Sometimes, however, the term is used in such a way to imply that physical damage to the painting can unwittingly be done by the complete removal of varnish. Difficulty in addressing this idea arises from the ambiguous and inconsistent use of the term.

Sarah Walden, a conservator and enthusiastic proponent for the preservation of patina on paintings, who warns of its destruction in what she calls “overcleaning”, gives the following description:

Patina is the by-product of time, and in the case of painting is an accumulation of a number of facets of the ageing process. The craquelure itself is one. The slow transformation of texture and transparency undergone by each pigment and medium is another; and the interaction with a deteriorating varnish a third. The overall effect is as distinctive, evocative and intangible as the vintage of a wine. [46, p. 125]

In his review of Walden’s book, Hedley made the point that the problem in presenting or rationalising arguments for the preservation of patina during cleaning lies in the lack of a consistent definition for the term. In Walden’s case, of particular significance with regard to the safety of cleaning is the alleged “interaction” of paint and varnish, which she does not define with any further
precision. Used in such a nebulous way, patina can sometimes appear to be an emotional rather than a physical term, used to account for the sense that something "intangible" is lost in cleaning. As Hedley observed, this is unhelpful in informing decisions as to how to clean a painting. He asked more pragmatically

What exactly are these interactions of paint and varnish? How do they appear? Are they removable during cleaning, can they be simulated when gone? Is it the aspect of age or harmonising which is most valued, or is it their particular inter-relation? [47, p. 4].

Walden's "interaction" perhaps corresponds to a phenomenon suggested by Franck, in relation to cleaning tests carried out at the Louvre on Leonardo's The Virgin and Child with Saint Anne

[restoration] would be of great danger to the pictorial layer in the flesh area, because in my opinion part of the pigment has migrated into the varnish. Even if the varnish is dirty, it plays a major role of protection, a sort of fixative for the underlying layer. [48, p. 157]

A comparable suggestion was also made by Stephen Rees Jones

...the boundary between paint and varnish may be anything but clear; it may be indeterminate geometrically and operationally – that is, in its reaction to solvents during cleaning. [49, p. 61]

although, from the rest of his text, it appears he was referring to specific, problematic cases such as the use of resinous or poorly bound paint layers.

The phenomenon Franck describes is conceivable in certain situations, for example, if a varnish was applied to paint when still wet, or if the painting had undergone some kind of regeneration treatment – paintings treated by the "Pettenkofer process" have been found to exhibit such inter-migration of paint and varnish [50]. Similarly, as Rees Jones indicates, varnish applied to extremely poorly bound or solvent sensitive paint layers may also result in indistinct boundaries between paint and varnish layers. These are problems associated with specific painting techniques and conservation treatments, however, and are not entirely relevant to the issue of patina. With regard to cleaning, such situations should become evident from initial cleaning tests and examinations, and cleaning would be carried out with appropriate caution: complete varnish removal may not be possible or advisable in these cases. For paintings made with more conventional and sound techniques – such as Leonardo's Saint Anne – migration of pigment into the varnish seems highly implausible, based on what is known of the properties of painting materials. David Bull, who cleaned another of Leonardo's paintings, the Ginevra de' Benci, gave his opinion on the Louvre Leonards
Leonardo was using oil paint, and I don't see that there's anything particular in the technique that could cause a conservator any special concern, other than one's obvious caution in working on any major work of art. [51, p. 159]

In a discussion of patina largely concerned with aesthetic issues, Paul Philippot has also made references to technical aspects of the problem. In contrast to Franck's theory, Philippot describes a concept of patina in which it is the medium, not the pigment, which migrates from the paint layer and is consequently vulnerable in cleaning:

...the migration of the binding medium toward the surface in the course of drying determines the luster of the surface, giving the tones their depth and transparency. Consequently, the luster may very well be altered by excessive cleaning long before this is revealed by a loss of pigment. In fact, we all too frequently find paintings ravaged by drastic cleaning that ... has "pierced the skin" of the painting. [52, p. 375]

There is obviously disagreement on the precise nature of the paint-varnish interface, and this is a critical issue in some of the arguments about cleaning. The phenomenon described by Philippot is unconvincing as a general problem, however, since it denies the material differences between paint and varnish layers exploited in cleaning, which will exist whether or not a paint layer has the medium-rich "skin" he describes. As elsewhere in the debate, an indiscriminate removal of material is implied, in which the removal of pigment is presented as the only really discernible indicator of "complete" cleaning.

The notion of patina is integral to the different cleaning ideologies – total, partial and selective cleaning – described by Hedley [2]. It is worth returning to this complex subject to consider some technical aspects of the different approaches. The three categories are useful in defining the aesthetic objective of each approach, in terms of the visual effect of residual varnish layers, but, as Hedley acknowledged, from a practical point of view these clear-cut definitions can be misleading.

Partial cleaning in its ideal sense – the uniform thinning of a varnish layer, or the removal of upper varnish layers to leave a single, even layer – relies on the varnish being reasonably uniform, chemically and stratally, across the paint surface. In many cases, however, varnish will show variation in solubility in different areas of a painting, and the layer structure may also not be uniform over the whole surface. In such cases, partial cleaning is likely to involve a degree of redistribution of varnish from undercleaned areas to areas where the varnish has been removed more readily. Even in an ideal case, the exact mechanism of partial cleaning is unclear. In cases where there are multiple varnish layers it may be
possible to selectively remove only the upper layers of varnish, but where there is no clear solubility differential a precisely controlled “thinning” may not be feasible, and some degree of redistribution of solubilised varnish across the paint surface is again likely to be involved [53]. As Hedley commented

*Candid partial cleaners are prepared to admit that frequently the ‘partial’ effect is achieved by reapplying a thin layer after the dirty varnish has, inadvertently, come off completely in the cleaning.* [47, p. 4]

Partial cleaning is also impossible for certain types of varnish, such as those containing oil. More importantly, it precludes the possibility of removing discoloured retouchings, or those which cover original paint, if these are present beneath the varnish layers. In order to remove such retouchings, as practitioners of partial cleaning acknowledge, complete varnish removal is necessary [54, p. 77].

Total cleaning, too, can be a misleadingly generalised concept in practical terms: adherents to this approach will not generally find it necessary, or advisable, to remove all traces of varnish from a paint surface [47, p. 4]. This is particularly true for paintings which include solvent sensitive or otherwise problematic paint areas, as discussed previously.

Another example of an approach to cleaning can be used to illustrate the overlap between the different categories. John Brealey, who is more often cited as a proponent of selective cleaning, describes an unusual conservation treatment he carried out on a portrait by Rembrandt:

*...when I examined it I could see that in the background there were still traces of the original varnish, which was very beautiful ... The rest of the picture had a modern varnish, which was easy to take off. The problem then was simply to remove those remnants of old varnish which were distributed here and there in the dark background. I squeezed out each swab into a glass jar, and reduced it by evaporation, and sprayed it evenly over the whole surface. And then I discovered that it was possible to put thin-brushed varnish over the picture without disturbing the old varnish.* [55, p. 53]

In this example the aesthetic effect of partial cleaning has been achieved by total cleaning followed by a kind of “retouching” using the varnish residues. This technique is particularly difficult to categorise as regards the preservation of patina. Some, such as Walden, might claim that the complete cleaning destroyed a vital interaction between paint and varnish; whereas others might regard the discoloured varnish residue itself as patina. The same visual effect could arguably also have been achieved by an overall tinting with a stable retouching pigment, effectively a tinted varnish, with the advantage that the long term behaviour – in terms of changes in solubility or colour – would have been more predictable. Any concept of patina would thus be lost, however.
Brealey's treatment, and the problems associated with partial cleaning described above, illustrate situations in which the different approaches to cleaning are used purely to aesthetic ends, since the methods used negate any perceived advantages of avoiding direct contact of the cleaning materials with the paint surface.

1.4. The influence of cleaning research

The investigations carried out in the 1950s and 60s into solvent effects and mechanisms of cleaning, initially by Nathan Stolow and Peter Jones at the Courtauld Institute of Art, and Ian Graham in the Scientific Department of the National Gallery, provided important new information on the response of varnish and oil paint layers to solvent. Of particular significance were the phenomena of swelling and leaching of oil films, described in detail by Stolow [56].

The potential for swelling and softening of paint layers in certain solvents, with a consequent enhanced risk of mechanical damage during cleaning, was already widely recognised by conservators in empirical terms. Stolow provided a physical description of the phenomenon, and outlined some of the main factors involved, particularly with regard to the solubility parameters of solvents and paint films.

Leaching – which is the focus of the research in this thesis – is a term describing the extraction of soluble components of the organic binder, and is distinguished from the problems of solvent sensitivity and solubility of the type addressed in previous sections in that it refers to the removal of organic material from a solid, insoluble matrix. Except in extreme cases, this process will not result in disintegration of the physical structure of the paint film. The potential risks of leaching are longer-term than the more direct risks of physical damage from swelling or softening. In the experiments, leached films were found to have an increased brittleness, as a consequence of the soluble components having a plasticising effect in the paint film, and increased surface mattness resulting from disruption of the paint surface. This effect may contribute to some extent to the matt and “ chalky” appearance which paint surfaces often exhibit after varnish removal, although it is not the only explanation: the natural processes of ageing will increase the mattness of a paint film to some extent, and “chalkiness” can result from residues of oxidised varnish left after cleaning.

An early reference to the effects of solvents, which has been cited by some as evidence of leaching [25, p. 56], was made by Morris Moore in 1853, criticising
Chapter 1

the treatment of Canaletto’s *Stonemason’s Yard*. This painting has, incidentally, since featured in subsequent controversies, as referred to previously. Following the 1852 cleaning, Moore said

*I will here remark, that the chalky, veiled appearance of the immediate foreground is owing to the solvent having disturbed some portion of the body pigment. The sky has a smudged appearance, such as I know, from experience, to be the result of an improper action of some strong solvent. [3, p. 260]*

However, since Moore was commenting on the appearance of the picture after cleaning and re-varnishing, his observations could not correspond to surface effects which might have resulted from leaching, since any chalkiness or mattiness in the paint layer would have been counteracted by the saturating effect of the varnish. Brommelle, examining the picture in 1955, acknowledged that it was in poor condition, and suggested that Moore’s observations may have been in reaction to a combination of residual varnish left by an incomplete cleaning, and the presence of extensive overpaint, which would have become more prominent as a result of the cleaning treatment [3, p. 261].

The research into solvent effects identified important principles which helped in devising and assessing the safety of cleaning methods. In terms of the more general debate on cleaning, however, an extra element of confusion was introduced, largely as a result of differences in opinion as to what extent the behaviour of the model paint films used in the experiments could be related to the behaviour of the significantly aged paint layers in paintings. It is worth noting that the limitations of the experiments were acknowledged by the researchers themselves:

*Although such experiments [on model films] permit studies on adequately characterized materials, the results are open to the criticism that they cannot be extrapolated to enable predictions of the behaviour of really old paint films. [57, p. 119]*

*...it must be emphasised that this paper is based on work as yet in its early stages ... Though we mean to extend our scope in the future to ancient samples of paint and varnish, so far the only materials examined have been varnishes [including oil films] painted out on glass plates three years ago or less. [6, p. 500]*

The change in understanding of solvent effects as a result of the research is reflected in statements from the National Gallery reports from different periods. In 1954 it was candidly remarked that

*The [cleaning] methods now in use may be capable of fundamental improvement, for they are still largely empirical. What actually takes place when a
Cleaning, controversy and research

Solvent comes in contact with a varnish or a medium or a pigment is still fundamentally a mystery. [58, p. 60]

Statements made later in 1962, following the publication of Stolow's research, referred to his data, but in a superficial and somewhat confusing manner. For example, it was stated that

N. Stolow ... has published quantitative data on solvent action and oil-paint solubility, showing that the amount of soluble material in an average pigmented old oil film could amount to about 4%. [59, p. 62]

Apart from the value quoted being irrelevant out of context, especially without a description of the paint film and solvent in question, the reference to "average" and "old" paint films is curious since Stolow hadn't examined films older than 25 years. The report acknowledged that leaching effects could be an issue for paintings, and commented, rather offhandedly, on how the effects might be remedied in practice

At the most we may assume that nearly all the soluble material could be removed from the very surface of the paint in a very thorough cleaning ... But any surface mattness caused by removal of soluble material from the medium can be entirely eliminated by the subsequent varnishing. [59, p. 62]

More recently, in 1996, reference was made to research carried out on paintings in the course of cleaning treatments at the National Gallery, to investigate the effects of the specific treatments used:

Preliminary findings show no evidence for degradative changes in the paint film as a result of the solvent cleaning methods employed at the Gallery...

and the opinion was expressed that

...test films are not a reliable means of assessing the safety of cleaning procedures. [60, p. 52]

This concern – for the relevance of studies of young, model paint films – will be discussed in more detail in the following chapter. It is a recurrent feature in references to the research, expressed in abrupt terms by Laurie as early as 1935

It is obvious that experiments made on recent oil films are useless... [61, p. 34]

In his book The Cleaning of Paintings, Ruhemann discusses cleaning research at some length. There are inconsistencies in his arguments, but his main point, repeated a number of times through the course of the book, reflects the same concern:

...the laboratory tests used are very far removed from what happens during actual cleaning of paintings. The samples tested were comparatively young paint
Chapter 1

films and they were immersed in the pure solvents for a considerable length of time. [18, p. 197]

Given the cautious remarks of the authors, though, he is perhaps unreasonable in asking

...whether the scientists have not considerably overrated the danger of leaching, misled by their own unrealistic experiments. [18, p. 305]

or dismissively referring to

...deliberately exaggerated token experiments [18, p. 201]

Despite these reservations, Ruhemann makes some quite specific interpretations of his own based on the research. For example, referring to Jones’ research [57], he writes

The percentage of soluble matter in stand oil films, which he ascertained to be so much lower than that in raw oil films, may be significant because most old masters’ pictures were probably painted with oils much more like stand oil than like raw oil. [18, p. 305]

This is tenuous considering his previous criticisms of the age of experimental paint films and the use of immersion treatments – the data he refers to is based on 1 year old films extracted for 2 hours or more.

Despite these peculiarities, Ruhemann makes valid points about the nature of the experiments and the danger in interpreting the results too literally. Others have not been so critical in their assessment of the research. In a more recent painting conservation manual, Stolow’s research on swelling and leaching is outlined, and the somewhat casual inference is drawn that

Removing varnish with organic solvents invariably leads to irreversible changes in the paint layer. [62, p. 360]

Other restorers have interpreted leaching and swelling phenomena as technical arguments for the benefits of partial cleaning, on the basis that direct contact of solvent with the paint layer is avoided by this method [54, pp. 72, 122]. This idea was echoed in Hedley’s comment that

Close contact must enhance the risks to the integrity of the uppermost layer of paint. [63, p. 176]

For the practical reasons discussed above, however, the argument is oversimplified, assuming that partial cleaning can be effected in its ideal, theoretical form – thinning, rather than redistributing, varnish. Additionally, Stolow demonstrated that a varnish layer on a paint film does not necessarily act as
Cleaning, controversy and research

a barrier to swelling or leaching, since solvents are able to penetrate rapidly through varnish into the paint layer [64, p. 58].

Elsewhere, the research has been adopted in a crude form by some critics to reinforce the idea that solvent cleaning is damaging to paintings. This can be illustrated by Daley's response to more recent studies of solvent effects and cleaning methods, reported in the 1990 IIC Congress preprints [65], from which he compiled a montage of sound bites from various papers for dramatic purposes, with an evident lack of interest in technical details of the individual studies

Cleaning science barely exists ... Swelling and leaching of moderately aged paints are substantial ... Pigment sensitivity to solvents has been neglected by researchers ... Methods of removing this disfigured [varnish] film are a continuous source of controversy or even polemic ... we may never fully characterise or understand the surface of an aged, varnished, grime-laden paint film ... The effect of solvents on paint films is not completely understood ... It is also known that solvents cause oil films to swell. Does the oil film eventually return to its original state or is it permanently changed? (all abbreviations are Daley's) [25, p. 57]

In a book co-written with James Beck, Daley adapts research results in a similarly superficial way, avoiding description of the details of the experimental conditions and model paint films used, apparently in order to imply that the effects were observed on paintings themselves [66, p. 134].

He also provides his succinct summary

...scientific evidence has recently confirmed that conventional solvents injure paint. [33]

This type of loose interpretation of the research was referred to by Caroline Villers in a review of the book written with Beck

The authors ... indifferently manipulate and misquote scientific evidence, for example on leaching during varnish removal, as if to illustrate confusion and uncertainty within the profession and undermine the apparent objectivity of the work. [67, p. 70]

The wider influence of the research on cleaning practice has been based on more moderate interpretations, somewhere between the extremes represented above of, on one hand, dismissing the work as irrelevant and, on the other, of taking the results at face value to directly represent solvent effects on paintings. As Aviva Burnstock remarked,

None of the research shows damage to old masters [68, p. 61]
Chapter 1

Even so, the principles identified by the research have emphasised the need for caution in the use of solvents, and have been useful in rationalising and informing approaches to cleaning. For example, Stolow’s data on swelling have been used in conjunction with solubility parameter theories to provide guidelines for selecting cleaning solvents which minimise risks to the paint layers [17]. Statements recorded from a cleaning workshop at the 1975 AIC conference also illustrate an awareness among conservators of the potential effects of swelling and leaching, and precautions taken in cleaning treatments [69].

It is clear, though, that the precise mechanisms of solvent cleaning and the relevant chemistry of aged oil paint films are still not fully understood, and that further research is necessary to build a clearer insight into the risks associated with cleaning.

1.5. The role of science in conservation

A dominant feature of every cleaning controversy has been the difficulty in integrating the aesthetic and scientific aspects of the debate, a problem which has been discussed at length before [2, 67]. As David Bomford noted

...conservation stands uniquely at the meeting-point between history, the arts and the sciences, and what concerns – sometimes enrages – [some] critics is that conservators tend to talk about supreme creations of our cultural past in matter-of-fact material terms. The inference is then drawn that conservators are ignorant of or uninterested in these artifacts for anything other than their physical and chemical structure. Conservators are perceived as technicians incapable of aesthetic or historical judgement. [70, p. 3]

The phenomenon was described in more general terms by Villers as

...a binary opposition of Science and the Humanities that has been at the heart of the cleaning controversies this century. [67, p. 70]

This opposition is demonstrated by frequent reference to “scientific” and “aesthetic” approaches to conservation, generally with the implication that the two are mutually exclusive, and the term “scientific cleaning” often used by critics in a derogatory sense, or replaced with other disparaging terms such as “clinical” or “hygienic”. Although it is certainly possible to rely too heavily on material considerations at the expense of aesthetics, or vice versa, both elements are essential in making judgements about cleaning treatments. Gombrich was rearticulating basic principles when he suggested that
Cleaning, controversy and research

...restorers ... should take account not only of the chemistry of pigments, but also of the psychology of perception... [71, p. 48]

The polarised view has also been expressed in romantic laments that

_The restoration studio has been transformed into a conservation laboratory_ [72, p. 349]

or that

_The white coat has replaced the artist's smock_ [66, p. 129]

Sometimes, criticisms reflect a more general confusion about the roles of conservators and scientists, for example Sewell's comment that

...laboratories and scientists have such clear stylistic identities that it is now possible to look at the Queen's pictures or those of the National Trust and immediately identify the restorers, so paramount are their scientific over their aesthetic considerations. [24, p. 21]

This situation creates a conflict. Clearly it is necessary to communicate information about conservation methods, to inform a higher standard of criticism, and to dispel ideas of what has been described as

...the secrecy and hocus-pocus with which many restorers have surrounded themselves in order to make their work appear more magical - and hence more valuable. [73, p. 21]

However, as remarked by Bomford, presenting the relevant technical considerations has always been complicated by an unwillingness among some critics to consider works of art in material terms. It is likely that this scepticism will always exist to some extent, but it can be hoped that it will be reduced by an increasing familiarity with technical conservation issues. In the past this has been attempted through such means as exhibitions and catalogues, an early example of which was the exhibition of cleaned pictures held at the Louvre in 1796, a predecessor of the controversial exhibition held at the National Gallery in 1947. Both exhibitions included partially cleaned pictures, which were doubtless a dramatic demonstration of the need for cleaning, but more important in the case of the National Gallery was the accompanying technical information in the catalogue which gave detailed descriptions of individual cleaning treatments [74]. More recent examples include the treatments of two paintings by Vermeer at the Mauritshuis, The Hague, which were carried out in a specially created studio in view of the public, and were described in a catalogue which explained conservation techniques, including the selection of cleaning solvents [75]. The conservation of Holbein's _Ambassadors_ at the National Gallery was the subject of
Chapter 1

a BBC documentary which followed every stage of the treatment, and included a description of analytical tests carried out to investigate potential effects of the cleaning solvents on the paint layers. These were also described in the catalogue of a focus exhibition based around the cleaned picture [76].

Continuing debate is also valuable. As Bomford observed:

_Controversy can be salutary. It makes conservators think about, reassess, justify and explain their actions and, if necessary, change the ways in which they work; it makes their critics confront the reality of what artworks and cultural artifacts really are._ [70, p. 4]

This is only true if the criticism is reasonably sophisticated and informed, however. The sensationalist invective favoured by some critics, which was a feature of the nineteenth century controversies and which has become prominent again in recent years, tends to be counterproductive, promoting an atmosphere of defensiveness and hostility which hinders open discussion. This further emphasises the importance of presenting and explaining conservation principles to a wider public.

As was mentioned above, the oversimplification and polarisation of issues is a problem in the cleaning debate, as it is with any controversial subject. The problem is not confined to criticisms of cleaning methods: statements intended to explain the safety of solvent cleaning have sometimes been generalised and misleading. Plenderleith, for example, wrote:

_The advantage of mastic is that, irrespective of its age, it can be removed, with ease, by solvents which have no softening effect on the underlying paint film_ [77, p. 524]

and Stout remarked:

_Dried oils do not respond to even the strongest of organic solvents_ [78, p. 21]

Such comments fail to acknowledge the complex chemistry of oil paint, and the risks inherent in cleaning. Caroline Keck was perhaps more realistic in stating:

_All cleaning is hazardous._ [29, p. 79]

The opinion expressed in the 1954 National Gallery report still holds true today – cleaning is, and is likely to remain, a largely empirical process. This is not to deny the value of having an improved technical understanding of paint materials and cleaning methods, however. Hedley provided a reasonable description of the
role, and limitations, of scientific research on complex subjects such as the cleaning of paintings:

*Science then cannot provide the practical conservator with all the answers, it can only give information on which judgements can be more soundly based, skill and experience must do the rest.* [17, p. 16]

**References**


Cleaning, controversy and research


43. White, R., personal communication.


Chapter 1


