

Chapter II

Painting technique : priming, coloured paint film and varnish

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The paint film laid on the support is made of an adhesive, a ground, a coloured layer and a varnish.

1. PRIMINGS AND GROUNDS

The ground is put on the skin glue¹ film which fills the pores of the wooden support, flattens the fibres of the canvas and protects its surface by insulating it from subsequent oil layers² of paint. This ground was of a white colour when used by Primitives, was coloured throughout the 17th and 18th centuries and reverted to white during the 19th century.

When applying the ground to an oak panel, a Flemish Primitive would have used chalk and skin glue, which would have been applied generally in two relatively thick layers ; the final layer would have been rubbed down and have received a priming oil layer³. The thickness of the ground decreased towards the end of the 15th century.

An Italian Primitive however would have used a ground composed of gypsum (*gesso*)⁴ and animal glue : a *gesso grosso* first, then *gesso sottile* ; traditionally throughout the 14th and into the 15th centuries cheese cloth⁵ would have been soaked in this ground and applied to a poplar panel. A glue and later an oil priming layer was sometimes used on the ground⁶.

Europe is divided between these two very different traditions : both in Provence⁷ and in Spain, the use of *gesso* and canvas soaked in the preparation belongs to the Italian tradition ; whereas in Bohemia throughout the 15th century, international gothic style used the Italian technique, Master

Theodoric in the second half of the 14th century preferred painting on chalk which had been previously insulated with oil, according to the northern tradition⁸. Germany and Poland⁹ also belong to the northern tradition, as well as northern France¹⁰, Touraine¹¹, England and Norway, the latter having maintained for a long time the use of textile soaked in the preparation, in the form of strips along the joints of the wood¹². In Portugal¹³ the ground is particularly thin with weak hiding power and is either made of *gesso* according to the southern tradition or of chalk according to Flemish custom, thus reflecting perhaps the political links between Lisbon and Flanders.

Paintings on canvas by Primitive painters have rarely been preserved because of their fragility, although they were numerous, as is shown in contemporary texts : *drapelet* in France¹⁴, painting made on *tela rensa* in Italy¹⁵, or *Tüchlein* in Germanic countries¹⁶. The preparation of the thin *tela rensa* in Italy is made up of *gesso sottile* and skin glue mixed with starch or sugar¹⁷, both these last elements helped to make the ground less fluid, therefore filled the hollows of the textile more adequately and by their hygroscopicity helped to make the whole ground a little more supple.

In Flanders only skin glue adhesive and no ground goes on to the very thin flax canvas called *Tüchlein*¹⁸.

In the 16th century a second white ground made of oil and lead white¹⁹ was inserted between the first white glue ground and the coloured layer of the painting ; oil lead white has insulating qualities because of its medium characteristics ; this white ground has an important part to play as it intensifies the light's reflexion because of the lead white which is a very hiding pigment with a strong reflecting power. It therefore strongly contributes to the vividness which is characteristic of the 16th century paintings ; oil lead white is not rubbed down as a glue white, it is sufficient to make the oil lead white visible under the coloured surface²⁰.

In the 16th century the new rigid stone supports (lapis-lazuli, marble, slate) could be painted on directly²¹ ; on metal supports in general a mere garlic juice²², or at times a clear oil layer without pigment, was put on copper or tinned copper, and secured the adhesion of the coloured oil layer.

The first coloured grounds on canvas appeared at the end of the 16th century²³ ; oil was substituted for glue which made the preparation less brittle and more adequate for supple cloth support.

From the 17th century onwards and except for the wooden supports of northern Europe which are still painted over with glue preparations, these white glue grounds disappeared on canvas and were replaced by oil coloured grounds either simple or double.



Fig. 1. Francesco d'Antonio, called 'Balletta', Virgin and Child (detail), Italy, 15th century. Avignon, Petit Palais Museum, Inv. 20 153 (Neg. Agraci = Arts Graphiques de la Cité).

A large network of horizontal craquelure, perpendicular to the woodgrain is caused by the movement of the poplar support transmitted by a thick ground in which the canvas is soaked.

The egg medium dries quickly and requires juxtaposed strokes to create the volume.

In Italy, from the beginning of the 17th century onwards, the oil ground²⁴ was brown-red and answered to the need for economy required by the *fa presto* ; on canvases the weaving of which was loose, this thick ground spread with a knife, created a structure referred to as *pavimenteuse*, typical of Caravaggesque artists²⁵. Red ground continued to be typical of the Italian technique in the 18th century in Italy with Canaletto and Piazzetta²⁶⁻²⁷.

In northern Europe from the very beginning of the 17th century, the ground was light ochre on canvas²⁸ and even on wood sometimes, later on with Van Goyen. However the most frequent structure was that of the double oil ground with either a beige layer (yellow ochre or « potter's clay »), or a red layer (red ochre or umber) covered with a grey layer (lead white and charcoal black), clear as with Van Dyck, Rubens, Jordaens²⁹, or with a darker grey in Holland, specially with Rembrandt or Lievens³⁰.

The French tradition illustrated by the works of Poussin³¹ consists of the use either of a simple oil red ground, even on wood (Le Sueur, painting of the *Chartreuse de Paris*, 1645-48) or superposes on a first red and warm ground, made up of nut or linseed oil, brown-red earth, with a little lead-white to improve the siccativity of the oil, a cold layer, called a « grey eye »³², which is made up of lead white and charcoal black, the thickness of which gives a more or less pink impression, typical of Boucher and Coypel³³.

Simple egg white makes the colour adhesive for ivory which was a usual support used at the end of the 18th century for miniature paintings or the art of limning³⁴.

Neo-classical painting, glossy and clear on white ground mentioned for the first time in 1788³⁵ succeeded baroque painting where luminous *impastos* stand out against a dark background. On the loose canvases of the early 19th century the ground was made up of oil lead white very thick and perfectly glossy ; later it became thin and let the texture of the close canvases of the Barbizon School and of the impressionnists appear.

Lead white more or less laden with kaolin³⁶ or barium sulphate³⁷ was replaced at the end of the 19th century by zinc white. Canvases of the second part of the 19th century were spread by an industrial technique on large surfaces and then were cut and bitted on a frame ; they can be distinguished from the canvases prepared by the artists because the edges spread with ground are folded onto the frame.

Imprimitura

The *imprimitura* is a greyish layer summarily spread with a large brush and which lets the white ground show through ; this layer is a medium term between shades and high lights which was frequently visible in the 17th century, especially in Rubens' works on wood ; its analysis has revealed its composition : lead white, chalk, bone black mixed with aqueous binding medium³⁸⁻³⁹.

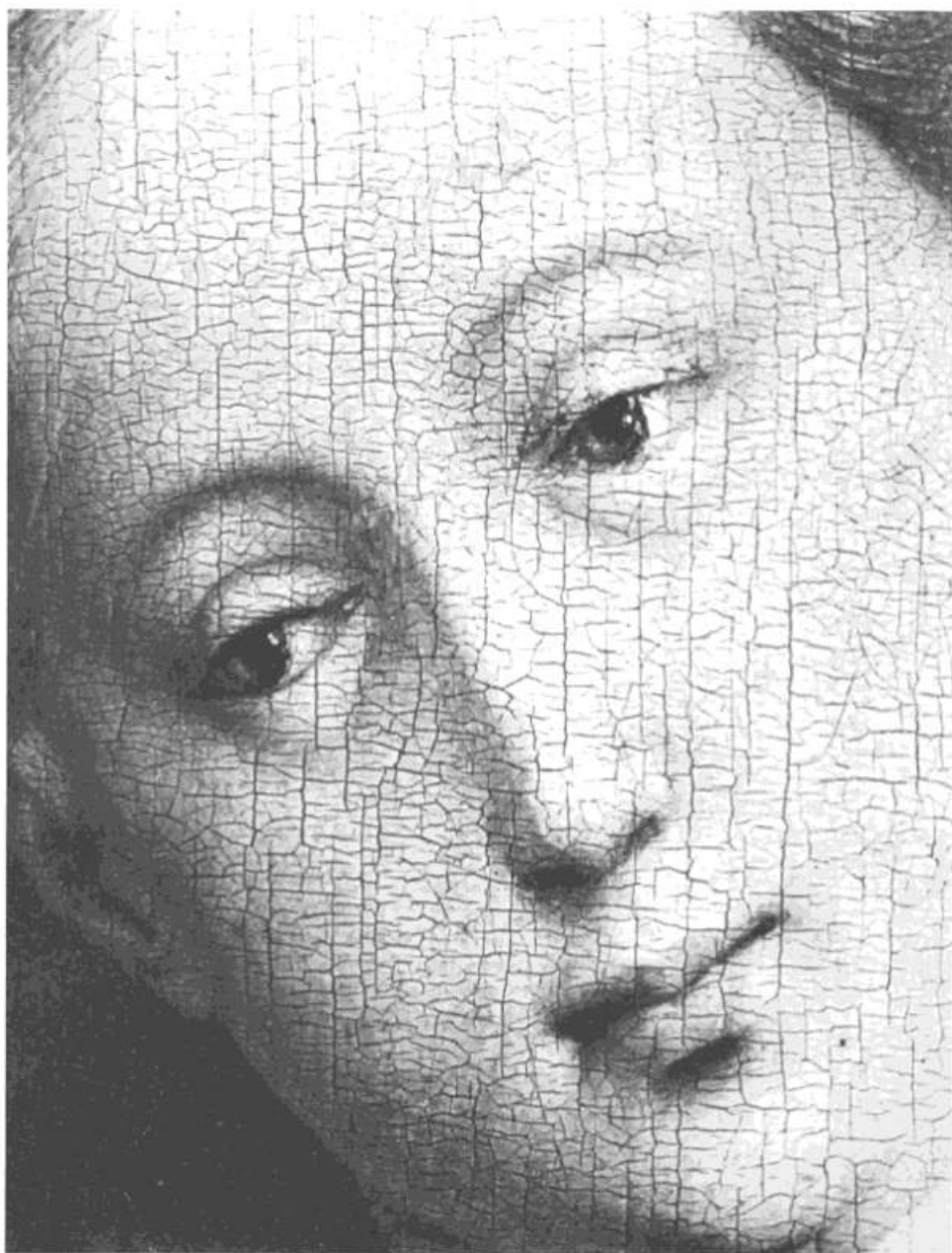


Fig. 2. Roger Van der Weyden, The angelic Salutation (detail), Flanders, 15th century. Paris, Louvre, Inv. 1982 (Neg. SRPMN = Service de la Restauration des Peintures des Musées Nationaux).

The fine network of vertical craquelure, parallel to the wood grain is due to the movement of the support of the oak that is covered with a rather thin ground. The oily medium covers and allows a mellow modelling.

2. COLOURED PAINT FILM

The coloured paint film is made up of pigments and mediums ; its nature and use have varied over the centuries.

Pictorial technique developed from the superposition of paint films which owed their colour to a small number of pigments and which did not show the trace of the paint brush to the complex mixtures of numerous pigments and the increasing importance of *impastos*, in so far as individualism as early as the 17th began to gain on the *bottega* manner or medieval workshop that unified painting technique. In the 19th century touches were juxtaposed and their form or treatment was essential and typical of each artist, and not any more of a group of artists.

2.1. *The colour palette*

A small number of pigments similar in Italy and in Flanders, almost all of them of mineral origin, characterizes the Primitives' palette ; enriched with smalt and copper resinate in the 16th century, it became broader during the 17th and 18th centuries through the use of yellow and green organic pigments and through the input of the new developments in chemistry, such as Prussian blue in 1704 ; this palette became even more diversified from the 19th century onwards as many chemical syntheses of colour were being developed. Each pigment is characterized by its colour, grinding and hiding power.

2.1.1. *Blue*

The two most common medieval pigments were azurite, blue-green with hiding power, also called German blue or mountain blue, and lapis-lazuli, blue-violet, with little hiding power, also called lazulite or natural ultramarine.

Azurite⁴⁰, a transparent light mineral blue also called copper carbonate has to be coarsely ground in order to retain its colour ; in the Italian Primitives' painting, it often forms a rather thick colour paint film, the interstitial oleo-resineous brown medium of which is responsible for the blackish aspect of the whole paint film ; there is often an underneath paint film which is either light blue (azurite and lead white) or grey (charcoal black and lead white)⁴¹. Azurite, which is very commonly used in northern Europe, is used with oil, often in the Flemish Primitives paintings, covered in surface with lapis glaze with an aqueous medium⁴². Azurite went on being used in the 17th century (Rembrandt)⁴³ and until the early 19th century.

Lapis⁴⁴, finely ground (alumino-silicate of sodium and potassium) is a very precious and expensive mineral ; it is often mentioned as is gold, in



Fig. 3. School of Avignon, Pietà (detail), Provence, 15th century. Paris, Louvre, R.F. 1569 (Neg. LRMF = Laboratoire de Recherche des Musées de France). The drying oil causes areas of build-up.

contracts concluded between artists and customer ; lapis may, because of its sulphur impurities, inhibit the drying of the oil⁴⁵ ; it has a very stable colour, except when submitted to the action of acid which discolours it. It is very common in southern Europe and is still in the 17th century the Romanelli's and Guerchin's⁴⁶ preferred blue ; it has been used unceasingly to this day.

During the 16th century appeared the use of smalt⁴⁷ which is light blue and transparent, glass coloured by cobalt and is stable in fresco, but very instable in oil which discolours it ; a smalt glaze in time becomes opaque and yellowish and may be confused with a *chanci* in French, sometimes called mould⁴⁸.

Indigo, or aniseed starch, was replaced in the 17th century by pastel or blue *de guède*, after the name of the plant the development of which was to establish the fortune of the Toulousan people⁴⁹.

Except for lapis, rare and expensive, all such blue colours have a weak colouring power ; this is why the fortuitous discovery of an intense blue, though somewhat greenish, in 1704 by Dippel and Diesbach in Berlin, Prussia, was greeted as a major event and published in 1710 ; this new blue (potassium ferrocyanide) seems to have been used in 1722 by the Dutch painter J.G. Collazius⁵⁰.

In the 19th century new solid blues were discovered : Thénard in 1802 obtained cobalt blue (cobalt oxide) which was hardly used before 1830 ; it replaced smalt which was no longer used in the 19th century ; after Tassaert's observations in 1814 at Saint-Gobain, Gmelin in 1822 synthesises ultramarine which was commercialized in 1830 by Guimet and Köttig in Meissen⁵¹.

2.1.2. Green

Green earth, of a pale green colour, not very covering, very hydrous iron oxide, is a stable colour which is constantly used.

The green-blueish malachite⁵², sometimes called azur-green, with low hiding power, a copper carbonate, more hydrous than azurite ; this pigment has to be coarsely ground to retain its colour ; it turns reddish brown in time through the formation on the surface of the paint film of red oxide. Malachite is the basic tone of underlying paint film in Flemish Primitives' painting, which is covered with a transparent green copper glaze ; it was commonly used until the end of the 18th century.

Verdigris⁵³, light but vivid, owes its colour to copper ; this copper acetate is manufactured with copper filing attacked by vinegar ; verdigris in oil has a very low hiding power and is the ideal pigment for green glazes ; these glazes turn brown with time by oxidation and formation of red oxides on their surface.



Fig. 4. Matteo di Giovanni, Tarquinia and Lucretia (detail), Italy, 15th century. Paris, Cluny, CL 7500 (Neg. Agraci).
Brocade in sgraffito : the gold background underneath reappears itself as grooved streaks in the woman's gown.

Copper resinate⁵³ appears in the 16th century with its transparency of green, obtained by steeping of verdigris in resinous solution (Venice turpentine), the whole mixture put on to hot ashes ; a transparent copper resinate glaze layed on a verdigris background often plays the part of a radiation selector and contributes to the brilliancy of 16th century greens. Copper resinate seems fairly stable and browns less than oil verdigris glazes⁵⁴, already being recognized as being so fragile by Leonardo in 1519 that they had to be locally coated with varnish as soon as they had been laid⁵⁵. Resinate thus layed in several films with a brush could be glazed with a very fine last film spread with the palm of the hand⁵⁶, probably on account of its weak fluidity.

In the 17th and 18th centuries, fugitive greens of organic origin are chronicled, such as the iris or the sap green⁵⁷, the latter deriving its name from the envelope which is used to preserve the colour obtained by fixing on alun a colouring material extracted from the shrub, the nerprun : it is a greenish lake which fades easily.

In the 19th century, new solid greens with high colouring power are created ; opaque chrome oxides discovered around 1809 and introduced in painting only after 1862 ; hydrous chromium oxide, transparent prepared in 1838 by Pannetier is put on sale in 1859 by Guignet (*vert émeraude* or viridian green) ; arsenic greens are either a copper acid arsenite, discovered by C.W. Scheele in 1778 in Sweden or a copper aceto-arsenite, discovered in 1814 by doctor Liebig and Braconnot in Schweinfurt (Emerald green or Vienna or Brunswick green).

2.1.3. Yellow

The two most important yellows used by the Primitives are ochre (Mars yellow), the colour of which derives from iron oxide, and *giallolino* of a lemon yellow colour, lead-tin yellow, wrongly referred to as *massicot* or lead yellow in northern European manuscripts⁵⁸ ; it is a double oxide of lead and tin which is very difficult to grind, erroneously known in the 17th and 18th centuries as Naples yellow⁵⁹.

Realgar⁶⁰, a more rarely used, orange (from the Arabic word *Rahj-al-gar*, powder of the mine) and orpiment, yellow (from the Latin *auripigmentum*, golden colour) are both arsenic sulphides, hence poisons.

Among organic yellows, there is safran, a colouring matter, extracted from a plant with a lye and which is used to confer to a varnish layer a golden colour to glaze a tin leaf⁶¹ and arzica extracted from reseda⁶², which generally fixed on alun, becomes a pigment and seems to be the Wau yellow (or Weld yellow)⁶³.

In the 17th century appeared a new type of yellow of a somewhat greenish or brownish colour, the *pink* sometimes *brown pink*⁶⁴ which is a lake obtained by fixation of the colouring material taken from the buckthorn



Fig. 5. School of Avignon, Saint Augustine (detail), Provence, 15th century. Paris, Louvre, R.F. 3697 (Neg. Agraci). Applied brocade : two horizontal lines define blending of the leaves, heavy in wax resin and gilded.

berries, isatis, and Avignon grain (nerprun) on chalk and alun. It was already said at that time that such a pigment was untrue because on the one hand it was fugitive and on the other its colour turned to brown or green according to how basic the manufacturing conditions were. Gumgutte (or gambodge) and Indian yellow made with urine of cows fed on mango leaves, were also used in painting.

In the 19th century chrome yellow (lead chromate) obtained in 1809 by Vauquelin, commercialized in 1818, appeared to replace Naples yellow, and cadmium yellow (cadmium sulphide) was also discovered by Stromeyer in 1817, tested in oil painting by Melandri in 1829 and commercialized around 1846.

2.1.4. Red

Red ochre or Mars red, clay coloured by anhydre iron oxide was continually used during Antiquity up to our times in the form of the Armenian bole of the Primitives⁶⁵, specific underlying film of gold and silver or in form of *sinopia* clay coming from Sinop on the Black Sea⁶⁶, and which forms part of the composition of the *cinabrese* of Cennino Cennini⁶⁷, which is not cinnabar but a mixture of two parts of *sinopia* and one part of white.

Cinnabar or vermilion⁶⁸, an intense red which is very hiding and has a high reflecting power, is a mercuric sulphide generally artificially prepared ; it is the usual underlying film of red garments of the Primitives, both flemish and italian.

Minium, red lead (red tetroxide of lead) light red, with high hiding power has been known forever, but is more rarely used than cinnabar.

Among organic reds which were more often used as lakes and especially in Primitives' works, can be quoted 'kermes' (berry in Arabia) which was found in Sassetta's painting⁶⁹ (colouring material taken from a dead insect which settled on a shrub, was mistaken for a berry, drawn out with a lye and fixed on alun to form a pigment). Layed over cinnabar the red transparent lake plays the part of a radiation selector and contributes to the brilliancy of the red colour ; as a thick film, it contributes a deep shade of a nearly black red of current use both in northern and southern Europe. The *dragon's blood* colouring material extracted with alcohol from a resin, is sometimes used to glaze gold leaves⁷⁰.

In the 17th and 18th centuries organic reds are mainly extracted from American cochineal⁷¹ (carmine) and Brasil wood⁷² fixed on chalk and alun. Madder lake⁷³ which is mentioned in the 17th century only became of current use in the second half of the 18th century and was mainly used in the 19th century.

Cadmium red (cadmium sulpho-selenide) seems to be known in Germany in 1892 and traded only after 1910.



Fig. 6. Pieter Paul Rubens, *The Village Fair* (detail), Flanders, 17th century. Paris, Louvre, Inv. 1797 (Neg. LRMF). *Imprimitura* : the vertical rapid movement of a large brush on a white ground is visible on the right.

2.1.5. *Brown*

Umber (which comes from Umbria) used throughout history is a raw or calcinated clay the colour of which comes from iron, Cologne or Cassel earth (Van Dyck brown), well known in the 17th and 18th centuries has a bituminous characteristic that means is liable to dissolve into oil⁷⁴ ; *brown pink* coming from England is very brown⁷⁵ ; since the 16th century asphaltum or bitumen is mentioned for obtaining the shades of flesh-tints⁷⁶.

2.1.6. *Black*

Charcoal black with blueish glints extracted from wine-shoots or peach stones, more or less equally ground, is constantly in use from Ancient times to the present days as well as bone black or ivory black.

Smoke or lamp black which is a little brownish, obtained by burning oil under a saucer and by taking the deposit is a very fine black ready for use.

2.1.7. *White*

St. John's white of Cennino Cennini is a chalk white which is partially carbonated⁷⁷.

Lead white⁷⁸ (basic carbonate of lead) one of the first artificial pigments, prepared since ancient times, is a dense pigment, very hiding with high reflecting power which corresponds to the *biacca* of very high quality of Cennino Cennini⁷⁹ and to the flake or silver white of the 17th and 18th centuries⁸⁰ (Krems or Cremnitz white).

Ceruse, an even mixture of white lead and chalk⁸¹, which enabled artists to obtain dryer impastos, is an adulterated lead white, currently called also in the 17th and 18th centuries *biacca*. At the end of the 19th century lead white was replaced by zinc white (zinc oxide).

2.2. *Mediums*

Egg medium painting called *a tempera* painting, is the technique used by icon artists and Mediterranean, especially Italian Primitives up to the second half of the 15th century ; egg, which is characterized by protein and fat, is an emulsion : it dries quickly and requires a juxtaposition of paint strokes to obtain a relief effect.

Aqueous medium painting, using glue (animal and vegetable), casein, fig-tree, arabic gum, is called distemper painting ; this is an additional technique resorted to for certain pigments by the Primitives⁸² and was a principal technique for theatre settings in the 17th and 18th centuries⁸³.

In oil painting, three media have been used : as from the Middle Ages linseed oil, the most siccativ, but colourful, so much it needs to be bleached, walnut oil, known in the 15th century, which is less siccativ, but lighter in colour, poppy-seed oil⁸⁴ even less siccativ and lighter in colour, used mostly



Fig. 7. *Nicolas Berchem, Landscape with animals (detail), Flanders, 18th century. Paris, Louvre, Inv. 1046 (Neg. Agraci).*
Working with the butt end of a brush : dark glazes of the trees have become animated and deep by turning the brush and using its handle.

from the end of the 18th century onwards ; the drying power of an oil depends on its nature⁸⁵, but it may be increased by a pretreatment (cooking heat and ultraviolet sun rays)⁸⁶ and by the addition of a drier ; the best are based on lead (litharge, for example) ; the so called clear and thick *stand oil* of the Primitives⁸⁷ cooked and sun heated with litharge, is a drying oil. To make the oil more fluid, essential oils (aspic, turpentine and rosemary) were added as early as the 16th century⁸⁸ ; to give the consistency resin was also added, and this is attested by sources in the 18th century according to a German fashion of the time⁸⁹. At the beginning of the 19th century, were obtained in France through heating, oxigenation and addition of lead, supersiccative oils, which were responsible for large drying cracks, often ascribed wrongly to asphaltum⁹⁰.

The passage from egg to oil was very slow ; oil was known very early in the northern Europe, as far back as the 13th century in England⁹¹, Norway⁹², and in the 14th century in Italy, where it was the preferred medium for certain pigments such as verdigris or red lac⁹³ but it was in Flanders, at the times of Van Eyck, in the early 15th century that its perfect mastery appeared, that is the exploitation of all its possibilities as a medium which spreads out and leaves, before it dries, enough time to blend the colours, it was also known as a medium having a certain degree of thixotropy which may still leave on the pictorial material the form of the touch given to it by the brush ; it is accepted that the flemish Primitives' medium was made up of oil mixed with an unknown material⁹⁴ which was according to some, a resin⁹⁵, or water or an additive liquid⁹⁶. In this mixture the latter element has partially disappeared and is only trapped by the emulsifier (protein drawn from egg or from glue) ; the oil medium, of current use in the region of Venice around 1480-1500, must have been still thick and difficult to use, to such an extent that it was often spread out with the palm of the hand, even in the entourage of Leonardo⁹⁷.

A mixed method *a putrido*, attested in Italy from the beginning of the 16th century, consists of a mixture of oil, water and egg⁹⁸ (the egg being used as an emulsifier) ; this may have been rather late but brilliant proof of the Flemish mastery of the oil painting technique.

Wax media, elaborated in the mid-18th century in France⁹⁹ and in Italy¹⁰⁰, are of three types : the *punic wax*, soap obtained by boiling the wax with a base¹⁰¹ and two encaustic methods, either the wax mixed with the colour and melted with heat, or a mixture of wax and resin¹⁰² fluidified with a volatile oil and fixed by heat.

2.3. Utilization

Stricto sensu, glaze is a colourful transparent paint film and by extension a colourful translucent layer, thus rich in medium and poor in pigment ; a



*Fig. 8. Jean-Honoré Fragonard, Inspiration (detail), France, 18th century. Paris, Louvre, MI.1060 (Neg. LRMF).
Rapid writing or glazes and dense build-up of color are deposited by a brush whose width is visible.*

glaze makes the underlying colours vibrate. Full paste is a very rich paint film in pigments but is poor in medium ; half-paste is the intermediary step between glaze and full paste.

The scumble is the effect obtained through transparent material rapidly laid with a brush, the traces of which are left visible.

The Primitives distinguished themselves by superimposing colour paint films and a fairly smooth matter.

In the Flemish Primitives' works, on the underlying layers which are already modulated, clear and still visible as if in reserve of light, are placed shades which are thicker, the deeper the shade ; in the Italian Primitive's paintings, the underlying paint film often corresponds to a middle tone on which white is placed in the high lights and a dark colour in the shades.

The process described by Cennino Cennini for painting a silhouette on a gold background is the following : on the gesso the coal drawing is confirmed with ink ; an incision made with the *stiletto* represents the limit between the part to be gilded and the figure which is to be painted ; the surface which is to be covered in gold, receives at least four Armenia bole layers mixed with beaten egg white (or skin glue)¹⁰³ ; the leaves of gold are put on egg white (or skin glue) ; gold burnished with bone or agate assumes a brilliant aspect ; the halos are retaken with a compass and the decors with chasing-chisel ; these decors, instead of being hollow may be enhanced *a pastiglia*, that is in gesso relief well stuck together and sculpted, and receiving the red bole and the leaves of gold. When silver replaces gold, the technique is identical. The Italian Primitives' brocades are obtained either by scratch or *sgraffito*, or by addition of mordant gilding or shell gold. In the case of *sgraffito*¹⁰⁴ current in the 14th century which was a dual technique of canvas painting and polychrome sculpture, the coloured layer put on the gold or silver background on the bole, is removed by scratching it with a *stiletto* which causes the brilliant underlying metal to reappear. It can be noted that in the very similar case of the Spanish *estofado* the colour alone has been removed from the underlying gold without incision. When a mat mordant gilding decor is added to a garment¹⁰⁵, which was a very frequent occurrence in both the 14th and 15th centuries, an oleo-resinous mordant is put on the garment to be decorated, during the drying period a beaten gold leaf is applied on top of it as thin as possible : after brushing away the excess, the gold remains only on the exact spot of the mordant ; a shell gilded decor can also be added on a garment, that is with a mixture of leaves of gold ground with egg white in a shell ; this is gold paint posed with a brush and is a technique which was hardly in use before the late 15th century.

An Italian Primitive's¹⁰⁶ skin colouring is obtained by superimposing over an underlying paint film of green earth mixed with white lead and bound with egg yolk, white touch-ups on the bright tones, red on the lips and the cheekbones and of *verdaccio*¹⁰⁷, which is a brown colour (yellow ochre, black,



Fig. 9. Louis David, Madame Trudaine (detail), France, 18th century. Paris, Louvre, RF.670 (Neg. Agraci).
Scumble called 'Davidian': the brush deposits rapidly a dark glaze on a light background.

white and red) in the shades ; this *verdaccio* does not cover the green under the skin to the point it prevents it from showing through. Current in the 13th and 14th centuries, this technique disappeared from the mid-15th century onwards.

From the 14th to 16th centuries the technique of applied brocade, or *Kuttendruck*¹⁰⁸, is found in England, Rhenania, Bohemia and extends to Avignon : a complex of glue, resin and wax mixed with chalk is moulded on a thin tinfoil at the bottom of a rectangular striped mould, then the whole mixture is unmoulded and gilded and heat applied with a resinous adhesive and constitutes an element of the supple brocade, adapted to both sculpture and painting.

The Flemish Primitives' brocades are obtained without metal and with paint only : in the 15th century a background modulated tone is touched up with vivid yellow touches of lead-tin-yellow, very dense in the bright tones and more spaced in the shades ; later on at the end of the 15th century, on a middle flat tone, the brocade effect is obtained by equally dispersed strokes of vivid yellow in the bright tones and of rose in the shades¹⁰⁹.



Fig. 10. Ary Scheffer, *The Intoxicated Women (detail)*, France, 19th century. Paris, Louvre, Inv. 7857 (Neg. Agraci).
Premature cracks are due to poor drying of a strong drying oil abundant in the shadows in glazes.

The gold backgrounds in northern Europe were often dull in the late 15th and 16th centuries and belong to the mordant gilding technique (leaves of gold on an oleo-resinous mordant).

Everywhere in the 16th century the use of an uniform general white layer of oil lead white was developed, used either as a visible plan on which the scumbles were laid and from which the graphic impastos of the high lights detached themselves as in Bosch or Breugel paintings¹¹⁰, or as a reflecting underlying paint film casting the brilliancy of the matter which is increasingly rich in glazes of Raphaël¹¹¹ and later of Italian manierists ; even if the pictorial matter was still constituted of superposed layers, its surface was already no longer perfectly smooth, but fraught with impastos which 'broke through' the glazes.

In the 17th and 18th centuries artists rapidly juxtaposed on a coloured preparation generous impastos and sought facture effects such as *dauidien* scumbles in which the width of the brush is visible¹¹² or the shaft work of many nordic painters¹¹³, or knife work such as in Rembrandt's works¹¹⁴ ;



Fig. 11. Ignace-Henri Fantin-Latour, *Roses in a Vase (detail)*, France, 19th century. Paris, Louvre, R.F. 1961-25 (Neg. Agraci). Great variety of impasto : on a canvas with a thin ground that leaves the texture visible, color density in high relief make up the rose.

certain pigments still locally required in the bright tones an underlying lead white paint film to get the maximum brilliancy, as in Guerchin¹¹⁵, the lapis-lazuli blue and the red lacquer used as a glaze : this was the end of the superimposition technique.

In the 19th century the taste for the neo-classical blend led to the mixture of tones which imperceptibly went from one to another in a fluid medium which 'spread' ; then the scientific research of Chevreul in the field of colorimetry introduced a new vision based on the recomposition in the eye of colours juxtaposed on a white background : announced by the *flochetage* of Delacroix the division of touches of the impressionists, achieved by frank colours taken out of the tube and laid by impastos, was codified by the neo-impressionists where the touches were spots of colour put on white preparation. At the end of the 19th century the impastos both thick and varied in form corresponded more to each artist than to a period of time : another step was taken toward individualism.

3. VARNISHES

The final protective paint film laid on a painting deepens its tones ; it may be made up of beaten egg white¹¹⁶ or more often a varnish said to be *maigre* made from tender resin (mastic, known from ancient times ; dammar known it seems in the 19th century) dissolved in an essential oil (turpentine, aspic or rosemary), or a greasy varnish of hard resin (amber and copal rather in the 19th century) dissolved (often after pyrogenation) and plastified by linseed oil.

On italian Primitives' paintings, even painted *a tempera*, a 'liquid' varnish according to Cennino Cennini¹¹⁷ could be placed, which was a mixture of sandarac resin and linseed oil ; in the 15th century essential oil varnishes appeared¹¹⁸ (made from mastic and sandarac) ; from the 17th century up to our days, the mastic varnish, tender faintly coloured resin, easy to re-dissolve was considered as the best painting varnish¹¹⁹.

4. NOTES

1. Parchment glue (1437, Cennino CENNINI, *The craftsman's Handbook*, the Italian *Il libro dell'arte* (by D.V. THOMPSON), New York, 1966, used warm to increase its fluidity and improve penetration. Parchment glue (in *Pierre Lebrun, Recueil des essais des merveilles de la peinture*, 1635, published by Mary P. Merrifield, *Original treatises on the arts of painting*, vol. II, New York, 1967, p. 767-841).

Animal glue is characterized by its protein content und thus differs from starch glue which has vegetable content.

2. A manuscript by Volpato written in the 17th century and published by Merrifield in 1967, p. 729 (*op. cit.*, note 1) : « If the canvas is not glued which would protect it from the oil, it looses its strength and becomes brittle. » When it grows old, the oil becomes acid and accelerates the decay of the textile fibres by means of catalyse of the cellulose oxidation.

3. P. COREMANS, *La technique des primitifs flamands*, in *Studies in Conservation*, 1952, vol. 1, n° 2, p. 145-161 ; C. PÉRIER D'ETEREN, *La technique picturale de la peinture flamande du XV^e siècle*, Congrès d'Histoire de l'Art, Bologne, 1979 ; R. VAN SCHOUTE, *Le Portement de Croix de J. Bosch au Musée de Gand*, in *Bulletin de l'Institut royal du patrimoine artistique*, II, 1959, p. 47-58.
A canvas drenched in ground was to be found in the 14th century, but was relatively rare and disappeared completely from the beginning of the 15th century.
4. The gesso *grosso*, gypsum from Volterra, crumched and sifted is very white and mixed with skin glue ; the gesso *sottile* kept under water and properly dried outside, undergoes partial carbonation and contains 1/2 white wash ; it is a basic material capable of being mixed with protein to give a very stable composition (albuminate or calcium caseinate) ; a further carbonation is possible ; gesso *sottile* or St. John white (see E. DENNINGER, *What is Bianco di San Giovanni*, in *Studies in Conservation*, 19, 1974, p. 185-187) is transparent and mixed with fish glue ; 1437, Cennino CENNINI, *op. cit.*, note 1).
5. When the canvas is drenched in a thick ground, this leads to a large network of main cracks which are perpendicular to the grain of the wood ; when there is no canvas the network of cracks is closer and its general direction is parallel to the grain of the wood.
6. J. PLESTERS, *Microphotographies de coupes de couches picturales et de préparations*, in *Museum*, XXI, 1968, p. 257-265.
7. The *Pietà* of Avignon School (RF 1569) in the Louvre is painted on gesso in which a canvas is drenched.
8. F. HORČIČKA, *Der Vorschlag auf die Restaurierung der Bilder M. Theodoricus, von Fr. Hořička. Nach dem Original abgeschrieben aus dem Archiv auf der Prager Burg*, Icom Committee for Conservation, 20/72/8, Madrid, 1972, 8 p.
9. J. NYKIEL, *The technical structure of paintings from the so-called Cracow School (1420-1460) on wooden supports*, in *Ochrona Zabytkow*, 22, n° 4, p. 273-284, 1969.
10. The oak support of Jean le Bon's portrait, dated 1360 (French School, Louvre, RF 2490) was prepared with chalk in which a canvas was drenched.
The use of chalk was mentioned in the *Manuscrit de le Bègue* (1431, Paris, published by M. MERRIFIELD, *Original treatises on the Arts of Painting*, vol. I, New York, 1967, p. 280).
11. Fouquet's paintings or those of the Maître de Moulins are primed with chalk ; this is evidenced by an analysis by the Louvre's research laboratory.
12. L.E. PLAHTER and U. PLAHTER, *The technique of a group of Norwegian gothic oil paintings, Lisbon Congress, 1972*, International Institute for Conservation, London, 1972, p. 131-138 ; L.E. PLAHTER, E. SKAUS and U. PLAHTER, *Gothic Painted Altar Frontals from the Church of Tingelstad: materials, technique and restoration*, Universitetsforlaget, Oslo, 1974.
13. A. DE MOURA, *A study of Portuguese painting technique in the 20th century, Lisbon Congress, 1972*, International Institute for Conservation, London, 1972, p. 301.
14. N. REYNAUD, *Jean Fouquet, Dossier du Département des Peintures*, n° 22, Paris, 1981, p. 9.
15. *Tela rensa* is fine Reims canvas, tightly woven in cheese cloth and was used by Mantegna. See J. RUDEL, *Le problème du support dans l'histoire de la peinture*, in *Revue de l'information d'histoire de l'art*, n° 4, 1962, p. 158-164.
16. A. PHILIPPOT, N. GOETGHEBEUR, R. GUISLAIN-WITTMANN, *L'Adoration des Mages de Bruegel aux Musées royaux des Beaux-Arts de Belgique*, dans *Bulletin de l'Institut royal du patrimoine artistique*, XI, 1969, p. 5-34 ; E. BERGER, *Quellen für Maltechnik während der Renaissance und deren Folgezeit*, Munich, 1901, p. XXXIII : Dürer's letters, Journal Ed. Thausing, p. 84, line 12.
17. Cennino CENNINI, 1437, p. 103, *op. cit.*, note 1.
18. C. PÉRIER D'ETEREN, *op. cit.*, p. 9. J.R.J. VAN ASPEREN DE BOER, *Examen scientifique des peintures du groupe Jan van Scorel d'Utrecht*, in *Catalogue d'Exposition, Musée de la Chartreuse*, Douai, 1977, p. 51-55.
19. S. BERGEON, *La Restauration des Peintures, Dossier du Département des Peintures*, n° 21, Paris, 1980, p. 14. In Flanders this second priming is present even at the end of the 15th century, see C. PÉRIER D'ETEREN, *Méthodes scientifiques d'examen à mettre en œuvre pour améliorer les connaissances de la technique picturale des primitifs flamands*, ICOM Ottawa, 1981, 81/1/10.
20. *Saint Paul* by Perugin (Louvre INV 721).
21. 1564, *Vasari on technique* (Luisa Maclehorse 1907), New York, 1960, p. 238-239.

22. R. DE PILES, *Les premiers éléments de la peinture pratique*, Paris, 1684 (éd. Minkoff, Genève, 1973, p. 65) ; J.A. VAN DE GRAAF, *Development of oil paint and the use of metal plates as a support, Lisbon Congress, 1972*, International Institute for Conservation, London, 1972 ; R.D. BUCK, *Note on laboratory examination : a landscape with Flight in Egypt by Domenichino*, in *Allen Memorial Art Museum Bulletin*, XXVI, n° 3, 1963, p. 103.
23. J. PLESTERS and L. LAZZARINI, *Conservation and restoration of pictorial art : preliminary observations on the technique and materials of Tintoretto, Lisbon Congress, 1972*, International Institute for Conservation, London, 1972.
24. « Red earth and earth of Umbria with linseed oil to be spread in two layers ; add a little water to the oil on the first layer. » See Volpato's manuscript of the 17th century (MERRIFIELD, *op. cit.*, note 1, p. 729) ; T.R. SCHNEIDER, *Technical analysis to Addendum Caravaggio : The Ceccoli Crowning with thorns reconsidered*, in *The Burlington Magazine*, CXIII, 1976, p. 679.
25. Ch. WOLTERS, *Le traitement des peintures : les supports de toile*, in *Museum*, XIII, 1960, n° 3.
26. Canaletto, n° 18, in J. PLESTERS, *op. cit.*, note 6.
27. In Spain, Pacheco's manuscripts (1571-1664) and those of Palomino (1636-1726) mention a first ground in two layers (potter's clay and oil) and a second grey ground (ceruse, black and oil) which is optional. Thus, Greco and Ribera often paint on a red background (see E. DU GUÉ TRAPIER, *A Ribera painting restored*, in *Panthéon*, 24, 1966).
Whereas Velazquez painted on a grey background.
28. Le Manuscrit de Turquet de Mayerne, 1620, by M.F. FAIDUTTI and C. VERSINI, Lyon, 1974, Audin, p. 123 and 143.
29. Rubens, *Ixion betrayed by Juno* (Louvre, RF 2121) ; Rubens, *Christ on the Cross* (Louvre, INV 1766) ; Jordaens, *The merchants sent away from the temple* (Louvre, INV 1402) ; Van Dyck, *Charles I on horseback* (n° 14, J. PLESTERS, *op. cit.*, note 6).
30. Rembrandt painted on a simple brown ground or on a double ochre, then grey ground. See J. PLESTERS, *A note on the material and technique of Rembrandt's portrait of Hendricke Stoffels, in Apollo*, 1977, p. 289 ; J. SIP and M. HANSIK, *Fragment of an Annunciation by Rembrandt*, in *Umeni*, 13, n° 3, 1965, p. 290-301.
Lievens also paints on a double ground (*Job*, National Gallery of Canada). M. STOLOW and G. ROGERS, *Gaz chromatography applied to cross-section of painting*, in *Application of science in examination*, Boston, 1970, p. 219.
31. Poussin worked either on a red ground only which is said to « reject » by added transparency layers which covered it more at the time of painting (See *Massacre des Innocents*, Chantilly ; *Enlèvement des Sabines*, Louvre, INV 7290), or on a grey layer which isolated the composition of the red ground and contributed to the freshness of the colours (*Moïse sauvé des eaux*, Louvre INV 7271 ; *La femme adultère devant le Christ*, Louvre, INV 7282).
See S. DELBOURGO and J. PETIT, *Application de l'analyse microscopique et chimique à quelques tableaux de Poussin*, in *Bulletin du Laboratoire de Recherche des Musées de France*, 1960 ; J.-P. RIOUX, *Note sur l'analyse de quelques enduits provenant de peintures françaises des XVII^e et XVIII^e siècles*, in *Annales du Laboratoire de Recherche des Musées de France*, 1973, and cat. *Exposition Le Nain*, Grand Palais, Paris, 1978.
32. LE PILEUR D'APLIGNY, *Traité des couleurs matérielles*, Paris, 1979, p. 70.
33. Boucher, *The pastoral nest*, Louvre, INV 7725 ; Van Loo, *A Sultana's bath*, Louvre, INV 6386 ; Coyppel, the series on *Don Quixote story*, kept at Compiègne (Inv. 3556 to 3585).
These double grounds are also usual in Germany (see I. TIMM, *Johann Samuel Hallé: des ateliers des arts contemporains ou une nouvelle histoire de l'art*, in *Neue Museumskunde*, 1969, 3) and in England (see M.K. JAILLEY JR. and K. GROEN, *Thomas Bardwell and his practise of painting of 1756 : a comparative investigation between described and actual painting technique*, in *Studies in Conservation*, 20, 1975, p. 44-108).
34. E.A. SAYRE, *Goya's Bordeaux Miniatures*, in *Boston Museum Bulletin*, LXIV, 1966, p. 84-123.
35. WATELET and LEVESQUE, *Encyclopédie méthodique*, in *Beaux-Arts*, Paris, 1788, II (*Dictionnaire de la Pratique des Beaux-Arts*).
36. In Courbet's work, see S. DELBOURGO and L. FAILLANT, *Courbet du copiste au maître*, in *Annales du Laboratoire de Recherche des Musées de France*, 1973, p. 6-20.
37. In the Turkish Bath by Ingres in the Louvre, see S. DELBOURGO, *Le Bain Turc d'Ingres. Étude du Laboratoire*, in *Annales du Laboratoire de recherche des Musées de France*, 1971, p. 25-35.

- For Cézanne see also, S. DELBOURGO and J.-P. RIOUX, *Contribution à l'étude de la matière picturale des Impressionnistes*, in *Annales du Laboratoire de Recherches des Musées de France*, 1974, p. 34-42.
38. P. COREMANS and J. THISSEN, *La descente de Croix de Rubens. Composition et structure des couches originales*, in *Bulletin de l'Institut royal du patrimoine artistique*, V, 1962, p. 119-127.
 39. The word « imprimitura » was mentioned for the first time by Leonardo and is of a beige colour (brick red, lead white and lead-tin yellow) aqueous (made up with fish glue) ; this same colour called also *mestica* was used with oil by Vasari in 1564 ; it was a little darker with verdigris and still made with oil by Armenini in 1587 ; see Ernst Berger, 1901, *op. cit.*, p. 50-59, note 16 and perhaps is it there brown colour which enhances the composition.
 40. R.J. GETTENS and E. FITZHUGH, *Azurite and blue verditer*, in *Studies in Conservation*, 11, 1966, p. 54-61.
 41. S. BERGEON, *Comprendre, Sauver, Restaurer*, Avignon, Musée du Petit-Palais, 1976, notes 1 and 26.
 42. P. COREMANS, *op. cit.*, p. 145-161, note 3.
 43. E. VAN WETERING, G.-M. GROEN and J.-A. MOSK, *Summary report on the results of technical examination of Rembrandt's Night Watch*, in *Bulletin van het Rijksmuseum*, 24, 1976, p. 68-98. J. PLESTERS, *Apollo*, *op. cit.*, p. 289, note 30.
 44. J. PLESTERS, *Ultramarine blue, natural and artificial*, in *Studies in Conservation*, 11, 1966, p. 54-91.
 45. Sulphur is the cause of drying microcracks of lapis in oil and this is why the Flemish primitives used it often in an aqueous binding medium.
 46. Romanelli, *The Israelites receiving charity in the desert* (Louvre, INV 576) and Guerchin, in J. PLESTERS, *Problemi per 3 dipinti del Guercino e loro indagine con mezzi tecnici*, in *Rapporto della Soprintendenza alle Gallerie*, Bologna, Alfa n° 1, April 1968, p. 51.
 47. B. MÜHLETHALER and J. THISSEN, *Smalt*, in *Studies in Conservation*, 14, 1969, p. 47-61 ; R. GIOVANOLI and B. MÜHLETHALER, *Investigation of discoloured smalt*, in *Studies in Conservation*, 15, 1970, p. 37-44. Smalt is also called powdered azur with reference to the way in which it was applied in the 17th century. It was the favorite pigment for the Florentine mannerists (except Andrea del Sarto and often Bronzino who both preferred lapis) and it was at its most popular in the 17th century (Zurbaran, Blomaert, Le Nain, Vouet, etc.).
 48. S. BERGEON, *Quelques pièges du nettoyage des tableaux*, published in *Problems of completion, ethics and scientific investigation in the restoration, Congrès de Veszprem, 1981*, published by Institute of Conservation and Methodology of Museums, Budapest, 1982, p. 191-202.
 49. Since P. LEBRUN, 1635, manuscript said that of Brussels (*op. cit.*, note 1) (pastel = « bleu de guesde ») ; then DUPUY DU GREZ, *Traité sur la peinture*, Toulouse, 1699 (« fécule d'anil ») ; often used as a base of ultramarine as on Tournier's *Christ on the Cross* (Louvre, INV 2007) for the Virgin's coat ; then by Watelet, 1788, and PAILLOT DE MONTABERT, *Traité complet de la peinture*, Paris, 1829 ; but it is not longer mentioned by Mérimée in 1830.
 50. R.D. BUCK, *Adrian van der Werff and Prussian blue*, in *Allen Memorial Art Museum Bulletin*, XXII, n° 2, 1965.
 51. M.V. ORNA OSU, J.D. LOW, S. BAER, *Synthetic blue pigments*, in *Studies in Conservation*, 25, 1980, p. 53-63.
 52. R.J. GETTENS and E. FITZHUGH, *Malachite and green verditer*, in *Studies in Conservation*, 19, 1974, p. 2-23.
 53. *Vert de gris* or *vert de Grèce* ; grunspan and *spaangroen* ; *verderamo*, *cardenillo* : H. KÜHN, *Verdigris and copper resinate*, in *Studies in Conservation*, 15, 1970, p. 12-36.
 54. Copper resinates seems to be mentioned for the first time by ARMENINI in 1587 (*op. cit.*, note 39), as a new fashion for « verdigris and varnish », it is the « glazed green » of the Brussels Manuscript 1635 « qui ne se mouvera pas si tost » (which will never alter) in MERRIFIELD, t. II, p. 813, *op. cit.*, note 2.
 55. L. DE VINCI, *Trattato della pittura*, 1519 (reedition 1977, J. de Bonnot, Paris), p. 35, Chap. CXIX.
 56. See ARMENINI, 1587, *op. cit.*, note 16.
 57. From 1620 (see MAYERNE, *op. cit.*, note 28) without interruption until about 1829 (see PAILLOT DE MONTABERT, *op. cit.*, note 49).

58. H. KÜHN, *Lead-tin yellow*, in *Studies in Conservation*, 13, 1968, p. 7-33.
59. Fougereux de Bondaroy in 1766 tried to establish the identity of *giallolino* (lead tin yellow) and *Naples yellow* (lead tin and antimony yellow), see LE PILEUR D'APLIGNY, *op. cit.*, p. 11-12, note 32.
60. Realgar or *risalgallo* was used by Michelangelo, see J. PLESTERS, *The technique of painting in a Madonna attributed to Michelangelo*, in *The Burlington Magazine*, 106, 1964, p. 550, and by Tintoret, see J. PLESTERS, *Lisbon Congress, 1972*, (*op. cit.*, note 23).
61. See Cennino CENNINI (New York, 1960, p. 60-63, note 1).
62. Naples Manuscripts of the 16th century, see E. BERGER, *Quellen und Technik der Fresko-, Oel- und Tempera-Malerei des Mittelalters*, Munich, 1912, p. 132.
63. Bologna Manuscript of the middle of the 15th century, see E. BERGER, *op. cit.*, p. 128, note 62.
64. This was called in the 1620 Mayerne (*op. cit.*, note 28) either *schitgeel*, *schudegrün* or *pincke* (p. 131 and 162) and was continuously mentioned up until the 19th century ; in French, *stil-de-grain*.
65. Cennino CENNINI, 1437 (*op. cit.*, p. 79, note 1).
66. In fresco technique, *sinopia* is the first drawing in Sinop earth on *arriccio* which is to be covered by *intonaco*.
67. Cennino CENNINI, 1437, *op. cit.*, p. 23, note 1.
68. R.J. GETTENS, R.L. FELLER and W.T. CHASE, *Vermilion and cinnabar*, in *Studies in Conservation*, 17, 1972, p. 45-69.
69. J. PLESTERS, *Technical examination of some panels from Sassetta's Sansepolcro Altarpiece*, in *National Gallery Technical Bulletin*, 1, 1977, p. 10-17.
70. J. PLESTERS, *Cross-sections and chemical analysis of paint samples*, in *Studies in Conservation*, 2, 1956, p. 110-157.
71. Carmine is an animal colouring extracted from an insect which is a parasite on American plants ; cochineal dye penetrated Europe in the 16th century after the fall of Mexico in 1523, and was described by Mathioli in 1549.
72. Brasil wood colouring is a vegetable dye and was extracted during the Middle Ages from the berries of Ceylon tree. It gave its name in the 16th century to the Latin-American country in which the tree was to be found.
73. Red vegetable colour comes from madder root and the cultivation of this root was introduced from the Levant to Avignon by Colbert in 1666, and then resumed by Margraaf in 1754 and really productive after 1815 (Mémoire de Robiquet, 1827) ; see PAILLOT DE MONTABERT, *op. cit.*, note 49.
74. The colour is liable to dissolve because the bitumen is partly soluble in oil.
75. *Stil-de-grain* or pink is brown when the conditions in which production was undertaken were very basic.
76. ARMENINI, *op. cit.*, note 16.
77. See note 4 on *gesso sottile*.
78. R.J. GETTENS, H. KÜHN and W.T. CHASE, *Lead-white*, in *Studies in Conservation*, 12, 1967, p. 125-137.
79. Cennino CENNINI, *Il libro dell'arte o trattato della pittura*, F. TEMPESTI, Milano, 1975, p. 61.
80. Pure lead white or *Schelpwit* (see J.A. VAN DE GRAAF, *Signification et application de « Lootwit » et « Schelpwit » dans la peinture néerlandaise du XVII^e*, in *Bulletin de l'Institut royal du patrimoine artistique*, 1961, p. 198-201.
81. It is surprising that the difference between lead white and ceruse is not very accurate in British sources, see R.D. HARLEY, *Artists pigments*, London, IIC, 1970 ; ceruse is an impure lead white (*lootwit* in Dutch), only mentioned in France in 1776, as begin mixed with chalk (see WATIN, *L'Art du peintre, doreur, vernisseur*, Paris, 1776, reedited in Paris, Laget, 1977).
82. With lapis-lazuli in Flemish primitives' paintings (P. COREMANS, 1953, and L. KOCKAERT and N. VERZIER, *Application des colorations à l'identification des liants de Van Eyck*, in *Bulletin de l'Institut royal du patrimoine artistique*, XVII, 1978-79, p. 124-126.
With azurite and sometimes certain greens (see Cennino CENNINI, *op. cit.*, p. 68, note 1).

83. R. DE PILES, *op. cit.*, note 22.
84. Poppy-seed or *oliette*, the oil of which is as quoted as early as 1757 in A.J. PERNETY, *Dictionnaire portatif de la Peinture*, Paris, 1757 (reedition Genève, Minkoff, 1972) ; J. MILLS and R. WHITE, *Organic analysis in the arts : some further paint medium*, in *National Gallery Technical Bulletin*, n° 2, 1978 : in the medium of Madame de Pompadour by Drouais (Nat. Gallery) poppy oil was put in evidence.
85. The more the macromolecule has double binding agents, the more siccativ is the oil siccativ.
86. An exterior energy source breaks the double binding agents and allows a molecular reorganization (cross-linking).
87. Cennino CENNINI (ed. Thomson), *op. cit.*, p. 59, note 1.
88. The essential oils perhaps in Flanders in the 15th century, probably used in the 16th century, were certainly used to liquify oil as early as the 17th century (see 1620, MAYERNE, *op. cit.*, p. 147, note 28).
89. E.C. FRERON, *L'Exposition des tableaux*, in *L'Année littéraire*, Amsterdam, VI, Lettre VII, 4 October 1765, p. 145-175.
90. J. PEIT, to be published ; analysis made in 1982 in Scheffer, *Les femmes souliotes* (Louvre, INV 7857), Géricault, *Le Radeau de la Méduse* (Louvre, INV 4884).
91. See E. BERGER, *op. cit.*, 1912, p. 223 : London, 1239 Westminster ; cathedral of Ely, 1325.
92. See note 12.
93. Cennino CENNINI (ed. Dover, 1960), *op. cit.*, note 1. verdigris on p. 61 and red lake p. 88.
94. P. COREMANS, R.J. GETTENS and J. THISSEN, *Thierry Bouts. Le retable du Saint-Sacrement de Louvain. Église Saint-Pierre*, in *Studies in Conservation*, 1, 1952, p. 1-29.
95. P. COREMANS, *L'Agneau mystique au laboratoire : examen et traitement (Les Primitifs flamands. III. Contribution à l'étude des Primitifs flamands, 2)*, Anvers, 1953, p. 76.
96. L. KOCKAERT, *Note sur les émulsions des Primitifs flamands*, in *Bulletin de l'Institut royal du patrimoine artistique*, XIV, 1973-74, p. 133-139.
97. T. BRACHERT, *Finger-maltechnik Leonardo da Vinci*, in *Maltechnik*, 1969, n° 2, p. 33-44.
98. No. 301 of the *Marciana Manuscript* from the beginning of the 16th century (between 1503 and 1527) see MERRIFIELD, II, *op. cit.*, p. 608 and 609, note 3.
99. MAJAILT and CAYLUS, *Mémoire de l'Académie sur la peinture à l'encaustique et la peinture à la cire*, Paris, 1755, and in PAILLOT DE MONTABERT (*op. cit.*, note 49) : Bachelier's experiments 1749 (*Zéphyr et Flore*), Wien, 1754 (*Minerve*), Hallé, Le Lorrain and two Bachelier paintings in 1755 (*Femme caressant une levrette, Femme de profil*).
100. Works by Giuseppe Baldrighi (1723-1803) (in Paris from 1752 to 1756) and Gaetano Callani (1736-1809), Callani manuscripts in the Archivio di Stato of Parma. See M. SIMONETTI and M. SARTI, *Considerazioni sulle tecniche della pittura, l'uso della cera negli artisti parmensi del 700*. Ministero dei beni culturali e ambientali, Soprintendenza Parma e Piacenza, 1979.
101. According to Lorgna in 1785 « wax is liquified for painting by natrum » ; see PAILLOT DE MONTABERT, *op. cit.*, tome 8, p. 559, note 49).
102. *Pharmaca* as resinous substance added to wax to be fixed by heat, see PAILLOT DE MONTABERT, *op. cit.*, tome 8, note 49.
103. Cennino CENNINI, 1437 (ed. Dover, 1960, *op. cit.*, p. 79, note 1) : Beaten egg ; the egg was often replaced by skin glue, see J. PLESTERS, *op. cit.*, note 69.
104. Cennino CENNINI (ed. Dover, 1960), *op. cit.*, p. 86, note 1.
105. Cennino CENNINI (ed. Dover, 1960), *op. cit.*, p. 84 and 96, note 1.
106. Cennino CENNINI (ed. Dover, 1960), *op. cit.*, p. 45, note 1.
107. *Verdaccio* means greenish in Paduan dialect, this brown mixture is also called *bazzeo* in Siena ; see Cennino CENNINI (ed. Dover, 1960), *op. cit.*, p. 45, note 1.
108. In manuscript *Liber Illuministarius* from Tegernsee (Munich), Th. BRACHERT, *Pressbrokat Applikationen, ein Hilfsmittel für Stilkritik*, in *Jahresbericht des Schweizerischen Instituts für Kunstwissenschaft*, Zurich, 1964, p. 37-47 ; K.W. BACHMANN, E. OELLERMANN, J. TAUBERT,

- The conservation and technique of the Herlin altarpiece 1466*, in *Studies in Conservation*, 15, 1970, p. 327-369 ; M. FRINTA, *The use of wax for appliqué relief brocade on wooden statuary*, in *Studies in Conservation*, 8, 1963, p. 136-149 ; M. FRINTA, *The puzzling raised decorations in the paintings of Master Theodoric*, in *Simiolus*, 8, 1976, n° 2, p. 49-69 ; G. OGNIBENI, *Representation of brocade in wax, a report on a series of experiments in the Braunschweigisches Landes Museum*, in *Maltechnik-Restaur.*, 1981, n° 1, p. 35-37.
109. C. PÉRIER D'ETEREN, *op. cit.*, note 18, and *Méthodes scientifiques d'examen à mettre en œuvre pour améliorer les connaissances de la technique picturale des Primitifs flamands*, ICOM Ottawa, 1981, 81/1/10.
110. C. PÉRIER D'ETEREN, *L'application des méthodes physiques d'examen à l'étude du modelé dans la peinture flamande du XV^e au XVI^e siècle : P. Breugel*, in *Annales d'Histoire de l'Art et d'Archéologie*, Bruxelles, U.L.B., II, 1980.
111. *La Madone de Lorette* by Raphaël (Chantilly) in *Dossier du Département des Peintures*, 19, Paris, 1979, p. 60.
112. *Madame Récamier* by David (Louvre, INV 3708).
113. *Paysage et animaux* by Berchem (Louvre, INV 1046).
114. See note 43.
115. Often found in Largillière's paintings.
116. Temporary protection as soon as the painting is finished before it is completely dry, was used from the Middle Ages and still throughout the 19th century.
117. Cennino CENNINI, 1437, Longanesi, *op. cit.*, p. 122, note 79.
118. ARMENINI, 1587, *op. cit.*, note 39. These varnishes containing essential oils dry even in the shade, unlike greasy varnishes which need the sun to dry (ordinary varnished with colophon, called *poix grecque* or liquid varnish combined with sandarac both with linseed oil).
119. G. ÉMILE MÂLE, *Étude historique des vernis à tableaux d'après les textes français de 1620 à 1803*, Comité pour le Conservation de l'ICOM, 4^e Réunion triennale, Venise, 1975.

5. RÉSUMÉ

La composition des diverses strates de la couche picturale évolue dans le temps et selon les pays : la préparation des primitifs est blanche et à la colle (craie dans l'Europe du Nord, gypse dans les pays méditerranéens) ; encore blanche au XVI^e s. (souvent enrichie d'une couche de blanc à plomb à l'huile), la préparation est colorée et à l'huile aux XVII^e et XVIII^e s. en Europe (soit rouge, soit ocre jaune, simple ou double) et de nouveau blanche et à l'huile au XIX^e s. (blanc de plomb puis blanc de zinc).

La couche colorée est étudiée rapidement selon les pigments principaux illustrant sept couleurs (bleu, vert, jaune, rouge, brun, noir et blanc) : nom habituel, composition chimique et historique de l'usage ; divers liants sont mentionnés (aqueux, à l'œuf, à l'huile et à la cire).

La technique picturale est aussi définie par les divers usages qu'ont fait les artistes des matériaux : or façonné en creux au poinçon ou relevé *a pastiglia*, or au bol, or à la mixtion ou or coquille, les brocarts italiens en *sgraffito* et ceux du Nord de l'Europe ou *Kuttendruck*, les divers traitements des carnations.

Les vernis originaux anciens sont peu connus et répertoriés avec précision : à côté des vernis dits « gras », à l'huile, se développent au XVI^e siècle les vernis dits « maigres », à l'essence ; la résine la plus utilisée semble avoir été le mastic.