THE PAINTER'S CRAFT

WESSELS

CALIFORNIA COLLEGE OF ARTS AND CRAFTS
Broadway at College Avenue Oakland, California

THE PAINTER'S CRAFT:

A Syllabus of Lectures for Students at the
CALIFORNIA COLLEGE OF ARTS AND CRAFTS
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THE PAINTER'S CRAFT

Course Outline Glenn Wessels

Aim of Course:

To make the student conversant with the qualities, possibilities and limitations of his painting materials, to enable him to prepare such of his materials as necessary, to choose good from bad materials and to choose the most efficient means for the execution of a given piece of work with a given purpose. To co-ordinate his knowledge of media.

("There is a peculiar satisfaction and a rich reward in the mastering of the idiosyncracies, the order imposed by a material and in making it reveal in its own peculiar way the felt experiences of the subject. It is not only that there is a mere overcoming of difficulties--though that is something. It is not even that the spiritual essence of the experience can be brought out in the process of formal expression, in a way that would have been impossible without it. It is more. It is that a new value and a new meaning, different from the previous experience and not discoverable in it, comes into being in the act of experimenting with materials. The artist 'builds better than he knew': as the marble or paint or sound takes form, there is born under his hands a subtle new thing of delight which but for his loving manipulation of material could never have existed."Louis Arnaud Reid)

("We should begin, I am convinced, from the very simplest facts. Why do artists make different patterns, or treat the same pattern differently in wood-carving, say, and clay-modelling and wrought iron work? If you can answer this question thoroughly, then, I am convinced, you have the secret of the classification of the arts and of the passage of feeling into its esthetic embodiment; that is, in a word, the secretof beauty." Bernard Bosanquet)

Lecture I. Sources of Painting Materials: Pigments, Brushes, Grounds, Binders, etc., viewed historically: Cave-dwellers, Egyptians, Greeks, Byzantine and Italian.

Laboratory assignment: Preparation of a pigment from natural earth.

Lectures
I. PIGMENTS
GROUNDS AND CARRIERS

Paper.
Most common carrier and ground for art work of a commercial nature is illustration board. This is, at its best, a well made linen rag paper which has not been bleached by chemicals such as chlorine, glued to a carrier of chip board, which is "cardboard" at its cheapest. Chip board comes in various thicknesses, and is useful for backing and carrying finer papers, for pad backs, etc.. Containing as it does, cheap glue and chemicals often dangerous to pigment permanence, it is seldom safe to use directly for permanent work.
All paper is made of somesort of vegetable pulp, or fibre, which is felted together and pressed between cold or hot rollers. Glue of some sort is the binder which holds the fibres together. The paper makes a more absorbent ground if it is made with less glue and pressure, as "blotting paper" and makes a less absorbent ground if it is made with more glue and pressure. It becomes even less absorbent if it is "hot" pressed, since heat makes the glue less insoluble and is apt to leave the paper with a slight polish. This polish is increased by "calendaring" where size is applied again to the paper surface and it is hard rolled between hot, very smooth rollers. Cheaper papers may be made to appear white by the addition of white chalky substances to the pulp. If the pulp fibres are long, as in good linen paper, the paper is tough, if short, it will tear easily as newsprint.
Paper may be died with permanent dies or impermanent ones. Chemically bleached papers will disintegrate and yellow, as "newsprint" does after it is old. "Fillers" such as zinc oxide, added to them, will not insure their permanent whiteness, but will temporarily increase their opacity and whiteness. Such papers are often used for the printing of magazines. "Slick paper" magazines are printed on cheap pulp which has been both filled and calendared. Such papers are seldom strong enough for even temporary work, tearing easily under a pencil point.
On the other hand, good "linen rag" paper, such as Whatman's will stand many erasures and is quite as tough as thin cloth. It will serve as a ground for almost any kind of drawing or painting if it is backed by metal, wood, or other panelling. Such paper has stood up for hundreds of years. It should be thought of as a kind of cloth. Names of famous paper makers which will be found watermarked on fine papers are: Canson & Montgolfier, Fabriano, Michallet, Arches, Arnold. Newer firms in Germany and in America are Schoeller and Strathmore.
The watermark will read forwards on the right side of the paper when held to the light. Whatman's cold and hot pressed have long been considered almost standard.
Sizing papers: Since gelatin, or some other ofrm of glue is incorporated into paper structure, the artist may increase the hardness of the paper or illustrationb oard surfaces by sizing. it. Even cheap chipboard may be made useable for practice work. Stretch the paper if it is thin. If it is greasy, and causes water to puddle, wash it with water, or alcohol in which a little ammonia or ox-gall is added. Then size it with a 1: 25 gelatin glue solution, or shellac it if a "flat" ground is desired. If cardboard is sized with glue, it will warp unless sized on both sides.
For watercolor or gouache painting. 1 part glue size, 1 part pure white soap and 1 part powdered alum will give a good surface.

Lecture
2 Grounds, Continued.

The ground is the first part of the painting to consider. It is the foundation of the architecture of the painting and must be considered in relation to the parts of the painting which are to come after. In the case of illustration board, the carrier is the chip board backing, and the paper on its surface serves as the ground, containing already what size or filler is considered necessary for the particular purpose for which the illustration board is made (pen and ink, pencil, crayon, or watercolor, etc.)

For permanent work in heavier media, however, other carriers and grounds take the place of paper, (unless that paper be especially mounted and backed, when it will serve in the place of cloth for most technics, where the painting is to be relatively small.)

Cloth carriers Linen.

Just as the best paper is made of linen, the best painting canvas has long been considered to be linen, tightly woven, smooth, even, with no loose threads or knots. Warp and woof, or twill canvas are both good. A grade of artist's canvas called "Roman", coming in heavy, medium and fine weaves is considered one of the best. It has doubled threads in both directions.

Canvasses are made of cotton, jute, hemp, sometimes mixed. Jute turns brown, therefore burlap, which is made from it is unsuitable for permanent painting. Hemp canvas is strong, coarse, and useable for large easel paintings and wall paintings. Mixtures shrink unevenly and are undesireable.

Cotton duck is next best to linen, though not apt to be so good in texture. Unbleached cottons are better for painting surfaces. Unbleached muslin is used largely in temporary scenic work, and will serve for very small permanent painting.

Sailcloth is made in different parts of the world from linen, cotton, or hemp, and usually make a good painter's canvass. About 10 ounce duck is useful for average work. It should be closely woven, but not so close that when held up to the light no light at all comes through. Very small apertures will serve to hold the ground to the surface.

The canvas must be stretched on a stretcher. Stretcher bars must be so cut as to stretch canvas only from one edge, the outside, otherwise the inside edge will interfere with the painting.

Wallboards are sometimes no better than cheap cardboard, but the type recently developed known as "presdwood" or "masonite" panel board or quarter board has been tested, and found to be an excellent carrier. The "untempered" sort contains nothing but the natural wood resins as adhesives, and may be glue sized and used directly for a very dark, very absorbent ground. "Tempered" varieties contain wax and must be washed with ammonia before they will take glue.

Aluminum sheet metal which has been sand-blasted, or otherwise given a "tooth" can be sized with any one of the grounds sold for preparing metal for lacquer. It may be painted on directly with oil. Zinc and Copper have also been used, but Aluminum is probably best, as it deteriorates less in moist air.

Woodpanels were largely used in Renaissance times, and are still useable, but wood warps and cracks, and is unsuitable unless "cradled", for large surfaces. The ancients prepared wood panels with strips of linen reinforcing the surface upon which the ground was to be applied. Modern plywood, when made with waterproof glue, can be used. The best is hardwood veneer that is straight sawed, not peeled.

Lecture
grounds and Carriers, Cont'd

When any of these are mounted on a wall, they must not be allowed to stand on their lower edge, or they will eventually slide and bulge. The top edge of panels should be supported by screws or other means, so that they will hang flat. This is particularly true of presadwood.

Priming.

Depending on the medium that the painting is to be executed in, the first step is to size the surface of the panel or canvas. This is done with either gelatin or casein glue size. If the surface to be sized seems too smooth and hard, it will be better to give it tooth by rubbing withpumice, groundglass, carborundum, marble dust, or other abrasive. The small fuzz on canvas treated thus makes a firmer bond with the successive coats of ground.

If canvas is too tightly stretched, it may split or pull out its tacks. Expect the glue to shrink it. Size both sides of panels, to avoid warping. If it warps anyway get it under weights as soon as possible after glue is applied.

The Ground consists of an adhesive, a color, and filler.

Chalk Ground is made: 1 volume of precipitated chalk or whiting
(or some sort of plaster of paris, if a gesso ground is wanted)
1 volume of glue size, stirred with it
1 volume of zinc oxide powder.

The glue size in this case may be hot, made of 7:100 parts by weight, with gelatin glue, high quality. (Fuller's Special Gelatin Glue local equivalent of European Cologne and Colle de Lapin glues,)

Chalk Ground makes a gleaming white absorben ground, rather brittle.On canvasses that are not tightly stretched it might crack. It is useful for special effects. Especially for very thin, transparent, oil and turpentine painting, which aims at a mat, fresco effect. The oil paint here will work quite a lot like watercolor. Impasto or heavy painting will not work on this ground.

Absorbency.

A too absorbent ground merely drinks up useful paint and binder. If the straight chalk is too absorbent for a given purpose it may be modified 1) by "isolating" it with resin ethereal varnish, or thin shellac. 5% castor oil added to shellac makes it blend and go on smoother. Shellac may be used as thick as one to one with alcohol by weight.

2) by mixing boiled linseed with the ground before it is put on. This makes

- Half Chalk Ground
After the Chalk ground is made, add from 1/3 to 1 measure of boiled linseed oil and beat it thoroly.

- Oil Ground This will be a yellowish fat ground like the commercial canvas grounds, too fat for any but direct oil painting. It is made by mixing parts of boiled oil in the chalk ground.

These last grounds will differ from chalk ground in their lack of absorbency. Some modification of Half-Chalk ground can be made to serve for almost every painting purpose, from egg-yolk tempera, to the fattest of resin-oil painting. It is also good for indirect oil painting. It should be made up rather lean, as once it is made it cannot be made leaner, but may easily be made fatter by isolating with turpentine-damar or mastic varnish, or shellac-alcohol-castor oil mixtures. It is not a good idea to make a ground less absorbent by drenching it with oil, as it will yellow and darken.

Toned Grounds.

Color may be added to these grounds by substituting some other earth oxide pigment for some or all of the zinc oxide. It should be opaque pigment.

Lecture-II.

Pigments: Mineral (Natural; as Ochres, Siennas, genuine Ultram
(Artificial; as Chromes, Cobalts

Organic (Animal; as Carmine, Sepia
(Vegetable; as Gamboge, Madder
(Artificial; as Alizarin

Chemically considered:
(See Periodic Table) (Simple elements; as Lamp Black
(Chemical compounds; as Chromes, Vermilions
(Physical mixtures; as Hooker's Green

Earth Pigments, natural or calcined.
Ochres, coloring principle is ferric oxide--
Fe_2O_3 (Show Chem.)

Yellow and brown Ochres derive their color from various hydroxides of iron which exist as natural minerals. Formation of crystals-water of crystallization.

Yellow Haematite, Xanthosiderite--$Fe_2O_3 . H_2O$

Brown Haematite, Limonite--$2Fe_2O_3 . 3H_2O$

Bog-iron ore, Lyminite--$Fe_2O_3 . 3H_2O$

These ochres are chiefly composed of either one or several of these hydroxides in varying amounts, with clay, sand, chalk, gypsum ($Ca\ SO_4$), barytes ($BaSO_4$) and sometimes diatomaceous silica, thus varying in composition, color, tinting strength, opacity. Ochres with large percentage of pure iron hydroxides are more transparent and more intense color.

Artificial ochres are prepared by chemical precipitation of iron salts and zinc or aluminum salts with soda or calcium solutions. These are called Mars Colors and due to their greater percentage of pure iron hydroxide are more transparent and intense than the natural ochres.

It is necessary to wash and levigate natural ochres before using them as artists colors, taking out sand soluble salts or organic impurities which would change color on exposure to air and moisture and light.

Yellow and Brown Ochres appear under the following names: Yellow Ochre, ocre jaune, ocriagialla, ocre amarillo, lichter ocker; transparent golden ochre, ocre d'or trans., ocria dorata, ocre de oro, goldocker, golden ochre, roman ochre, ocre de rome, ocria di roma, ocker roemisch, brown ochre, oxford ochre.

Raw Sienna, terre de sienne, terra di siena, tierra de siena is the Tuscan Italian variety of yellow ochre, it is deeper and higher in iron hydroxide content than most other ochres.

Natural Red Ochres are of similar composition containing only a greater percentage of iron oxide which causes their red color. They are: genuine Indian red, Venetian red, Terra Pozzuoli, Terra Rosa, Red Chalk, Bole or Bolus, Ruddle, Red Iron Ore, Red Haematite, and the Sinopis and Rubica of ancient times.

Lecture III. Calcined or Burnt Ochres.

Demonstrat: Calcining of ochres.
Pastel making with Gum Tragacanth.

Calcined or burnt ochres.

When natural ochres are roasted, the iron hydroxides first lose their water of crystallization, then their total water and hydrogen content, changing color as the crystalline structure adapts itself to less water, finally losing crystalline structure and becoming pure iron oxide, Fe_2O_3. Different varieties of yellow ochre yield upon calcination colors varying from orange red to deep brown the temperature during roasting affecting their final physical structure and thus their color. The varied color of bricks is thus understandable.

Burnt ochres are Light red, Brun rouge, Bruno Rosso, Pardo rojo, Burnt ocher, Ocria brucate, Ocre brulee, Ocre tostado, Gebrannter ocker, Burnt Roman ochre.

Artificial mineral: Glass Colors.

Frit, Smalt, Egyptian Blue are artificial mineral colors, frit being discovered by the Egyptian potters. Egyptian Blue is $\begin{matrix} CuO. \\ CaO. \end{matrix} 4SiO_2$.

To understand these colors one must understand something of the constituents and making of glass.

Glass is: $CaCO_3$ plus Na_2CO_3 plus SiO_2(with 1200° heat) goes to $\underbrace{Na_2SiO_3 \text{ plus } CaSiO_3}_{\text{glass}}$ plus $\underbrace{2CO_2}_{\text{gas}}$

It is ordinarily made by the melting of quartz or pure sand in proper proportions with Sodium Carbonate and limestone to make the fused residue have the composition $Na_2O.\ CaO.6SiO_2$.

Molten glass will dissolve many oxides of metals, since it contains silica capable of joining thus:

Cu_2O plus SiO_2 goes to Cu_2SiO_3

Cuprous oxide

Silicon dioxide

Cuprous silicate (rubyglass)

Cupric oxide produces a glass. Coblat oxide blue, chromium green, uranium yellow, etc. Finely divided gold in glass produces a deep red, tin oxide a milky glass, etc.

Lake Colors

Organic Pigments; vegetable, animal or artificial.

Egyptians had yellow and red dyes.
For red they boiled madder root, gypsum and a little lime.
Yellow lakes by boiling some unknown plant in the same way.

We usually think of lakes as transparent colors, but the Egyptians made them opaque by using chalk or gypsum as the base upon which to deposit the transparent dye. More modernly lakes are deposited on transparent substances, such as Alumina ($Al(OH)_3$) or semi-transparent as Barium Sulphate--$BaSO_4$ called Baryta White commercially.

Lake pigments are the most complex, chemically which the artist has to deal with. They are the natural coloring matter of plants or animals, or are synthetic products which imitate or parallel these life products. The chief animal lakes are:

Lac, or Indian Lake, now out of date, which is the coloring matter found in the Coccus lacca an insect which lives on east Indian trees (figs) forming as a protecting covering for its nest a coating which is shellac. Lac is of importance nowadays mainly since it has given its name to a whole family of pigments. It is not so brilliant nor as permanent as other lakes.

Carmine, Crimson Lake, Purple Lake, Scarlet Lake are all varieties of a dye obtained from the female cochineal insect (Coccus cacti), found on Central American cacti, and cultivated in S. Europe and Algiers. This dye replaced previous red lakes immediately after the conquest of Mexico in 1523. It is now almost entirely replaced by modern coal-tar synthetic pigments.

The essential coloring matter of Carmine is carminic acid, obtained by boiling the insect in water then adding small quantities of alum ($K_2SO_4, Al_2(SO_4)_3.24\ H_2O$), often used as a mordant in dyeing. The coloring matter fixes on the alum, depositing it as a fine red powder. This is pure carmine and is sold in small pressed blocks.

Various hues are obtained by varying the carrier on to which the dyw is deposited, thus if there is iron, manganese or copper present in the alum the reds obtained will be very dull. A little lime will yield Purple Lake. Carmine lakes fade in time, quickly in sunlight. Are destroyed by metallic pigments (earths). Alizarin Lakes are replacing Carmine lakes almose entirely, being more dependable and brilliant.

Kermes Lakes or Venetian Scarlets were obtained in a similar manner from a Mediterranean insect in the earlt times, but were replaced by the Carmine or Cochineal lakes on the discovery that the latter were more brilliant. Kermes dyes are said to have been used from the time of Moses.

The usual procedure in making any lake is to prepare a decoction (extraction by boiling in water) of the coloring matter as highly concentrated as possible, to which is then added a solution of the metallic compound to be used as a carrier. The color is largely influenced by degrees of concentration, acidity or alkalinity, temperature during precipitation, as well as the bases employed.

Some natural coloring matters are ready formed in nature and do not require any special base or mordant to bring out their color (carmine). These are called substantive.

Others, called adjective do not develop their color until combined with certain bases, yielding different colored lakes, according to the base upon which they are deposited. Madder root is of this kind. With aluminum hydroxide it yields reds, with iron dull violets.

The madder root extracts are about the only natural lakes permanent to light.

Yellow Lakes are extracted from Quercitron Oak Bark, Persian, Turkish or Avignon Berries, buckthorn (rhammes) and from weld called wild mignonette or dyer's weed.

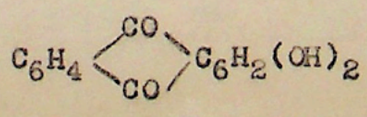
Italian Pink, Dutch pink, Stil de grain brun, and Yellow Madder are the richer yellow lakes prepared from the Oak bark and the berries. Brown Lake is a deep variety of Quercitron Lake.

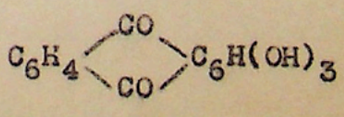
To make these lakes, the berries or sections of bark are ground into small pieces and decocted. The decoction is treated with Alum solution, and on the addition of a Soda solution a precipitate of Alumina carries down the dye. This is the lake pigment. These pigments were known in A.D. 77 according to Pliny.

These lakes are now imitated by using some very permanent and alkali proof synthetic lakes which are much less fugitive than the older yellow lakes. These newer colors are excellent transparent colors for overglazing.

Artificial Lakes

Chemistry found that the essential coloring principle of madder lake was Alizarin and Purpurin





The alizarin is made chemically from petroleum and coal-tar. It yields brilliant crimson, rose, purple, violet and maroon hues which are permanent when rightly handled. Purpurin yields orange-reds. Both are safe in any technic where they do not come in contact with lime, (fresco, etc.) Are safe in mixture with the burnt earth pigments, but not always with the raw earth pigments due to presence of Iron Hydroxide. The chemical colors such as white leads, Chrome Yellow, Naples Yellow, Chrome Greens, etc., somewhat bleach them. True vermilion, Cadmium Yellows and Blacks do not affect them. They yield brilliant and permanent results when applied as a glaze over colors which are thoroly dry. (Rembrandt's reds made by madder glaze over vermilion)

Three things are necessary in the making of a lake pigment from artificial coloring:

I The coloring matter (Substantive or Direct dyes
Basic or Acid
(Adjective or Mordant dyes

II The precipitation agent

III The Base, carrier or extender

Varieties of Lakes based on Alizarin:

Alizarine Blue; Aliz. Carmine; Aliz. Crimson; Aliz. Green; Aliz. Orange; Aliz. Scarlet; Aliz. Yellow; Rose madder Aliz; Aliz. Madder lake; Aliz. Burnt carmine; Indian Lake Aliz; Permanent Violet; Permanent Crimson; Aliz Sap Green; Aliz. Olive Green; Aliz. Olive Lake; Aliz. Crap lakes; Scarlet Crap lake; Violet Crap Lake; Laque d'alizarine carmiosie; Lacca d'alizarina cremisina; Laca de Garanza cramois; Alizarin Farben.

Varieties of Lakes from Madder Root, natural.

Madder Lake, Lacca digarance, Laque de garance, Laca de garanza, Krapplack, Rose madder, Garance Rose, Garance Rosa, Pink Madder, Madder Carmine, Rubens Madder, Rose Doree, Madder Purple, Madder Brown, Crap Lakes.

The Substantive or Direct Dyes fix themselves chemically or by absorbtion upon a suitable carrier. Basic dyes are salts of complex organic bases which form colored precipitates with certain weak organic acids. The Acid dyes are not all of acid nature but are called that owing to their property of dyeing wool and silk in baths containing a small quantity of free acid.

The coloring matters termed adjective or Mordant dyes are usually not themselves of the desired color. Many mordants react chemically with the dye to develop the color.

Demonstrations: Decocting yellow and red natural lakes and precipitating them.

LECTURE BINDING MEDIA.

Water soluble binders.

At the base of all watercolor paints are water-soluble adhesive material of various kinds. Gum arabic, cherry gum, tragacanth, egg white, dextrin starch, and various glues, soluble in hot and cold water, are such binders.

Usually for aquarelle, transparent watercolor, fossil gum arabic, or a synthetic product with similar character, is most desirable, as this does not discolor the thin coats of pigment, and is very transparent.

Gouache, which is opaque watercolor, though dependent upon a similar binder, does not lay such stress on absolute transparency of binder, nor on such fine grinding of pigment. Indeed, transparent colors are purposel made opaque with a little titanium white, for this medium. Hence it is more easily prepared for oneself, out of relatively cheap and easily obtained materials. (See Laboratory notes) Commerical mucilage may be use but with some risk as to permanence of pigments with unknown preserv

Distemper, is the proper name for any glue paint. There are as many distempers as there are glues, and with as many different properties. "Scene paint" is one of the simplest of distempers. Commercial Sizing Glue is made, by first soaking glue several hours, just covering with water, then melting same in double boiler, then adding enough hot water to make proportions of one pound of glue to three quarts of water. Stir with a stick. By dipping the thumb and first finger , pressing them together, and holding for a moment, you willbe able to test the adhesive quality of your size. Since glues vary widely in adhesive power, this is important.

Cheap pigments, relatively fugitive, can be used for scenic work, since it seldom must last long. Here is a list of such pigments: The may be purchased almost in any paint store: Carmine lake, Chrome Green, Chrome Yellow, Cobalt Blue, Dutch pink, Raw Sienna, Vermilion, Lampblack, Prussian Blue, Turquise Bleu, Ultramarine Blue, Bolted Whiting, Purples and Violets are best made by coloring whiting with a strongsolution of analine dye, such as Magenta, which may be bought from National Analine and Chemical Co, or similar firms.

Scene paint which is mixed with ordinary sizing glue, such as "Cooper's" must be applied white warm. The si-e will jell when cold. The pigment must be stirred in it while size is warm. In mixing in pigment it is best to work up the pigment first with water. If it is greasy and refuses to mix, dampen the pigment with denatured alcohol. When pigment is smoothly mixed to a ~~thick~~ very thick cream, add to it one half pint of the hot liquid size, to one quart of the color paste. The resulting mixture should be of the consistency of cream. Strain it, if necessary, and keep it warm while using, but don't heat it too much or burn it. Add hot water as water evaporates from it. This paint tends to settle out of solution and needs frequent stirring.

LECTURE BINDING MEDIA

Watersoluble binders cont'd

Vegetable Glues

Rye flour paste for pastel grounds, or for use as binder for starch painting on paper or starched cloth is made as follows:

Rye flour, one measure, stirred in 10 to 15 parts of boiling water.

Many commercial "tempera" paints are based on rye paste in combination with glue solution and boiled linseed oil.

COLD WATER ANIMAL GLUE

Casein in some form has been used from the earliest beginning of art as a binder. It is the adhesive ingredient in cheese, or milk curd. It can be made from technically pure caseinx
Commercial casein glues must be tested for lye with litmus, for they often contain alkali which will destroy sensitive pigments. Prepared casein paste paints are now sold which are relatively good, especially for painting large scale wall decorations which are to be permanent. "Texolite" and "Luminall" are two such. If prepared casein blues red litmus acid should be added to just neutralize the alkali.
To make casein binder use 40 grams of technical pure casein, mixed with a little water, then add a half pint of warm water. Dissolve 10 gram of ammonium carbonate in a few drops of water, pressing out lumps, and pour into the casein solution. It effervesces. Stir till foam subsides and the casein is ready for use. It is kept in well-corked bottle, and diluted as desired for use.

Milk curd, dried and mixed with proportional amount of ammonia will work, but is not so dependable as the above.

Lime Casein

Casein will join with approximately one fifth of its volume of lime(slaked) and becomes then a liquid glue which can be emulsified with oils, etc., lime-casein makes the most durable of all cabinet maker's glues. When casein solutions are painted on walls containing lime the formation of lime casein makes them quite weather proof and waterproof, after enough time has been allowed for the interaction to take place. The casein may draw so strongly as to pull weak plaster from the wall.

Casein will emulsify, just as other animals glues with resins, oils, etc. Emulsions with fatty oils yellow and spoil quickly.

SOAPS

Soaps are used in crayons, and as paint binders. They are essentially a chemical union between a fatty oil, acid, such as stearic acid, which is found in animal tallow, and some metal, such as aluminum. Aluminum stearate a soap which is often mixed in proportions of 2% with oil paint to make it more pasty.

Pastel sticks which contain such substances mixed together as cocoa butter, tallow, Japan wax, and non drying oils are sold as oil crayons. They can be made soft or hard. Soaps are often used in them. They are useful for temporary sketch work.

LECTURE: BINDING MEDIA

Water soluble binders, cont'd

Scene Paint

The hot water scene paint described is one of the cheapest paints possible, and is suitable only for comparatively rough, temporary painting.

Corn Dextrin may be bought for about twenty cents a pound, and is useful as a cold waterbinder for scene paint. It works a little smoother than the hot glue paint, but is a little more expensive. It may also be used for posters and signs, where watersolubility is no hazard.

Gelatin Glue Distemper is based on animal gelatin.

This is a higher grade binder, and may be used with higher grade pigments for relatively permanent work. It was often used as preliminary exercise for oil painting, and even as underpainting. At other times is is used as the watery constituent for certain tempera emulsions. (Distemper is never tempera, but glue alone, while tempera is an emulsion, always containing some oil)

Cologne Glue is the standard glue, which one finds mentioned in most artist's formulas. Colle de Lapin "rabbit skin glue", is the French equivalent. Locally a very goodglue is "Fuller's Special Gelatin". Slightly more expensive and somewhat less adhesive is pure Gelatin, obtainable in drug stores.

Gelatin, dissolved in hot water, 6% or thereabouts, by weight, depend! on strength of glue, is a generally useful solution, as a glue binder, and in grounds. By spraying glue sized surfaces with a 4% solution of formalin (formaldehyde) they become non-suluble in water. This is important when painting with gouache, or similar water media, on pure chalk grounds. Paper is really only lint held together with glue, a sort of fine felt, and may be glue sized to make it less absorbent. It may be made even less absorbent by spraying, then, with formalin, though too much formalin will burn the glue and make it yellow and brittle.

Glue will sometimes coagulate, and strong vinegar added stops this, but may injure some colors, ultramarine, for instance. Too much boiling and refinement reduces adhesive strength of gelatin.

Vegetable Glues, such as Starch paste, from rice, potato or wheat or rye, are used as binders. Japanese painting is largely starch painting. To make starch paste for binder, ~~xxxxxxxx~~ bring 50 grams of starch to a boil gently in 350 cc. of water. It is best to mix the starch with cold water, to a cream and then put it in the boiling water. The quality of the paste will depend upon its continual stirring till it is cold.

This binder is useful for gouche-like painting, but, unlike animal gelatin, cannot be used with oils with any great success, though it will emulsify with them, for the reason that it does not adhere well to fat grounds.

Commercial vegetable glues are often strongly alkaline, dangerous to pigment and must be tested, at least with litmus, before use where pigments are concerned.

Watersoluble binders

SOAP is also much, and carelessly, used to cause emulsions to emulsify, to cause too lean a binder to spread evenly on too greasy a surface. Mixing a little soap with the paint will cause it to handle better in such cases, but it will make the paint permanently soluble in water. Lyes found in most common soaps will attack colors. It is only useful for temporary effects.

MIXED TECHNICS

We have discussed in the main the uses of various binders and their solvents in their simple form. Oil paint has been considered separate from water soluble paint, etc. But many of these ingredients may be used in combination as binders. The combination media which result from mixing oils, or oils and resins seem obvious enough. We may add a little varnish to our oil paint to give it a more enamel like quality. We may add any of the watersoluble gums or glues together if their mixture gives us a binder with advantages over the separate ingredients. Some such mixtures will have the good qualities of both binders and few of the bad of either, others will have most of the bad qualities of both.

When we come to mix water soluble binders with oil media, however, we are dealing largely with a different kind of mixture, which is somewhat more than just a mixture. All these media are more or less in the class of substances known as Emulsions.

EMULSIONS

Usually oil and water separate, but there are in nature a number of natural emulsions, such as the yolk of egg, milk, the milk of fig trees, milkweed, etc., These, insofar as they serve as binders for paint are the most permanent, non-separable emulsions, but many artifical emulsions are possible and useful. Some of them are made by adding other ingredients to a natural emulsion, such as egg. Others are made by chemical union.

EMULSIONS

Natural emulsions, such as egg and casein, adhere to thin as well as fat painting grounds, even to wet oil colors. Artificial emulsions adhere well only to lean grounds, relatively oil free. Natural emulsion set with the passing of time, artificial emulsions remain permanently soluble.

Emulsion painting in general is referred to as TEMPERA PAINTING.

The simplest tempera is that in which pigment is used with egg and water. Egg-yolk and water is slightly fatter. Egg white and water slightly leaner.

But one may make a fatter tempera by adding oil to the egg, or a leaner tempera by adding glue, or a more enamel-like tempera by adding varnish,--any of the resins or balsams. Any such materials as soap, glycerin, honey, sugar, which are sometimes recommended as additions will only make the pigment permanently removeable by water if used in any appreciable amount. There is no end to tempera recipes, as many are possible as there are glues, waxes, soaps, oils, gums and resins, and almost every condevable mixture has been recommended by some painter. It is best to stick to the simple ones and the ones whose use you best understand.

If one wishes to go beyond the use of pure egg yolk the first to try is:

Medium Fat Tempera emulsion: One whole egg, an equal quantity of linseed raw oil, thickened in the sun if one desires a heavy binder. Shake with two measures of water. Be sure to put in oil first.

Varnish may be substituted for part or all of the oil. Resin etheres or oil varnish msy be used.

Binding power can be still further increased by ~~xxxing~~ using, in place of water 5% gelatin solution. In which case picture should be made insoluble with formalin or varnished.

For painti g on metallic grounds, such as gold leaf. 1:10 alum solution replaces the water.

For preservative xylol, or oil of cloves. Vinegar will aid in preservati but will discolor ultramarine pigment, and attack zinc and lead whites.

EMULSIONS CONTD

Various Tempera emulsions.

Egg white and gum was emulsified as the medium used in Middle Ages by the illuminators of the Missals. This can only be used in thin layers, or it peels.

Pure egg white has so little oil that it is essentially a thin form of distemper, or glue paint.

It may be mixed with thick dammar or mastic as a medium for painting.

CASEIN TEMPERA

Casein solutions may be emulsified with linseed oil, but turn very yellow. Resin varnishes, wax soap, balsams will emulsify with it.

Casein tempera has great adhesive power and many prefer it to egg emulsion for this reason.

Skim milk thinned withwater is a good thinning media for tempera emulsions casein

Artificial Tempera Emulsions

These do not set permanently, but remain soluble in water, and are not as easily thinned as natural emulsions. They hold well only on lean grounds. If suddenly thinned they may separate. The intimate mixture is not so close as with naturally rpoduced emulsions.

GUM WATER EMULSION with oils or resins.
Gums which are water soluble, such as apricot, cherry or gum arabic, in proportions 1:2 with water may be emulsified with fatty oils in the same way as egg tempera. Also with varnishes.

OX GALL has a low surface tension, and is much used to prevent coagulatic of lean liquids on a comparatively oily surface. It is also use to prevent separation and clotting of pigment in watercolor. For making a gum-oil medium adhere to too fat a ground rubbing with ox-gall, garlic, potato, onion, or ammonia will make the paint puddle less, but this is only an emergency measure, ans should not be depended upon.

It is better to add some egg emulsion to such artificial emulsions to bring about a more homogeneous union.

LEAN GLAZE
Cherry gum which is freshly exuded is easily dissolved in water. Plum, apricot, etc are similar. It absorbs much water. 10% is enough for a thick solution. It is easily emulsified with fatty oils or balsams.
One glazing formula, supposed to give the lean glaze effect of Venetian painting is: 1 part cherry gum or gum arabic solution. I part 1:2 damar or mastic ethereal varnish.

Cherry gum as an ingerdient give great transparency and enamel like quality. It is inclined to chip off by itself, but not when used in mixtures or emulsions with egg, casein, emulsions.

lecture

Emulsions, Lectures.

WAX PAINTING

is useful for mural or decorative work, where picture must be mat. It is a little more difficult to handle than oil painting, but does not tend to muddy as soon as oil, since the colors are less opaque.

Bleached beeswax melts at about 144° F. It sometimes is adulterated, commercially. Good wax should dissolve completely in spirits of turpentine, leaving no residue.

Painting in pure wax is apt to be too soft, so it is usually mixed with a resin. It sould be used on a very absorbent ground

To emulsify wax there are two methods.
Method I. Wax Soap or Emulsion.
25 grams of white cleaned beeswax melted over 1/4 liter boiling water. Add 10 grams ammonium carbonate. It effervesces. Keepit boiling until effervescence ceases and stir till cold.

Method II.
Boil ten parts of water violently, and shave in one part Pure white wax in fine slivers. When wax melts add ammonia, drop by drop till water turns milky, when the wax is emulsified. Let stand till the emulsified wax forms a cake above the water. Pour off water. Pour oil of spike (or turps) over the wax to cover it and allow it to dissolve and soften in a warm place for a few days. Thin with turpentine till it is a thick cream. Leave receptacle opn for remaining ammonia to evaporate.

This medium used on absorbent plaster will give fresco effect. Used on paper or other surface which has been prepared to receive oil paint with glue, shellac or half chalk ground it gives the effect of gouache, but it is not fragile nor water soluble. It may be used as an addition to tube oil paint and as a painting medium to tube oil paint. It dries then with a mat, lighter appearance than when first applied.

Elemi resin is considered the most congenial when mixed with wax. It is a wild olive: amyrisolemifera sap. This resin dissolves in oils and evaporates with a little heat. Colors may be ground with elemi resin dissolved with desired quantity of wax in oil of spike or turpentine. Almost any resin may be used in this way, copal, for instance, if a very hard mixture is desired.

Wax emulsion, or resin wax mixtures may be polished and caused to enter into the surfaces of ground by the application of an electric iron. They are often used as a last varnish on pictures which must not shine.

WAX MEDIA

Wax in various forms has been used from early times to bind pigment together and to bind it to surfaces. Mixtures of resin, wax and pigment were made into crayons, the mixture was softened with heat and applyed to the wall with a spatula and ironed in. This was used by the Greeks and Egyptians.

Wax emulsions are the more modern way of using it. They were used from Byzantine times on, wax and glue mixtures were called "cera colla".

WAX EMULSION (wax soap)

25 grams of clean beeswax are melted over a half pint of boiling water, then 10 grams of ammonium carbonate are mixed in very little water and added to the wax. Maintain boiling temperature of water until bubbling ceases and then stir mixture till cold. Alkaline impurities in water may prevent emulsionfrom taking place. Use distilled or boiled water.

Any alkali in solution will cause the wax to emulsify, but ammonia has the advantage of disappearing, while such alkalis as soda remain and weaken the binder by remaining watersoluble, as well as attacking some colors.

Wax emulsion is milky white, lasts for years and may be mixed with resin ethereal varnishes or fatty oils such as poppy, or with balsams, such as Venice Turpentine, with glue water or gelatine, and with casein, egg or cherry-gum tempera emulsions. If any of the substances mixed are on the acid side of neutral, due to some oversight in their making, the wax will show them up by separating.

It may be used as a wax varnish for finishing fresco, or oil painting, and may be polished to a half gloss.

Wax will dissolve in turpentine and this may in turn be emulsified with yolk of egg or casein.

The above process is typical of saponifying, or soap making.

MIXED TECHNICS Application and use.

Various mixtures which typify most of the possibilities have been described. It remains to consider the possibility of combining the hitherto separately considered media: water, oil, varnish, natural emulsion, and wax painting in various layers of one painting.

The great variety of methods grouped under the heading INDIRECT OIL painting include two methods famous because they are said to have produced the results for which the Venetians, on the one hand and the Flemish and Dutch Painters on the other are famous. There is much dispute as to details of their methods, but we know that they were somewhat alike in some respects. We know that they combined the use of opaque layers of paint with transparent layers. If we can do this in a fashion which will be permanently durable, we may approximate their effects.
One of the most important considerations seems to be in keeping the paint from one layer from mixing in with the new layer as it is applied. Two methods are applied: using alternate layers of tempera like media, and varnish like media, and the use of intermediate insulating

But it is foolish to use this method if one does not desire that the color of the ground dominate the picture. If many cool colors of relative purity are desired, it would be better to use a cool toned ground, and to modify the smaller, warm areas first with white then with the desired hue. In any case, with an imprimatura coat of Burnt Sienna, one must expect to plan one's color scheme to be more or less analagous to Burnt Sienna. This is like the Flemish method.

If wider variety is desired, the underpainting may be done in several "body" colors. It has been claimed that Titian used a reddish white ground, or imprimatura, and that he painted flesh upon this in a similar color with white, and the other parts of the picture with other earth color, approximating the final hues and values, letting the ground show through only where it was the right color. A yellow white might be the basis for a bright red, or a green white for a cool red. Half tones were created by fusing the edges of the white with the ground with the fingertip, or by dragging the brush with thick paint over the coarse texture of the canvas. This was done with opaque paint, and opaque coats alternated with glazes, which might or might not cover all parts of the picture. Titian is said to have used sixty or seventy applications of glaze, but not, of course, over the whole picture.

BODY COLOR

The recipe for this body, or opaque color used for modelling is:
One part of thick oil color, mixed with equal parts of tempera color. This is a hard drying, quick drying, relatively lean mixture, which is a good basis for the relatively fat glazes which must go over it, and yet oily enough to "take" over glazes. It can be used very heavily, as paste, or scumbled and rubbed to soft, veil-like tones. It may be painted into wet glaze, though not scrubbed in, so that the glaze mixes with it. As one works over the various parts of the picture the body color drys enough in a few minutes to allow the flowing of glaze over it.

GLAZE COLOR

Glaze which is lean, and yet works as varnish can be made by shaking together one part cherry gum solution in water with one part 1:2 dammar. ethereal varnish. Finely ground transparent pigments, or tube oil color is mixed with this to make a colored glaze.

It is a basic consideration of this technic that no layer be dissolved by the layers succeeding it. Glazes should be flowed, not scrubbed on to the stiff, quickly drying layers of body color, and the bodycolor should not be scrubbed into the glazes.

The above method, when properly understood, produces the widest possible texture and color range, more than that of any other medium.

Isolating methods

When the tempera painters first began to feel their way towards a broader technic, they began varnishing each layer of tempera with a colored varnish, to tone it, and to make it keep separate from the next coat. Linseed oil came into use in this way and later, oil painting developed from it. Resins and balsams, or varnishes, were also developed for this purpose. Essentially the method is to paint in tempera body color or white over resin, oil glazes, then to glaze. The base was a solid white gesso ground, with drawing on it in India ink, or tempera black. The imprimatura was oil color in ethereal varnish applied thinly, so lean as to hardly show a gloss, with the drawing showing through.

and the use of intermediate"isolating"or separating coats. Also, by letting each coat dry thorely before another is applied. This last, is safe, but slow, so it would be better to consider the first and second methods.

As the effect of "indirect" technic depends a great deal on relative transparency and opacity of coats, the color of the ground becomes more influencial than in direct, opaque, painting. Some parts of the picture may show the ground through several transparent coats of paint. Since all oil paint tends to become more transparent with time this effect of the ground increases rather than diminishes as the painting grows older. A white ground painting will tend to become lighter and more brilliant in the light colors, a dark ground painting to become moresubtle and rich in the deep tones.

Grounds for indirect oil painting.

Toned grounds: an already prepared half-chalk ground on canvas, which is not very fat, may be toned by a thinly applied coat of color in medium fat tempera, or in resin-oil. Any opaque earth color pigment may be used. Titian is said to have used red ocher, Veronese golden ocher, and Tintoretto Venetian Red. El Greco's effects can be approximated by the use of raw umber or terra verte. So called "bolus" grounds were toned with Armenian bole pigment clay, which was red rust color.

Opaque color grounds can be made by adding a little of the pigment to the last coat of half-chalk ground, the pigment being substituted for one of the zinc white in the half-chalk ground formula.

White grounds will produce most brilliant color, but not always the most subtle harmonies. The relating of colors on a white ground is the most difficult. Toned grounds with transparent or semi-transparent painting modify all but opaque patches of color in their direction, and create a great number of "optical greys" which tend to fuse the color of the picture into a unison. These "optical greys", resulting from the effect upon the transmitted light of two, or more, somewhat differing layers of color, are entirely different in quality than such colors would be if achieved by the direct method of mixing them together upon the palette. Unless the worker is sensitive to this difference, there is no point in his adopting this indirect technic, for he will only vulgarize it. Study of the work of Durer, Rubens, Rembrandt, El Greco, Tintoretto, Titian, is recommended, either in the original, or in very good color reproductions. Since color reproductions cannot reproduce paint texture even the good ones are unreliable in this kind of study. The quality attributed to Venetian painting, the "Venetian glow", which is due to the glazing treatment, cannot be seen in any but the originals, or in copies so painstaking as to reproduce the very same layers of paint.

Underpainting

Here also there are many disputes as to exact methods. There is evidence that some of the earlier indirect painters painted the form, the modelling, upon a dark ground with opaque white, and then modified both ground color and white with transparent glazes, painting over the glazes with white again, in a solid or scumbling fashion, either when it was desired to raise the value, or to radically change the influence of the ground as to hue. If for instance, pure blues were desired and the painting had been grounded with Burnt Sienna, it would be necessary to entirely obscure the ground in such areas with opaque white and then to put on a series of coats of blue, till the desired color was reached.

CRAFT OF PAINTING: LECTURE: BINDERS AND BINDING MEDIA

The binder is that which causes the pigment to adhere to the ground. Binding Media used for painting may be classified as:

Fatty Oils
(the fatty oils used in painting are mainly of vegetable origin.)

Such oils are, however transparent, not pure chemical substances, but are mixtures of liquid and solid, drying and non drying parts. The only dividing line between the oils and the fats is that of temperature. At high temperatures all fats will liquify, at low temperatures all oils will solidify. The liquid fats and solid fats ordinarily referred to are dependent upon average conditions of temperature and pressure for their condition. The non-drying parts sometimes are of such a nature that they evaporate, leaving the drying parts. According to the content of drying or non-drying ingredients an oil drys quickly, slowly or not at all.

The painter is sometimes concerned with non-drying oils as "cutting material"..dilutents to aid in the working of the medium which evapporate during the drying process. The convenient oils which come to us after simple extraction processes are:

Non-drying: Peanut oil, olive oil.
Semi-drying: Soy bean oil, rape-seed,oil, cotton seed oil, sesame oil. Closely related to these are the fish oils and animal fats, used sometimes in painting, but by their nature usually bad in their effect on the painting process.

Artists have in the last hundred years or so been more interested in colors which will remain wet and permit rework-

ing for a long period and this has led to the practice of mixing slow drying oils...often, wrongly, non-drying oils with the oils which are finally to bind the color particles to the ground. The usual result of delaying the drying of paint by such admixture is prolonged stickiness of surface and eventual darkening. However our reliable painting oils are mixtures of drying and non-drying parts, but wisely chosen and mixed, to avoid unfortunate final results.
The oils with which the artist is most concerned are those which by their natural constitution will completely dry... that is lose, or change their liquid parts, so that the final result is a transparent, durable film.
These are the:

Drying oils: Linseed oil, poppy oil and walnut oil. These oils undergo a chemical as well as a physical change in drying. They absorb some oxygen from the air and some moisture. Thus, the housepainter opens the windows when he is ready for his paint to dry. Drying oils will dry very much more slowly if kept under water, thus the practice of keeping oil palettes with paint upon them under water in a shallow pan until the painter is able to take them up again.
This drying process, depending so largely upon the action of the air, begins on the surface of the oil, forming a skin which becomes uneven due to the shrinkage and expansion caused by temperature and by the fact that the oil which has absorbed oxygen from the air has gained in volume. Thus, too much oil in the paint will tend to a very uneven surface. Fresh air in motion, warmth and light hasten the process of

drying. Opposite factors retard drying. Different pigments affect the drying rate of the oil. Earth colors are usually quick driers, but vermilion retards drying. Lake colors are often slow driers. Finally the oil loses elasticity and if subjected to extremes of temperatures, may shrink so much that it cracks and the scales of dry oil and pigment may rub off like chalk. Proper oils and proper conditions of temperature and moisture prevent this.

Aged oils darken more or less, particularly impure oils. In protected rooms and with expert care this deterioration can be greatly delayed and even prevented.

<u>One of the great enemies of the permanent film of oil is the addition of driers and substances which retard drying.</u> The bad practice of the present day is to use commercially prepared tube paints which contain non-drying substances put in by the manufacturer to prevent the paint from drying while on the shelf. Then in order to get the canvas dry enough to handle and to exhibit the painter is forced to use driers which eventually darken and destroy the binder which holds the color to the ground.

The natural yellowing of oils is not really disturbing unless the paint is used in <u>impasto</u>,...heavy, buttery, palette knife, effect. Darkness and dampness increases the yellowing of the oil. Thus Titian is said to have baked the underpainting of his canvasses in the sun for <u>six months</u> to insure the thorough drying of the under coat. Light, not darkness is the friend of a properly prepared painting made with good oils, rightly mixed with good pigments rightly put on.

This yellowing naturally affects the cold colors more than it does the warm colors. The uniform, "Gallery tone", so called, of most old paintings is due to this yellowing. The old masters were originally quite bright in their blues, violets and greens. Those who copied them have become enamored of their so-called warm tonality and painted paintings which will be in time more brown than ever. This is the "brown-soup" school of painting, which has had a tremendous influence on ideas of color harmony in the past generation. Properly restored old masters are quite as brilliant in color as are the moderns, who often have been accused of garish colors.

Van Dyck, in order to avoid this yellowing of the blues, used a tempera, (oil emulsion) for his blues. Restorers have many chemical tricks for removing the oil yellow which are in the main only temporary; for instance, the practice of applying hydrogen peroxide to the yellow spots.

At best the color, fluidity and drying power of the same oils vary. Impurities resulting from weed seeds getting into the press are partly accountable. Theophilus, who wrote the early 12th century manuscript on painting complained that his linseed oil didn't dry. He used the press which was ordinarily used for olive oil. No wonder!

CRAFT OF PAINTING: LECTURE: BINDING MEDIA

The painter often blames his materials when he is unknowingly at fault in using them. Oil varies according to its source, according to temperature and atmospheric conditions. In exceedingly cold climates painters uniformly find less linseed and more oil of turpentine better for painting. Oils are adulterated in a number of ways hard to detect. The painters test is to try it out as to odor, appearance and drying power. Fish oil odor is perceptible, animal fats have their smell, a violet color is perceptible if mineral oils from petroleum sources are used as adulterants. Mineral and resin oils appear a deep blue if laid over a black ground. Old oil is thready and viscous, often old paint is rubbery. Fatty oils are useful to the painter as media in themselves, as part of tempera emulsion and in the preparation of grounds.

OILS SHOULD ALWAYS BE USED AS SPARINGLY AS THE TECHNIC DESIRED WILL PERMIT. THEY ARE A NECESSARY EVIL.

Linseed oil: Cold pressed is the best, but almost unobtainable except at prohibitive prices. Even so, it varies according to the ripeness of the flax seed, the locality in which it is grown, etc. Baltic linseed is the best European linseed. Nearly equal are Dutch and South American linseed. Indian Bombay is bad.

Cold pressed oil is the result of the first pressing without the use of heat. Unripe seeds contain watery substances which produce a milky effect. Fresh cold pressed oil is almost odorless, very fluid, and does not become viscid so quickly as others with cold.

The oil you will most probably use is
HOT PRESSED, darker, containing some undesirable mucilage, becomes thick when cold, has a pungent odor, does not dry through so well, but it may be purified and used with some satisfaction.

Chemically extracted oils are unsuitable for artistic purposes but are the cheapest due to the large yield from the seed. Cheap house paints are ground in this oil.

Bleaching of oil is done by the action of sunlight or chemically. Chemically bleached oils contain substances dangerous to the color, the pigment itself and are not permanent in their bleached effect. Sunlight bleached oil is better, harmless to pigments, but will, if left in the dark return to its dark color. It is better to paint with unbleached oil, or only partly bleached (sun-bleached oil), and to paint in such a way that the color of the oil does not injure the painting, by making the blues more powerful. If the painting is executed in bleached oil and left in a dark room the darkening effect of the oil is unpredictable, whereas if the oil is properly used in its natural color the oil on drying will be very close to the appearance of the painting while it is being executed. Sun bleaching is effected by exposing the oil to bright sunlight for several days in shallow pans protected from dust and dirt with glass plates laid over the pans. It is better if the pans are white. Pictures will sometimes turn brighter after they dry if completely unbleached oil is used, but partly sun-bleached oil seems to produce the best all around results.

Other bleaching methods are: heating the oil till it looks white, heating with fuller's earth or clay, or heating with bone charcoal which contains no fat. All these produce an oil clear as crystal but it will turn yellow again with a little age, especially if not kept in bright light.

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CRAFT OF PAINTING. BINDERS. FATTY OILS. LINSEED.

The best picture varnish is not boiled linseed oil varnish, but sun thickened oil. Boiled oil varnish soon becomes cloudy and being of the same nature as the oil in the picture is removed by retouchers with great difficulty.

Stand Oil is a form of linseed which has been treated with carbonic acid. It dries more slowly than raw linseed. It is highly weather proof, dries with a high gloss. (It is also known as English Oil Varnish.) It can be added to other painting media when its effects are desired or used as

Half Oil, which is half stand oil and half turpentine.

OZONIZED OILS are oils which have been brought to the last stage of drying by blowing oxygen through them. They are useful for enamel like effects, mixed with turpentine. Sun-thickened oil is better for this purpose however.

Siccatif, siccative, or drying oils, are: manganese, cobalt and metal oxides dissolved in oil. They cause a quicker absorbtion of oxygen by the fatty oil. They can dry oils in a few hours, but are dangerous to permanence. They should only be used in commercial jobs where permanence is not important and time is. Too much drier causes cracking, discoloration. 2% of drier to the painting medium is entirely sufficient.

Siccatif de Haarlem: thickened oil and dammar varnish, is unharmful if properly used. Japan gold size, Courtrai siccitif, lead siccatifs, malbutter, megilp, etc., should be avoided in work where permanence is desired.

NUT OIL is walnut oil pressed from ripe walnuts. Its particular qualities are sometimes useful. It is more fluid than linseed and is not so dark in color, but linseed dries more thoroughly and is thus safer. Nut oil permits a very fluid free technic. It has fallen into disuse because it turns rancid so quickly.

POPPY OIL is pressed from the seeds of the white poppy. The second pressing produces a reddish oil.

Poppy oil, on account of its slow drying qualities, is indespensible to the manufacturer of tube colors, but not to the painter. It has special uses however. Poppy oil forms less of a skin as it dries and is an advantage in "buttery" technics. Opaque or semi-transparent painting or "scumbling technic" may be practiced with great freedom with poppy oil colors. The oil does not skin over for six or eight days, and one may paint wet in wet for a longer time than with linseed. When painting in successive layers, as did the old masters, linseed oil is much more reliable if the successive layers are permitted to dry, but if one wishes to paint direct, wet in wet, poppy oil will dry as a more homogeneous mass and wrinkle less. Poppy oil takes too long to dry for use as an underpainting.

Colors are sometimes ground with poppy oil if they are quick driers, to make them dry more as do the other colors ground in linseed.

Poppy oil should be remembered as the slowest drying of the useable fatty oils and should be used where slow drying is especially desireable, not elsewhere. For instance grounds and underpainting should not be prepared with it.

Commercial canvas is prepared with it for the convenience of the dealers shelves...so it can be rolled...but such grounds will cause the canvas to crack eventually.

Hemp oil, sunflower oil, soybean oil, cottonseed oil, candlenut oil, spruce, fir, and pine oil, even castor oil, have been tried out, but linseed and poppy oils furnish all the variety of quality that the painter needs.

THE VOLATILE OILS (essences)

The fatty oils leave permanent grease stains, the essential oils do not, but evaporate entirely, thus they are useful to dilute the fatty oils.

Most essential oils are soluble in the fatty oils.

Organic essential oils evaporate with the absorbtion of oxygen.

Essential oils are used largely for "thinner" and as solvents for balsams and resins.

Keep essential oils in dark cool places in full bottles.

TURPENTINE, Terebenthine, Oil of Turpentine, Spirits of Turpentine. This is the most useable by far of all the essential oils for the painter. It is prepared from balsam, which is pitch of pine trees by steam distillation. The residue of balsam left after the liquid turpentine is carried off as a vapor is called fused colophony.

French oil of Turpentine has long been considered the best, when twice rectified and completely free from resin it is the best for painters purposes...but only because it is made with the painter's needs in mind.

American oil of turpentine was formerly the best, but attempts to get more turpentine out of the pitch and adulteration with petroleum distillate have made the pro-

duct wariable.

The petroleum adulteration can be distinguished by the odor. Good oil of turpentine should make a rapidly evaporating spot on paper with no grease spot or residue left. When shaken in a bottle the air bubbles should disappear without iridescence.

If not kept in full, closed containers in a cool place it becomes resinous and brownish. This has a drying effect like siccatif up to a certain point but often causes color to remain sticky a long time.

Oil of turpentine containing water causes "bluing" and cloudiness in varnishes. It will be freed from water by putting a piece of quicklime (unslaked line)(Calcium Oxide which takes on water to go to Calcium Hydroxide) in the bottle.

A test for purity is to shake together white-lead, linseed oil and oil of turpentine. If the turpentine is not separated from the rest of the mixture in one hour, it has b een adulterated.

Substitutes.

Destructive distillation of wood produces a liquid which has an unpleasant piercing odor and is a poor drier and usually contains substances injurious to pigments. "Near turps", German, Polish, Russian, Swedish turpentine or any patent turpentine substitute is at best uncertain in its effect on color. In time a substitute may be perfected which will be reliable when used with the pigments artists must use, but for the present they are at best only safe with some house painta .

Test:

Inferior turpentines turn brown-red when mixed with concentrated HCl. Good turpentines yellow only a little.

Qualities of turpentine:

In no sense should turpentine be mistaken for a binder. It is a solvent, which causes the heavier oils and resins to thin into a workable form. It will not in itself bind paint to a surface, any more than will so much water. The "leaner" the medium, that is the less oil and the more turpentine, the less durable the oil coating. After the turpentine has evaporated there must be enough oil to form a complete though thin film in which the pigment particles are imbedded.

If used in too large proportions oil of turpentine will cause the film of oil to crack in its effort to stretch over the surface as it dries. Painting on any oily ground is dangerous with too much turps, causing cracking, and dissolving the oily ground in such a way that it mixes with the paint. If oil paints have hardened in the tube the addition of turpentine will not bring back the binding qualities of the oil.

Turpentine is in itself a drier, not only evaporating quickly, but causing the oil to dry more quickly. It is a solvent. If painted over already dry surfaces in overpainting it dissolves the lower layers of paint and causes a spotty softening of the under coat which results in later darkening. The excessive use of essential oils is one of the practices of present day painting.

The most permanent practice is to paint under coats the leanest, that is each successive coating of paint from the ground on the canvas to the varnish on top should be slightly richer in oil content and smaller in turpentine content. This is true whether one is painting wet on dry or wet into wet.

Terpineol is hydrate of turpentine which remains wet longer when used in turpentine's place.

Volatile mineral oils.

Do not absorb oxygen in process of drying therefore are not such aids to the drying of oil. They simply evaporate leaving some carbon residue, more or less according to their purity. Benzine, gasoline, kerosene, vaseline, are all of this nature. The heavier mineral oils such as vaseline do not evaporate and therefore have no drying effect at all.

Kerosene was used early in Italy under the name olio de sasso, or olio de petra and some of Leonardo's unsuccessful experiments employed it. It has been used as a solvent of fatty oils with uncertain and variable effects. The colors often rapidly darken and remain greasy. Certain very pure, modified forms of Kerosene have found use as cleaners and solvents, but they are just as expensive as turps.

Benzine is useable as a thinner, evaporating very rapidly, but it is such a fire hazard that it is avoided. It is used as a solvent for gum dammar in pastel fixative. (2% dammar).

Benzene (not to be confused with Benzine) is a powerful solvent. It has been used where very thin effects were desired and sometimes with the addition of beeswax. Pure benzene has permanent value. It is colorless, strongly odored and highly inflammable. Impure benzene turns brown and causes colors to darken.

Toluene, Xylene, Tetraline, Decaline are all useable as cleaners, but seldom as painting media. They have the general characteristics of Benzene if they are spelled ene and of Benzine if spelled ine.

Semi-volatile oils.

These are essential oils which do not completely evaporate, but leave a resinous spot. They dry more slowly than turpentine and are useable only in pure direct painting where slow drying is desireable and there is no overpainting. They cause cracks if wrongly used. Rosemary oil, Oil of Spike, Lavendar Oil are somewhat alike. Oil of Cloves is light when made from clove blossome, darker when made from stems. Through its used a picture can be kept wet longer than with any known painting medium. With zinc white it remains wet up to forty days on non-paurous grounds. When painting with it care must be exercised, or it will dissolve the ground or any under coat, and the coalescence of the two layers will cause darkening. Good oil of cloves completely dissolves in alcohol.

Copaiva Balsam Oil Has the peculiar property of being a fast drier, but evaporating not at all. It is a power-

ful solvent and is adaptable to purpose of the restorer, but Dammar and Mastic varnish can do more cheaply anything that his oil is needed to do.

Elemi, Cajuput, Copal, Amber, Wax, are all oils of this sort, useless, expensive, or useable only in very special places.

Camphor is sometimes used to preserve tempera emulsions.

BALSAMS

These are liquid exudations of plants. They are distinguished from gums in that they do not dissolve in water. When exposed to air their essential oils evaporate and they become resinous. Pine pitch is such a balsam. The resin is splintery and decomposes easily.

Venice Turpentine is larch pitch, coming usually from Trent. It is aromatic, light color, with a whitish cloudy appearance. Impure it is brownish. It is more or less viscous, depending upon how much essential oil (oil of turpentine) has evaporated from it. It will dissolve again in more turpentine.

BALSAMS Venice Turpentine

Pure Venice Turpentine is an excellent non-yellowing painting medium where an enamel like effect is desired, especially when used with sun-thickened oil. (Rubens used one-third thickened oil). If it is not used sparingly the dark slow drying colors will not dry and "bluing", will result. It must not be used as a finish, for it quickly becomes splintery exposed to air. It should be protected with mastic or dammar varnish. It

has a fluid quality which permits an easy stroke and a fusing of intermediate tones. Van Dyck painted into a very thin film of Venice Turpentine to avoid hard edges in his over painting.

Since Venice Turpentine varies according to the amount of oil which has evaporated from it, turpentine must be added till the desired degree of fluidity is obtained. In mixed technic of certain kind a glaze of Venice Turpentine with thickened linseed is painted into with an opaque tempera.

Strasbourg Turpentine, from the white fir, was used by the old German and Flemish masters, but is now almost unobtainable pure.

Canada Balsam may be used in the place of Venice Turpentine. Undoubtedly the carefully selected pitch of many species of native fir could be used.

Common Turpentines, simple pitch, or galipot has a strong unpleasant odor, is dirty brownish. After oil of turpentine has been evaporated off the residue is colophony or violin rosin. Pitch of this sort is hard to clarify and is useless to the fine artist.

Copaiva Balsam, like Copaiva Balsam Oil, must be considered only for direct painting purposes, never in tube colors and never in overpainting. It is mainly valuable to painting restorers. Elemi Balsam the same.

RESINS

Resins like balsams do not dissolve in water, but only in fatty or essential oils and partly in alcohol. A balsam

whose essential oil has evaporated becomes a resin. Resins are: hard, such as copal, or soft, such as mastic and dammar.

Soft resins:

Mastic and dammar, which are soft resins are most useful as varnishes, are good painting media for certain effects and good in combination with oil colors. They tend to prevent the formation of skin and wrinkles and preserve against shrinking and decay.

Their most essential characteristic is that they dry from the bottom up and through all the layers of paint simultaneously as their solvent evaporates. They resist attack by atmospheric gases and dampness and can be usually saved by proper treatment if they are attacked. They give depth and clarity to colors with which they are mixed and when used as heavy glazes will produce a polished effect. They will dissolve in essential (turpentine), hot fatty (linseed or poppy) oils.

Mastic Resin or Gum Mastic is derived from the balsam or pitch of the pistachia tree. Since good varieties come from Chios, they are called Chian or Levantine mastic. Inferior sorts come from East Africa and India. Levantine mastic is bright yellow inside and the gum drops are covered with white powder. Inferior sorts are made to look like Levantine gum. Pure mastic will dissolve in alcohol. Mastic softens at 90° Cent and melts at 110° Cent. It is the most widely used picture varnish.

PREPARATION OF RESIN ETHEREAL VARNISH: Pulverize the resin. Warm it a little...enough to drive off the water. Put it in a gauze or net bag and hang it in a widenecked jar partly filled with pure oil of turpentine, so that the gum hangs an inch or so into the surface of the turpentine. The pure resin will dissolve into the turpentine and leave impure particles in the bag. Keep the jar tightly covered.

For Picture varnish and painting medium one part mastic to three of turpentine, for use in tempera emulsion, one part mastic to two of turpentine.

If heating is attempted in making the varnish it will discolor and darken. Cold prepared varnish will remain water-clear for years.

Enamel like effects may be procured by adding Venice Turpentine to the final varnish when it is used as a medium to grind colors in.

DAMMAR or Damar resin comes from dammar fir. Sumatrian and Batiavian dammar is best. Dammar is softer than mastic, softening at 65° Cent. Lumps of pure damar should be water-clear inside. Inferior sorts are yellow.

Damar may be treated to make varnish just as mastic. This varnish yellows the least of all resins.

Mastic and Damar varnishes added to tube colors...not more than 10%...enable the colors to meet the modern requirement of putting on coats in rapid succession, not advisable with pure linseed colors.

Resin oil varnishes are made by dissolving mastic and dammar in hot fatty oils. These varnishes are darker

in color and are subject naturally to a greater yellowing. They are fat and shiny giving to pictures the tone so much admired formerly. They should be used, perhaps as additions to painting media, but they are too yellow for use as a final varnish.

COLOPHONY or violin rosin is used as an adulterant and causes cracking in the varnish. Shellac is often so adulterated.

SANDARAC is a Moroccan pitch, it is not the same as the ancient sandarac, which was massicot. Sandarac will crumble when chewed, mastic won't. It is not needful to the oil painter, but has special uses.

SHELLAC: White shellac is orange shellac which has been boiled with Potassium Carbonate. It comes originally from India being the resinous shell formed around the lac insect during propogation period. ✓ Shellac is soluble in alcohol, moreso in the vapor than in the liquid. Thus flasks containing shellac lumps should be frequently stood upside down. 2% white shellac is a satisfactory fixative for drawings. One part to two of alcohol serves as an isolating medium for grounds (to keep the ground from being disturbed by painting over it) 5% castor oil added will make it work smoother.

Shellac loses its solubility in alcohol when exposed to light and air, therefore should be kept in dark, full bottles.

Shellac is not useable as a final picture varnish. Unless protected by other coats it finally cracks. Metal containers will discolor it.

HARD RESIN

Copals: copals vary in hardness from that of damar to that of rocksalt. Fossil copals and Mozambique, Sierra Leone and red Angola varieties are insoluble in alcohol, and will not easily dissolve in fatty oils. They must be pulverized and roasted, forming copal colophony, a dark brittle mass which melts in hot oils producing a dark resin varnish, very glossy, useable in small amounts if at all as additions to painting media. The artist had better avoid them entirely, as they are more suited to furniture finishing. Mastic or Damar with sun-thickened oil and Venice Turpentine are better in every way. Many copals check and crack and if used as a final picture varnish will darken and are difficult to remove and replace without injury to pigments.

Coach varnish, when genuine is the highest quality of fatty-oil-copal varnish, but most often a simple linseed oil varnish masquerades under this name. English coach varnish is the best. Coach varnish gives an enamel like quality to the colors, but should be avoided either as an addition to the medium (oil and turp) or as a final picture varnish. It will cause deep cracks if varnished over paint not dried thoroughly.

Soft Copals, are, unlike hard copals, soluble in alcohol. They are called Brazilian, kauri, Manila, and Borneo copals. White Angola is so soft that it rubs off on cloth. It makes a sticky varnish. Many soft copals will swell in oil of turp or other essential oils and afterwards easily dissolve in hot fatty oils. Soft copals are

sometimes confused with dammar, under the name of damar copal. When shaken up with ether soft copal solutions will be clear, damar will show as milky. Most copal varnishes are from soft copals.

Amber is a fossil resin derived from many sources, chiefly on the Baltic coast. One sort, succinite, represents the hardest known resin. Light to dark yellow in color, transparent or cloudy, these have long been thought the best of all materials for varnish making. Amber is like hard copals and must be roasted to colophony before it will dissolve in hot fatty oils. Such varnishes are very hard, but very dark. Commercial "amber" varnishes seldom if ever contain amber, but are only hard drying varnishes. There is no need for such a hard drying varnish to the modern painter, either for painting media or final varnish. Amber, like copal will darken and turn cloudy with age if used as a final varnish.

Synthetic Resins. Lacquer. There is an increasing use of lacquer as a medium for painters, but nothing definite is known as to its long time durability. The best known are the so called nitr-cellulose lacquers, such as Duco in America, and Zapon in Europe. The transparent lacquers of these sorts are useful for isolating purposes, and as a varnish for watercolor. Acetone is the solvent. Additions of 5% castor oil increase elasticity and workability. Lacquers will yellow with age, the phenol-resins and formaldyhide-resins less than the kumarum-resins.

There is no pressing need for a synthetic resin to replace mastic and damar for the artist. Though many show possibilities as painting media, their effects may be duplicated without uncertainty with the better known older natural resins.

WAXES AND TALLOWS

These are animal and plant products similar in nature to the fatty oils.

BEESWAX is by far the most important for artists. It should be made from year-old honey combs which have not been hatched, producing "virgin wax", bright yellow and clean. Older wax is dark yellow and must be melted with water, then cooled with alum water over and over again to clean it. Iron vessels will discolor it. Beeswax is often adulterated with mineral wax, paraffin, which makes it harder and more brittle. The test is the taste when chewed. Warm wax dissolves in oil of turpentine, benzine and fatty oils. If warmed too much it browns like butter.

Wax is very resistant to acids, but it forms an emulsion with lyes. It does not oxidize or change in any way with age, though it may melt. Very ancient paintings of Egyptians and Greeks show that as a surface it forms a better protection from moisture than oils.

It produces beautiful effects when used for mat effects with oil and tempera, as well as the half mat effects produced by rubbing it with the ball of the hand or a cloth. Ironing it with hot spatulae produces a high gloss, as in encaustic painting.

Once wax has been introduced as an ingredient in a

painting the rest of the painting must employ wax. Wax grounds will not take paint containing no wax. Wax is added to tube pigments to prevent sudden hardening.

There is a question as to whether wax painting is good in cold climates because of its brittleness at low temperatures, and tendency to crack.

PARAFFIN WAX, a mineral wax is more brittle than beeswax and harder. It is soluble in benzine and vaseline and not so beautiful in painting media as beeswax.

Carnuba wax is a very hard palm wax used to harden beeswax, but usefull mainly in shoe polish.

Other waxes and tallows have from time to time been used, but unfortunately.

Isolating methods.

Then, either into the still wet, or dry imprimatura, tempera white was used for highlights, as hatchings, and the lights built up precisely and delicately. Then a resin-oil glaze, colored, was applied. This may have been sun-thickened oil and some balsam dissolved in it. Or it may have been sun-thick oil mixed with a resin varnish made with turpentine. (damar would do) . It must have been very thin with turps, and lean. Another refining of the forms with tempera white took place, and then another glaze was applied, and resin-oil color painted into it semi-opaquely. More colored glazes applied as needed.

The heightening with white will always be lighter at the beginning than the values aimed at in the finish. Each layer of glze is very thin. Soft brushes were used, and hard edges blended with a "blender" brush.

This method, by imperceptible steps, was simplified into direct oil painting with only a little glazing, until, with the outdoor direct work of the Impressionists, glazing was abandoned almost entirely. Its great change took place at the hands of the Venetians, as described, in the direction of more pasty use of opaque, and broader brushing.

It is well to realize that the older oil paint without the addition of wax or aluminum stearate, was not pasty, but was syrupy, and was in itself more like a glaze. The painters using it had more need to distinguish body color, or relatively covering and opaque color, from relatively glaze, or transparent color than do the users of pasty tube paints, which are all made somewhat opaque for direct painting. Some brands are more so than others, but it is usually safer to use modern tube paint as though it was not entirely transparent, that is, very thinly where transparency is desired. For really transparent varnish or oil glazes transparent pigment ground only in raw linseed and varnish are best. The differentiating body color can be coarser ground, the glazes finer ground.

Other glaze binders and General Considerations.

One part stand oil, two parts heavy varnish, two to three parts turpentine. (Stand oil is sold under this name. It is linseed oil, prepared so it dries more slowly, but is very weather proof, and dries with a high gloss.

A few drops of Venice turpentine(balsam) in this medium makes it more precise in handling and adds to its enamel like quality. But Venice turpentine should not be included in the final coat, which is to be exposed to the air, since it will not stand prolonged exposure to air and moisture, without protecting varnish over it.

Venice turpentine dissolved 1:1 in turpentine is said to have been used by Van Dyck as an intermediate, isolating varnish, over which he painted the next glazes and body color.

Even in Glazing you should observe "fat over lean". If many glazes are to be used, begin with as little medium as possible, and add a drop or two of the "fat" ingredient as the successive layers go on. Excess of medium will cause blackening of the blues and the madder reds when the picture is old.

When the picture gets too "glassy" after several glazes, let it dry and rub the surface down with fine pumice. If part of the glazing sinks, and becomes too dull, give it a light coat of thin damar.

Isolating methods.
There are many technicalities about indirect painting and glazing methods, but one can avoid confusion by sticking to basic principles.

To sum up: Colors used are opaque, or transparent. One may begin with a glaze or with an opaque color as an imprimatura. One may then work only with opaque white, alternating with successive glazings, or with several body colors. Everything should be done to keep the successive coats from sinking into each other, and yet they must be nearly enough related to adhere. If the glaze will not go on smoothly, but tends to puddle, it is too lean. Successive coats should very slightly gain in oil and/or varnish content, at the expense of lean constituents, such as glue or cherry gum. If the body color tends to mix with glazes when they are applied (1) wait till it is drier (2) don't scrub so hard with the brush ful of glaze (3) or use an isolating medium over them. Such an isolating medium might be gelatin solution, shellac, or varnish. But if you are using a body color of oil-egg, or oil-casein opaque it should hold without isolating.

If you use body color of straight egg tempera, your body color will lend itself to the refinement of technic which characterises this medium. If it is an oily tempera body color it will lend itself to broader effects, such as the Venetians used. You can work into a half dry glaze.

Remember that the most powerful binder for very thick body color is casein. It will not crack up to a quarter inch thick. A mixed white for underpainting, including casein is: ¼ casein distemper, ¼ oil paint. If you wish it leaner, and to work it with water instead of oil, use two parts of the casein to one of the oil paint. Rembrandt, Titian and Veronese are claimed by some to have used this for body color.

Canvas grounds lend themselves better to oily tempera and glaze work, panel grounds are better for the leaner painting and for Flemish methods. The texture of canvas is very useful for the drybrush scumbles which produce the half-tones in the Venetian methods, not so useful to the hairline hatchings which characterise the straight tempera Flemish methods. Larger canvasses are suitably painted in the Venetian style, smaller panels in the more delicate Flemish style.

Fresco Painting

Fresco is the Italian word for "fresh". Strictly speaking, fresco painting refers to painting with water color on fresh plaster. The lime of the plaster, in forming crystals with the carbonic acid gas of the air, hardens to a marble like surface which increases in translucency with the years, hdding the pigment particles imbedded in it. It was so much used for wall painting in times past that the term fresco has been loosely used to refer to wall painting of any type.

True fresco, or "buon fresco" is not so practical as a medium in present day wall painting as it was in the days when plaster rubble and brick and stone walls were the rule. Concrete and steel walls are unsuitable without special precautions.

The tradition in the use of plaster-like materials which is the possession of the Italians has supplied them with a whole group of terms which differentiate the sorts of materials which we group carelessly together under the name of "plaster". It is necessary to make these distinctions in order to understand fresco painting. Cennino's system of fresco is the classic one, but many modifications, some good, some bad, have been worked out since. It is best to use fresco only where the building and wall surface is suited, rather than to go to great trouble in preparing special walls for it. It is a part of its character that it should be an integral part of the architecture of the building, where this is not true, it is practically and esthetically speaking, better to choose another medium which does adapt itself diractly to the conditions obtaining.

Fresco is best done where buildings are not in use, as fresh plaster must be handled. Where buildings are in use special provision must be made to protect floors, etc., from wet plaster, water, etc.,

The technic of fresco restricts the palette to pigments which are color fast in strong alkali, for lime is both the binder and the white in this medium. Generally speaking, this excludes all the the earth pigments, with the addition of one lake, rare, and seldom used: Helio East Red dye, ~~xxx~~ Cobalt Blue, ~~xxx~~ Viridian or Chromoxide Green, Vine or Bone, or Ivory Black. Ultramarines of various sorts must be tested for change with lime water, as it is often adulterated with gypsum, when it will turn white in lime.

This provides a guide to the color harmony characteristic of this medium, one built around the earth colors. This should guide the sketch preliminary.

In general all colors dry out lighter and more transparent in fresco. Colors put on when the plaster is quite fresh dry out the lightest, those put on late come out darker, the darker tones having warmer quality than the light, early painted, tones.

Often colors are given more body by underpainting and overglazing, as in Giotto's skies in the Assisi murals, where terre verte underlaid cobalt. Both are of course done during the period while the plaster is still wet, the undercoat earlier the glazing later.

Fresco Painting

Preparation of Wall

For permanent fresco work, the wall should be:

strong enough to stand the addition of five or more additional pounds of weight per square foot.

It should not contain moisture, nor should it contain any steel or iron which has not been isolated in such a way that it is impossible for iron stains to come from it to the plaster surface. It must not contain unreliable cement and concrete. Portland cement, frequently used in concrete contains as much as 75% caustic alkali which takes at least two years to settle and stop harmful chemical action & harmful color. If it its a new wall of any kind, it should set a month or so before plastering for fresco.

If old plaster is present it must be completely removed, and even the mortises between the stones or bricks picked back about an inch. If the bricks are glassy smooth--as dark red bricks sometimes are--the surface must be roughed. The whole surface should absorb water evenly.

The wall must then be soaked for a day or so with water. Wetting down cloth hung against the wall will do this. It should absorb all the moisture it will. .

Exudations, which look like mould, or salty encrustations, which appear sometimes on bricks or on plaster are due to incomplete chemical action, which has been arrested for lack of moisture, and which begins again in the wall when it is wet down. This "bloom",or efflorescence, is dangerous to color. Hot thinned muriatic (hydrochloric) acid brushed over the wall may remove this satisfactorily. The wall must then be rinsed copiously. Grease spots, will of course,prevent plaster adhesion.

Sometimes coats of tar mixed with dry, coarse sand, are applied to a wall which insists on "blooming". Asphalted felt building paper has also been used to isolate a fresco from an unsuitable wall. Such processes are always uncertain.

Preparation of mortar

Tools for plastering will be a mortar box, hoe, trowel, and smoothing board. A plumb-line, staightedge, bricklayers pick-hammer, broom and sail will be useful.

Lime fresco

The substance upon which all adhesion depends is lime. Natural limestone is Calcium Carbonate. When burned in a lime kiln this gives up Carbonic Acid Gas(CO_2). It is then called unslaked lime and is CaO. It is very hygroscopic, that is, water-thirsty. It combines with water with the emission of considerable heat to form Calcium hydroxide ($Ca(OH)_2$) which is slaked lime, or, lime putty. Lime putty slowly changes in the presence of the Carbonic acid gas of the air, back to Calcium Carbonate, in which state it is very permanent. Marble, alabaster and limestone are all various crystallizations of Calcium Carbonate, and the surface of the fresco changes slowly toward more transparency, even though it may be slightly cloudy at first.

Fresco Painting

Preparation of mortar.cont'd

The best lime is that which has been burned over wood fires, containing no sulfur from coal or oil fumes. It is hard to get, most of it coming from regions where wood is cheap fuel, as Canada. Sulfur in lime causes efflorescene.

The lime putty should be mixed thorely with clean water and allowed to run into a buried box, or a pit, where impurities settle to the bottom. Two years in the pit, kept coverd with water, and the lime becomes buttery and gluey in consistency, creamy, not lumpy. The older the lime kept under such circumstances the better the fresco. The water keeps thhe carbon dioxid in the air from joining the lime.
When removed from the pit the top crust, which has been somewhat exposed the the carbonic acid of the air should be discarded. It should be seived to extract crust and lumps.

There are grey limes, iron stained yellow limes, and lime which is a biproduct of acetylene production. The best is pure white marble lime, with no gypsum or plaster of paris content.

Sand.

The sand must be clean, containing no chemicals such as sea salt, and no iron pyrites or other iron impurities. (These will adhere to a magnet and appear as black specks) Sand containing clay causes plaster to crack. Sand may be washed to remove impurities, but must be dried, as it absorbs moisture which it later gives up in the plaster, keeping the plaster soft too long. The best sand has very angular particles, not rounded and smooth. It is called "sharp" sand.

Course sand is best in undercoats, fine sand for fine finish coats. Rock sand, from gneiss, granite and porphyry, is excellent. Marble dust, or alabaster dust is sometimes used in final coats as sand. These produce very high key, bright frescoes. Ground pumice has been used for a greyish final coat.

Mixing. First coat, or roughcast.

Putty and sand should be chopped together with the hoe before water is added. If water is added too soon lime will not adhere well to sand. For roughcast mix 3 parts course sand with 1 part lime putty. Add water till mixture will just threaten to run off tilted trowel. Later coats may be applied stiffer, but this must be splashed on.

Application
Go over the wall with a stiff broom. It should be wet, but not dripping. It must have absorbed all the water it will, otherwise it will draw out the limewater from the plaster and leave the plaster crumbly.
Throw the mortar from the trowel against the wall from a distance of about two feet. This excludes air bubbles. Throw it obliquely so it slides a little along the wall. Cover the whole surface to about 3/4 inch to one inch. As soon as the plaster has hardened so that it will stand the pressure of a finger with no more than an imprint, it may receive the second or "evening" coat. If an interval of more than a few hours occurs here the surface of the rough cast must be raked and scraped to remove the dry, crystalline film of Calcium Carbonate which

Application of Mortar. cont'd

forms, and which will prevent the next coat from adhering firmly.

Surface should be dampened again with a brush if it is dry and will take water.

The evening coat, or second coat, is composed of 1:2 lime and sand. If four coats of plaster, or more are contemplated, then this coat should be 1:3 again. It is applied a little dryer than the roughcast and is trowelled on, and smoothed and pressed again and again, firmly into the roughcast, using the straightedge from time to time. It is applied horizontally from bottom to top. The finish surface should be rougher if this is to be the second of four coats, smoother if it is to the the second of three. The intonaco, or last coat, may be applied on this.

The coarse painting coat may be the same as the evening coat, but in fine fresco work a 1:2 coat is applied here, using finer sand or marble grit, again as soon as the undercoat allows itself to be only slightly dented. These intermediate coats are about ¼ to ½ inch thick.

THE CARTOON

Here the cartoon, or full sized drawing which has been prepared on heavy butcher paper comes into use.

The cartoon is a final drawing which indicates all necessary outlines and color changes and is the result of much preliminary sketching and experimentation. Often a model of the room is built and small sketches installed, in order to study lighting and color schemes. The results, of this study insofar as they affect the shapes of the color planes in the picture, must be indicated in some way in the cartoon.

The cartoon is perforated with a perforation wheeland is cut up into convenient pieces for handling. Since approximately one square yard of painting is a days work for one man in fresco, the pieces of cartoon, which will be very much like a large size jig saw puzzle, may approximate this area.

These pieces are now hung in place, one by one, on the wall, and their outlines traced with, first charcoal and then a distemper black or earth red. Casein distemper is good. Most painters will wish to pounce the perforated detail lines onto the coarse painting coat and carry out the whole painting in line, in order to study its effect in place. Pouncing is done with charcoal dust contained in a little sack of open weave cloth, which will permit the charcoal dust to enter the perforations of the cartoon when they are tapped with the bag. Then the lines are picked out in distemper color. When this is finished the final work may begin.

When the last plaster coat no longer gives under pressure of the finger but may easily dented it is possible to transfer the cartoon by means of pressure on the lines with a brush handle. This indents slightly, and makes a drawing in low relief.

The last coat, or intonaco

If a brilliant white is desired, 1 part lime putty and 1 part marble dust is used, and smoothed on the dampened coarse painting coat with the wet smoothing plane. Only as much is applied as the painter can cover in four hours work, for the plaster is not good to paint on if it has set longer than that, unless one of several means has been used to prevent its chemical change to calcium carbonate &t normal speed.

Fresco Painting.

Last Coat or Intonaco.

Butyl Alcohol sprayed on the newly plastered surface delays its setting so that it may be painted upon for a longer time. Experiment will be necessary to determine just how long, for plasters harden differently. This alchol treatment, however, has been xxxxxxxx said to lengthen the possible painting time from two to four times.

Sometimes the intonaco may be scrubbed, after hardening, to remove the crystalline film, and wet with lime water, and this painted into. This method, of course, produces a different texture of surface.

General Considerations about plastering.

Very wet, and very "fat", or high lime putty content plaster tends to crack if it is applied in thick layers. Thus, as the lime content increases, the layers should be thinner, until the intonaco is hardly more than ¼ inch thick. Immediately developing fine cracks are not very dangerous, but may be filled with limewater, and theedges pressed together while the mass is still wet.

Roughrounds are usually better in outdoor frescoes.

For best results mortar is not mixed more than a day or two in advance.

Painting.

When a section of intonaco has been plastered on, and no longer gives under the pressure of the finger, but may be easily dented, the cartoon is again placed on the surface and the design pounced on. Since the intonaco has obscured whatever drawing lines were put on the coarse painting coat, the area covered by the intonaco should correspond approximately to one of the sections of the cartoon. The plaster should be trimmed very neatly at the edge with a small trowel, to correspond with the previously decided drawing and division lines which appear on the coarse painting coat. The work is done, a section at a time, and the divisions between these sections will be more or less apparent in the finished work, so they should be planned, and too large plain areas avoided. Where seams do not correspond// to color divisions.

Usually one begins painting at the top of the composition to avoid dripping on areas below

Along with the cartoon, a small color sketch is necessary to guide the work. This should have been executed in the same colors as are to be used on the lime, but the binder for the color sketch may be gouache, or opaque tempera.

To determine which colors may be used they should be tested by shaking the same color in equal quantities up with pure water and with lime-water, and the bottles containing these solutions compared after a few days. If no difference is evident the color may be considered safe. Cheap ultramarine may contain gypsum, which is bad at all times in fresco work. The colors may be gound in pure water, lime water, gouache binder, skim milk, or thin casein solution. Each of these gives a slightly different "feel" to the paint, and a slightly different surface texture when a little lime putty is sometimes added to some or all of the colors to give a pastell or opaque effect.

Fresco Painting

Painting.

Much depends upon just when the color is applied. Colors applied early will dry much more transparently and lighter, as they sink into the surface more. Colors which are applied later will be darker and more opaque, and slightly warmer in effect. Colors put on too early will run, and the brush will roughen the plaster. Put on too late the colors will appear mouldy on drying, and will dust off when quite dry. Thick applications will not all bind to the wall, and the surface will dust off, being not bound by the lime.

A useful pallete for fresco is a white lacquered metal palette with indentations for color. Brushes may be any of the soft sorts which do not lay down to thick a film of color. They must be cleaned after each days work or the lime will destroy them, but must be saturated with limewater before beginning work with them again, the excess pressed out before dippinginto the color.

Methods of work are as many as there are painters. Within the limits of the medium one may invent ones own. If the painter has a very clear idea of his intentions as well as a good idea of the limitations of his materials he may do pretty much as he pleases. One might begin by drawing the outlines of the design with a warm color, then filling in with local colors. Overpainting may be practiced while the plaster is still in right condition. The paint should be liquid, but not runny in drops. Generally one should paint more deeply than one wishes for a finish effect.

When the brush begins to drag, instead of sliding smoothly over the surface the plaster is nearing the hardness when it will no more absorb paint, and one should stop at the nearest outline, or color plane edge. Remaining unpainted plaster must be removed, cutting a little obliquely. The next section is applied neatly against this.

The picture plane

All through the work one must be conscious of the fact that a fresco must be truly part of the wall surface in fact as well as effect. The design, the cartoon, the painting, the choice of colors and outlines, the modelling and brushwork must be all ruled by this primary consideration. Althoug fresco is a medium imposing certainstylistic limitations it is quite possible to over model. Such defects will be very apparent when the work is viewed from a distance. Notso apparent when viewed near at hand, and will appear as holes and bumps in the surface of the wall.

Hardening of the wall

The fresco will be susceptible to injury by touching for almost a month. By this time, under ordinary conditions, the Carbon Dioxid of the air has penetrated into the pores of the plaster which have been left open by evaporating water, far enough to crystallize the surface and harden it. It takes several years for this process to complete itself, and only then does the full beauty of a carefully painted surface appear.

Retouchings

If they must be done, retouchings can be executed in some form of tempera or distemper. Casein mixtures are the most enduring on lime.

But it is much better not to need them, as they never quite blend in.

Plaster Methods

Lectures

Marouflage.

Fastening paintings to walls.

Any panel work may be fastened to walls, also canvas. Most oil paintings that appear on walls are first painted on canvas and then marouflayed to the plaster or concrete surface.

Oily pastes are no longer recommended, as they are supposed to seep through a canvas and darken it. They are probably safe with panels, such as pressedwood. White lead and linseed, boiled, with or without the addition of Venetian Turpentine. Casein-oil paste emulsions also used. White lead and gold-size (a quickdrying varnish/ ot of dryer incorporated) is used for quick work.

The canvas is pressed onto the"buttered" tacky wall surface with rollers, working from center out.

A water adhesive recommended is: 3/4 pint boiling water, into which 1/2 pound of Dextrine is dissolved. Add 2 oz. Triethanolamine (an emulsifier) 1/2 pound whiting, 6 3/4 ounces powdered asbestos, 3 to 4 drops carbolic acid and 3-4 drops formalin. One gallon of this paste will hang about thirty five square feet. The wall must be clean of oil paint and grease and should be coated with commercial glue size. Apply adhesive with trowel.

Marouflage demands skill, and the person who attempts it without some special experience is apt to be disappointed. Panels, however, are easier to handle than canvas, if not too large.

"Fresco secco" or painting on dry plaster.

Fresco secco is a denial of terms, as fresco means fresh, and dry plaster is nôt fresh. The word fresco has here become stretched to mean wall painting in general. The Italians emphasise the difference between fresco secco and true fresco by calling true fresco "buon fresco" or good fresco as contrasted with dry fresco.

Colors painted on dry plaster by various methods are seldom as durable or quite so beautiful in quality as true fresco. A possible exception may be made as to durability in the case of casein fresco secco, for the caseinactually joins with the lime to be come part of the wall. However, many combinations have been employed more or less successfully.

By the same method one may paint on already dry plaster, new or old. The wall should not be damp, and if needs patching, do not use plaster of paris. If it already has calcimine, or some other paint on it this should be entirely removed. If it cannot be removed it should be examined and painted over with a similar sort of binder, that will bind with it and not pull it off. (A strong contracting binder like casein will, for instance, pull off calcimine underpainting.) Hollow and loose places can be found by tapping with hammers. If the plaster, when dampend, turns red litmus blue, then only the colors useable with lime can be used. Otherwise one may use a full tempera palette. If the surface is too polished to take paint it can be roughened.

Limewash methods.

Here the adhesive is lime again, this time applied as limewater to an already dry surface. Paint into the limewater wet surface with colors ground in limewater or skim milk, or with casein binder. The"bianco sangiovanni" of Cennini is neutral lime, no longer caustic, and havin no more adhesive power, and was used simply as a white addition to colors ground in egg or casein.

Casein methods

Casein colors ground stiffly in water and used with diluted casein. one to four parts of water.are good. Commerical casein pastes have stood up very well if used when not too long open in the can, and if they are not used too thickly.

Egg yolk methods

Egg yolk and lime combine. The wall is covered with diluted egg yolk and the colors ground stiffly with 1:1 egg. Little water is added. They are painted into the egg yolk covered surface. Limewater may be used. Egg may also be painted into a wet limewash on a wall.

Encaustic or wax methods

The colors mixed with beeswax, are kept heated on the palette and electrically heated spatulas, or even a small electric iron may be used to press the color into the plaster. Sometimes resin or balsam or nut oil is used in the wax-color mixture to make it more workable. Too much heat causes the wax and pigment to separate.

Wax soap or emulsion

Wax emulsion methods cont'd

Wax emulsion may be used straight, mixed with glue, or with casein.

Liquid Wax

Wax melted in oil of turpentine or liquid balsam was combined with pigments and used on Egyptian walls. More wax than oil should be used. A number of later mural painting processes depend on such uses of wax, as: Cambier Parry's process. Liquid wax is sometimes used as overglazing for fresco, or as a simple varnish.

Painting in Oil on Plaster.

Oil on lime turns very yellow, and is only useful on poaster as slight admixture to egg or wax media. However, many plaster walls are oil painted in direct defisnce to considerations of permanency and beauty. Shiny oil paint,--and it is hardly durable on plaster unless it is shiny--shows up any irregularity in the surface, shines and obscures the wall surface. It is not desireable mor mural work directly on the plaster, but canvas or panels painted in oil may be marouflayed to the plaster surface by the use of casein or white lead mixed with linseed oil varnish or Venetian Turpentine Balsam.

Glue Color (Distemer) on Plaster.

Good quality glue may be made into a sizey not to strong, into which barytes, or pipe-clay, is stirred to make a translucent solution. Pigments stiffly ground in water may be mixed with this and used for light airy wall decoration. More than three coats of such paint will not stick. The last coats should be slightly less in glue than the first, or they will pull off. Spraying with 4% formalin solution renders the glue color insoluble in water. The glue color may be waxed or varnished. It changes a good deal when thus fixed. If the walls are first soaped, the glue colors go on more smoothly. Calcimine and soap combine. Too much soap kills the color.

This method can only produce slight and temporary effects, but is useable for semi-permanent decorative work.

Plaster of Paris surfaces may be painted on, if completely dry, with tempera or distemper. They should be sized with glue water and alum 1:10 in water. Wipe off alum crystals after drying, and paint. No color will stay on gypsum if it gets damp.

Sgraffito methods consist in coloring the various layers of plaster and cutting back to them when their color is desired in the finished design. Sgraffito, fresco and mosaic have been successfully combined in the same design.

MOSAIC

Mosaic work is the most architectural of all the wall decorative media. It is essentially building up a design of small stones or tiles set in plaster. The name "mosaic" is derived from the same word as music, which shows how the creators of this art form thought of it. It's very nature imposes a simplified, formal, stylized even abstract treatment. The

colors used are limited by the colors obtainable in the three materials used in mosaic work.

Mosaic pieces are known as tesserae, and are anywhere from a quarter inch square upwards, depending upon the scale of the work. Since in most mosaic materials the holding power of the plaster is largely confined to the rough cut edges, it is inadvisable to plan designs calling for large areas of glass, or similar non absorbent material, such as hard tile. This sort of design would be better executed in another technic, that of inlay, where different methods of anchoring the individual pieces are used. For permanence the tessarae should be comparatively small.

The three possible sorts of mosaic are glass, tile glazed or unglazed and natural stone. They may be all combined to good effect in interiors if their difference of texture is considered in the design, but shiny mosaics are seldom good out of doors. They appear at their best under controlled, even dim light conditions. Gold is incorporated into them by fusing leaf between two layers of glass, and cutting the glass up for tessarae. All the different colors of polished and unpolished marble or other stone all kinds of tile, and all kinds of glass are the pallette and texture open to the mosaicist, and all the colors are permanent.

The work begins with a color sketch in which the colors are chosen according to available tiles, glasses and stones. The cartoon, full size is laid on a floor or table area. It is executed upon heavy kraft paper in reverse. Then the tessarae are glued in place face downward. (It may be best to lay them face upward first, to study their effect, and then glue them down.) The glue used is of such a nature that it immediately releases the tesserae faces when the paper is dampened, as will be described later when setting into the wall is outlined. Mosaic paste for fastening the tesserae to the cartoon is:

The tesserae should not be quite tight together.
When the mosaic tesserae are glued in place, face downward, the cartoon is cut into pieces with a knife, cutting between the stuck on tesserae, dividing the cartoon into pieces about two feet square, so they may be easily handled. These are slid onto boards, still face down, then transported from workshop to wall where they are to be placed. This wall has been prepared much as fresco walls must be, but it must be chosen not for its freedom from chemical impurities, but for it's ability to carry weight. Mosaic weighs about 25 lbs per square foot.

The wall has been prepared in such a way that the scratch coat is firmly fixed to the wall, perhaps with the aid of metal lath or by much roughing of its surface. The scratch coat is also roughed, and now receives, an area at a time, a coat of stiff, buttery plaster such as is used for tile setting. Sometimes fireclay is added for buttery consistency, as well as lime putty. The lime should be chosen, as in fresco, as old and pure of efflorescing materials as possible.
The wall is buttered about one inch thick and the mosaic sections pressed into place, one at a time, and held in place until the plaster sets enough to hold them by itself. Then the paper is wet, releasing the mosaic tesserae faces, and is stripped off. When any bad joinings and misplaced tesserae can be corrected before the plaster has entirely set.

After all tesserae are set the wall is grouted. Grouting consists in pressing plaster into the interstices, then wiping surface clean. This plaster may be colored. When set, thewhole is washed with muriatic solution.

Preparing Tesserae

Glass is cut with glass cutters, tile with a tile cutter which scores and breaks tile, and sheets of stone or marble are chopped in a "guilloting", or with a chisel-head hammer. Tiles may be clipped into tesserae with pincers in which the handles allow sufficient leverage. Tesserae for marble may be up to 3/4 inch thick, tile should be ground down till it is 1/4 to 1/2 inch thick, and glass used its usual thickness. Grinding the back of the tile increases the adhesive and holding power of the cement. The harder the body of the tile the less the cement can grip its back.

Different colors of tesserae must be sorted into individual containers, and a sufficient supply of each gradation of color desired kept on hand. Since mosaic doesnot show the personality of the artist in the brush manipulation, his design may be carried out by many hands.

History of Pigments and Binders summary.

Summary of Pigments, Binders and Methods of Painting.

Cave Man

Pigments: Natural Earths and some volcanically burned earths, charcoal chalk.

Binding method: Natural roughness of cave wall.

Application: Finger and rubbing

Ground: Smooth rock

Egyptian: (source ref. Flinders Petrie Works)

Pigments: Raw and burned earth. Orpiment (Arsenic yellow, Arsenous sulfid--As_2S_3. Ground up pottery glazes, frit blue and green, coloring due to copper and perhaps cobalt ores. Lakes: prepared from plants and animals made by boiling the coloring matter in water to make a colored solution and evaporating it to thickness and mixing with gypsum and chalk to make an opaque lake pigment. Madder root. (reds and crimson) Woad, or blossoms of a blue mustard plant (blue). Weld, wild mignonette, (yellow) Kermes, an insect (red and crimson) Murex a shellfish, producing royal purple. Litmus, a moss producing blue and pink. Quercitr on, or oak bark and Persian berries giving yellow lakes.

Binders: glue, egg, wax, resin, gum of pine or mastic, sandarac. some forms of varnish.

Application: spatulae and brushes.

Grounds: smooth stone plastered, with lime and plaster of paris.

Walls plastered.

Wooden coffins covered with gesso
surfaces "

Papyrus manuscripts

Greece and Rome (writings of Pliny)

Pigments: as above adding Terre verte (green earth colored by Iron Silicate (Fe Si_3O_8) called green ochre.

Terre Verte also known as Terre de Verone, Veronese Gree, Veronese Earth, Terra verde, Tierra verde Gruenerde. Burnt Terre Verde forms an ochre brown. Terre verte sometimes is affected by lime to change to an iron rust color due to calcium hydroxid in plaster forming iron hydroxide from the terra verte. Thus not dependable in fresco.

Azurite: blue copper carbonate $2CuCO_3 . Cu(OH)_2$

Malachite: green copper carbonate $CuCO_3 . Cu(OH)_2$

Cinnabar: red mercury sulfid HgS natural vermilion.

Orpiment: natural Arsenous sulfid As_2S_3

Whitelead; $2PbCO_3 . Pb(OH)_2$ prepared by vinegar fumes and the action of the CO_2 in the air upon lead.

Red Lead or minium, Pb_3O_4 (sometimes confused by the ancients with vermilion) Prepare by heating litharge, natural monoxid in presence of air it takes on oxygen(PbO) gradually to form the higher oxide.

Orange mineral, the finest variety of this pigment is today prepared by roasting white lead, which is converted to purer litharge and then to Red Lead.
Red lead in dry powder turns black on exposure to light. When the pigment is protected by oil or resin it darkens very slowly, thus in oil color it is fairly lasting. Sulphur gases turn it to black lead sulfide. It is now used chiefly to paint metal for protection against rust, seldom as a fine artists pigment. Known also as Saturn Red, Paris Red, Rosso di Saturno, Minio, Mennige.

Verdigris $Cu(C_2H_3O_2)_2 H_2O$ A mixture of several copper acetates. Blue verdigris is produced by allowing copper to be acted upon by the vapors of vinegar in the presence of air. Green verdigris is a mixture of di and tri basic acetates, blue is dibasic acetate. It is the most fugitive of the copper greens, unsafe in mixtures with organic pigments (lakes) and affect- some minerals. In oil it is fairly permanent when

heavily varnished, but becomes greener and darker, being acted upon by the fatty acids in the oil. It is now used principally in the manufacture of Emerald Green.

Lakes: Weld, madder, murex, kermes were used as by Egyptians. Woad, a blue flower of a variety of mustard used to make a blue lake in the same manner.

Application: Brush or spatula,(cauteria), depending on technic.

Binders: Two schools, used beeswax and pitch and eggwhite. Varnish known.

Grounds: Walls, coated with plaster made of marble dust.
Painted upon dry with egg, gum glue or wax.
Painted upon wet, painted as in true fresco.
Often polished afterward with wax.
Or mixed fresco, (buon fresco touch up with egg color.)
Panels, canvas.

Byzantine and Early Italian

Mosaic, pictorial stone setting, practiced along with all previous forms of painting. Byzantine knowledge of Greek and Roman methods brought by Cimabue and others to Italy. Source: "Lucca Manuscript of Theophilus." "Schedula Diversum" tr. Laurie.

Painting on walls in buon fresco.
Painting on wood with wax.
Painting upon parchment with fish glue.

First artificial manufacture of vermilion.
Preparation of ultramarine from lapis lazuli.

Amount of ultramarine in lapis lazuli small. Pounded down it appears light grey. By levigation of finely ground stone repeatedly ultramarine may be separated from rest of stone. When finally extracted ultramarine is a puzzling chemical compound of sodium, silica, alumina, sulfur and oxygen. It is now prepared artificially by roasting these substances together in an electric furnace. The real construction of the compound is not yet.definitely known. It comes, naturally, in the finest varieties from Thibet. Variable qualities come from Siberia, Persia, and China. The method, essentially the same as the first known one for extracting ultramarine is:

Purest pieces are selected, after finely grinding them, they are levigated and washed, kneaded together in the form of a dough (with a little wax, rosin and linseed oil) in a weak solution of potash or soda lye. The finest particles of the color are withdrawn from the mass by the alkaline water and settle out when left standing. The dough retains the foreign substances and impure ultramarine. The second and consecutive extracts become greyer in color, the last contains much foreign substance and is least valuable. It is known as Ultramarine Ash.

Ultramarine genuine is permanent to light moisture, unaffected by sulfur gasses and is safe mixed with other durable pigments.

Artificial Ultramarine was discovered in 1814. It is identical with the natural lapis lazuli coloring matter.

Three kinds: Soda Ultramarine, pure blue, high in sulfur content.
Soda Ultramarine, deep violet blue, with high silica and high sulfur content.
Sulfate Ultramarine, greenish and pale in color.

When ultramarine is applied very heavily in the oil medium, some varieties tend to grey with age. This is known as "ultramarine sickness." This never occurs, however, if some white has been mixed with the pigment.
Otherwise it is an absolutely permanent pigment under all conditions of painting. It is sensitive to weak and strong acids, except carbonic acid (CO_2). It is safe with alkalies, therefore for fresco, though there is some controversy still on this point. Safe if no acid in air.

Ultramarine Violet and Ultramarine Red are obtained by heating it with sal ammoniac (NH_4Cl) and dry hydrochloric acid gas (HCL) at a high temperature.
These are valuable in fresco, because of dearth of available colors, otherwise superfluous.

Ultramarine Red converted to

Ultramarine Yellow when heated to 360° with HCl gas.

Silver Ultramarine (yellow) is also obtained by replacing the Sodium (Na) with Silver. Ultramarines of various colors may be made by replacing the Sodium (Na) content by other metallics. Zinc produced a violet, Potassium or Lithium a blue, Barium a yellow brown, Manganese a grey. The sulfur content of the ultramarine is replaced by selenium and tellurium producing brown and violet ultramarines.

Finest Ultramarine formerly came from France where the artificial variety was discovered, it is now made as well in the United States.

Ultramarines should not be used with copper colors, (Emerald Green, Verdigris). In tempera, when mixed with egg it may decompose if left wet long.

Theophilus manuscript gives us insight into methods and knowledge of the scientist-monks of the Pre Rennaisance.

It gives a recipe for making a glue of cheese, a kind of casein glue.

a glue from skins and stag horns, gelatin
a white gypsum gesso ground
a linseed (flax seed) oil, just like the modern methods
a linseed oil varnish, essentially boiled oil and gum (fornis - varnish)
gold leaf application with white of egg
an oil and cherry gum medium
silver and gold leafing in manuscripts with white of egg
parchment glue

Cennino Cennini "Book of Art" - trans. Laurie., is greatest source of knowledge on painting of 1473 and thereabouts. Cennini was instructed by Agnolo Gaddi, son of Taddeo Gaddi, godson and pupil of Giotto di Bondone. The treatise sums up the painting methods of the 14th century and founds those of the 15th. It is the first known complete textbook for the painter.

Cinnabar, prepared by subliming sulfur with mercuryin covered crucible, minium by raosting litharge amatisto (Haematite) of a purple hue.
Dragon's blood (resin from the palm, Calamus draco, a deep red gum) sometimes was wrongly called cinnabar.

Lakes, Madder, Kermes.

Yellows: Ochres; giallorino (Naples yellow) lead antimoniate- $PbSb_2O_6$. made by roasting lead and antimony oxides together, with tin oxide for lighter colors; orpiment, risalgallo (realgar) arsenic disulfid As S orange-red; Zafferano (saffron) a bright yellow obtained form the plant Crocus sativus; Arzica, a lake prepared from wild mignonette (weld), the most permanent yellow lake.

Greens: Verdeterra, verde azzuro (copper green malachite) verderame (verdigris)

White: bianco sangiovanni (chalk), biacca (white lead)

Blue: Azzuro della magna (azurite), azzuro oltre marine (ultramarine). Indigo. Natural black chalk.

Black: Vine charcoal, almondskin charcoal, peachkernel charcoal, Lampblack.

Gold, in ground or leaf form.

Cennini mentions as safe to use in fresco: Sinopia (red ocher), amatisto, ochre, Naples yellow, terre verde, bianco sangiovanni and black. He mentions no blue, but copper frits were probably used.

Our permanent fresco palette today is similar, with the addition of cobalt blue and green, and oxide of chromium green. These colors are lime-fast.

The other colors mentioned were used for tempera painting on prepared panels or on manuscript parchment.

PAINTERS' CRAFT

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Laboratory Assignments:

I. a. Gather natural earths of as wide a color range as possible.

b. Grind them first in metal mortar, then in porcelain mortat.

c. Levigate them: Shake them up with water and let the heavier particles settle to the bottom of the jar (use wide mouthed jar or jelly glass). Pour Off extra water and take off the finer powder which will be about the top third of the settled material. Rub smooth on marble slab.

d. Dry this on paper.

e. Store in jars or envelops.

II. Calcine some of these powders, as demonstrated.

III. a. Prepare a paste of Gum Tragacanth, thus: Soak 1 1/2 grams (about a tablespoonful) of Gum Tragacanth in water till it forms a jelly. Use 500 c.c. (about a pint) of water. When the gum has become clear, warm the mixture until it forms a smooth paste. Wave set from a 5 & 10 store may be used.

b. Prepare pastel from one of the ground up earths thus: Grind together one tablespoonful of the Gum Tragacanth paste with one tablespoonful of the pigment. Rub it till very smooth on marble slab. Use enough of the pigment to mae the mixture into a very stiff paste. Let dry on paper somewhat, till almost crumbly, and roll in waxed

paper to form crayons. To find if there is too much gum, which will make the pastel too hard, dry a little of the mixture by heat. If the resulting pastel is too hard grind mixture again with more pigment and water and less gum. Different pigments will produce different degrees of hardness with the same amount of gum. (lake colors, Prussian blue and Cadmium red, for instance, form with Gum Trag. very hard pastels, and are ground instead with strained oatmeal gruel as a binder, Oatmeal gruel is very slightly adhesive. Skim milk may be used, as it also makes a very soft pastel.)

After just the right and desired hardness is determined, make up the pastel and let it dry naturally in moderate warmth (too much heat cooks gum and may change the pigment).

c. After a pastel of the pure pigment has been made, make another mixing with earth pigment an equal quantity of zinc oxide white. Rub the pigment and the zinc oxide together on the marble slab, till smoothly mixed. Add enough Gum Trag paste to equal quantity of zinc oxide added. This will produce a lighter pastel.

This may be continued, halving the pigment mixture and adding more zinc oxide each time, till a complete range of colors between the pure earth and white is achieved.

Old pastel particles may be reground with oatmeal

gruel and reshaped.

IV. Preparation of a ground for pastel:

Take a cardboard or illustration board or a stretched canvas. Paint smoothly with starch paste (best made with 1 measure of rye flour stirred slowly into 10-15 parts boiling water, though ordinary flour can be used. Dampen the flour first to avoid lumping). While the starch paste is still sticky sprinkle it with finely pulverized pumice powder. Cover well and shake off extra powder onto a paper. Paste must be laid on smoothly or when dry the ground will show brush marks, which will again show up in the pastel when finished. Paste may be spread smoothly with the palm of the hand, or a sponge. When dry it is ready to work on. This ground holds the pastel exceptionally well without a fixative.

Pastel technique:

Tones best placed broadly and abruptly alongside one another. May be wiped with finger, brush or chamois, or left unwiped for different textures. Too much wiping produces cheap and sentimental mushiness. Fresh, direct, spontaneous handling best. Large surfaces are covered with side of crayon, which should be made somewhat larger than the commercial varieties for this purpose. Unsuccessful parts may be blown off. Don't rub so hard that the tooth is polished from the ground. Too hard pastels will do this. A heavy application of color and a rough ground tend to prevent

the danger of the picture's losing too much pigment if jarred.

Pastel is most wuited to a rapid setting down of ideas or effects in a sketchy way. It is most use- for color notes which are later to be translated into another medium (in this connection it must be remembered that each medium having its own possibilities and requirements it is impossible to copy the pastel sketch. It must be re-interpreted in terms of the oil, tempera, watercolor, or other medium).

Pastel Fixing:

If fixed too carelessly or too strongly all the peculiar powdery charm of pastel is lost and it becomes only a muddy opaque, like watercolor or tempera or distemper, but much worse than the worst of these. In pastel fine particles of color lie irregularly and loosely and they reflect light from many angles. The air which lies between has an effect on the color. When fixed the powder becomes mud and the air between the particles is replaced by gum or glue. They become darker and change their optical effect. If chalk, clay or gypsum have been used for fillers this change is even worse. Zinc white filler is not so bad. That pastel fixative is best which evaporates quickly because it will cause fewer changes in the position of the color particles. Thus: White dammar, 2 % in benzine is the best. However ordinary shellac, 2 % in alcohol, will do. Spray the fixative over, not directly at

the drawing, in order to avoid blowing off pigment. After covering the surface very lightly once, let dry, and repeat a second and third time. This avoids drowning the particles by wetting them too much at a time.

Pastel framing:

The pastel should be kept from touching the glass by a sufficiently thick mat and sealed at the edges to keep out dust.

CAUTION: DO NOT MAKE PASTELS OF POISONOUS PIGMENT POWDERS, AS THE DUST IS EASILY INHALED: Thus avoid Cremnitz or other lead white, Naples Yellow, minium or red lead, chrome yellow and especially emerald (arsenic) green.

The following pigments may be used:

Zinc white, Lithopone Titanium white, Clay, Chalk, Gypsum, Talcum powder (soapstone), Ochers and siennas, and umbers, raw and burnt, zinc yellow, yellow ultramarine, Indian yellow, Cadmium yellow, Alizarine madder, vermilion, Cadmium red, Helio fast red dye, Ultramarine blue, red or violet, Cobalt blue, Paris blue, Manganese violet, Chromium oxide, Green earths, Ivory or vine black.

All coal tar dyes except Alizarin and Helio Fast Red are apt to "bleed" when fixed.

Advantages of homemade pastels:

Commercial pastel boxes are gotten up more with an eye for beauty of appearance in the box than for practicality. They contain an unreasonable number of intermediate tones

which are cheaper, containing cheap white, and very few of the more valuable full strength pigments from which mixed tones are easily managed. Thus the box soon develops gaps and the rest is wasted.

Arbitrary and fantastic names are given to most of the color tones and most are not light fast. On a test of 64 pastels from French firms 30 completely faded in one month. They had been prepared from fugitive dyes.

It is better to prepare the few crayons one needs. A limited palette is all that is necessary, which can be varied for special needs. The irregular shaped of home-made crayons do not hamper their use. Pastel colors, homemade from pigments of full chromatic strength produce a degree of brilliancy and richness unknown to the trade materials. It is so different as to be almost a different medium.

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PAINTER'S CRAFT

MAKING OF A GOUACHE BINDER

Gouache is essentially an opaque watercolor medium, in that the pigments are not ground so finely as to produce the maximum of transparency. In really opaque watercolor, or in gouache, in which opacity is desired, the pigments, such as the lake colors which are naturally transparent, are mixed with white extender (zinc oxide or other opaque white) to render them opaque. In the case of aquarelle, or transparent watercolor, all the pigments are ground as finely as possible to render them as transparent as possible and the lakes are precipitated upon some one of the transparent whites, as barium or alumina white.

Gouache far surpasses transparent watercolor in solidity of tone. It should be used heavily, more nearly as in oil technic. The colors should be put on the paper with the consistency of thick cream. If too thin a technic is used, the effect will be that of a somewhat muddy aquarelle in most cases, although a degree of transparency may be used if desired. It is one of the beauties of the medium that it permits variation between opacity and transparency. It offers, because of its covering qualities a much greater freedom of handling than transparent watercolor or aquarelle.

Colored grounds and colored papers may be used with advantage. The best results are produced with

ordinary watercolor brushes in combination with flat, red sable brushes.

A good way to work in gouache is to begin thinly, painting more heavily as the work advances.

Gouache painting may be hardened and made insoluble to water by spraying it with 4% gelatin-water and then with 4% formalin solution.

Gouache should be distinguished from Distemper, which is simple glue and water ground with pigment, and from Tempera, which is the name of a whole class of pigments depending upon an emulsion binder--tempered, that is,

PAINTER'S CRAFT: LABORATORY

To prepare watercolor binder for Gouache or Aquarelle (opaque or tran

Materials: one cup of gum arabic crystals, grade known as"sorts" good. or, use cherry gum. same proportions. Any similar water soluble, hard drying, gum may be used.

one pint of hot water. Put gum in water in a straining bag, unless, gum seems so pure as to not need straining. Let stand overnight. If all apparently good gum does not dissolve. Add more hot water, and rewarm solution.

one fluid oz. (about four tablespoons ful) of strained honey The honey is a blender and makes the binder work more smoothly off the brush. In climates where paint dries too fast glycerine may be used instead of honey, but in wet climates glycerine attracts too much water from air and keeps paint sticky for a long time.

one pinch benzoate of soda.

two or three drops of xylol or xylene, from time to time. Both benzoate of soda and xylol are preservatives, protecting paint from various forms of decomposition. Usually xylol is enough if paint is to be used soon, but it evaporates out. Very little xylol is sufficient.

Store solution in stoppered bottle.

MAKING GOUACHE

To prepare pigment with binder, for painting.

Put one tablespoon ful of pigment on grinding stone or in mortar, along with about an equal quantity of the above described binder. Grind binder and pigment together thoroly, to a smooth creamy paste, which can be just picked

Slice up nicely with a palette knife, or a "slice". (a "slice" is a thin wedge of hardwood, most useful in picking up paint fromgrinding stone, etc. It is better than metal, as some pigments are a little contaminated by contact with metal. It is conveninet to have several slices, one for each color ground, if much work is being done.

If the above proportions of pigment and binder make paint too stiff, the gum is unusually strong, and more water can be added during grinding. If mixture ground is too thin, more pigment should be added, until paint will stay on pallette knife.

Store pigment and binder ground together in widemouthed, easily cleaned, jars. From two to six oz. jars are good, depending upon quantity needed. If paint is allowed to dry in jar, it must be again ground, this time with warm water. Regrinding necessary because pigment tends to re-crystallize into clumps ifnot kept in solution. It is better to have a little too much water in the jars than too little. From time to time add a little xylol to each jar. The smallest possible drop is enough. Too much will cause greasiness.

LABORATORY ASSIGNMENT GOUACHE BINDER

Gouache binders are of various sorts. The formula below has proved the best of a great number.

Dissolve one cup clean gum arabic (or cherry gum) in one pint of hot water.

Add 1 fluid oz (1/12th of a pint) of strained honey.

To keep from decomposing while wet:

Add 5 drops of xylol or xylene, and as a further preservative: 1 pinch of benzoate of soda. Keep in a corked bottle, grinding the desired pigments in this medium to a creamy paste, preparing only enough at a time for a week or so ahead. In this way less paint is wasted by drying up, etc.

If the gouache mixture should dry: Wet it and grind again without the addition of more binder.

Keep an atomizer handy to spray the palettes, pans or bottles full of the prepared gouache pigment and grind them again as soon as they show signs of hardening or settling in spite of continued sparying.

The palette may be sprayed and dried colors on the palette brought back into useable shape almost indefinitely.

Any of the pigments recommended before may be used with gouache.

We will find Aliz. Crimson, Cadmium Orange, Cadmium yellow pale, Zinc white, Viridian or Emeraude Green, Cobalt and Ultramarine Blue, Vine black and any

or all of the iron oxide colors useful. Barytes or Barium white will be useful in mixing with pigments as transparent extender if they are too powerful to work conveniently with others on the palette. Such may be the case with Cadmium Red, for instance. To make them more opaque use Titamium Oxide white.

Stretch paper for gouache. Best paper is Whatman's Cold pressed, or similar quality. Sizes not bigger than charcoal sheet, preferably smaller, are desirable for gouache. Illustration board may be used.

Painter's Craft
LABORATORY NOTES

TEMPERA

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Grounds for Tempera Painting.

Assignment.
Make up enough ground for two small tempera paintings, using. Pressedwood panel board untempered.

Basic formula will be:

Glue size (Fuller's Special Gelatin Glue, or equivalent)
made up 7 parts by weight of glue to 100 parts by weight of water.

This size is brushed over the canvas or panel while hot.

Then make up:

X 1 volume of same glue size beaten up with
1 volume of whiting, precipitated chalk(or gypsum plaster if gesso ground is desired)
1 volume of Zinc oxide white, medium fine grind.

The above is full chalk ground, useable for painting in any medium where a very absorbent ground is desireable.

For egg-yokk tempera painting stir into the above
1/2 volume of boiled linseed oil. Ground is now called "Half-chalk".
For fatter, less absorbent ground use 1 volume of oil.

For very fat, shiny oil painting ground, like commercial grounds, use up to 2 volumes of boiled linseed. Ground is now called "Oil ground".

Any of these mixtures must be applied hot in at least three thin coats to board or canvas. Rough places may be shaved with razor or rubbed with pumice.

White in full chalk state (without oil) mixture may be kept as long as glue will keep, but after oil is added it begins hardening immediat
Assignment.
Use one of your panels for a painting in egg-yolk tempera.

This will be done according to a carefully planned design, which must be executed, full size, in pencil, pen and ink, or brush and monochro before beginning work on panel. Plan brush stroke direction to follow form, or to emphasise pattern, as brush texture will show in tempera

Now execute, on transferred outlines, on panel,a monochrome wash rendering,keeping values very close and in high key. Use a dilute wash of India ink, say one drop ink to a tablesppon water, and put i on with an almost dry sable brush. Strengthen the darks by adding more ink to the wash. If desired the drawing can be done with egg medium and a pigment instead of ink. It is important to establish the dark and light pattern and gradations by this prelminary under painting. Pay not attention to local color in this rendering. only dark and light modulations.

If there is to be any gilding, scratch outlines of metallic areas lightly, so they will show through overlapping gold leaf.

Chose Pigments according to previously planned color scheme. Pigments previously ground in gouache binder and kept under water in small bottles may be used. If pigments have dried up they will have crystallized again and must be reground.

Choose the relatively opaque pigments for tempera painting, relying on thinness of application for translucency: Suggested palette: Yellow and Red Ochres. Opaque Oxide of Chromium. Cobalt Blue. Burnt Sienna. Titanium White. Ivory. Vine or Lamp Black each give different hue quality in tempera. Vermilion (chinese test). Indian and Venetian Red. Cadmium Red. Raw and Burnt Umber. Cennino used a mixture or black, white, yellow and red which he called verdaccio, and used for a drawing color. Raw Umber will take it's place. Terre Verte is useful particularly for under painting flesh, but is somewhat transparent.

Transparent pigments which may be used when there is a specific need, as glazes, are: Alizarin crimson or madder, rose madder. Viridian, Raw Sienna, Prussian Blue. Aureolin is a strong transparent yellow. Colors ground for aquarelle in cakes or tubes may be used, though some of these lose tinting strength by being too finely ground. Transparent glazes are really not necessary in straight egg yolk tempera painting.

Take a small quantity of the desired color on a palette knife tip and place it on the tempera palletie.

The palette should be a piece of glass or enamell or porcelain.

The painting medium will be prepared as follows.
EGG YOLK MEDIUM.
Take one egg. Separate yolk from white. Pick yolk up by skin, letting all white fall away. Puncture skin of yolk and let contents flow into small glass vessel. Add two parts water and a very small drop of xylol. Shake. This is a natural emulsion, and the simplest form of tempera binder. Under MIXED TECHNICS other emulsions are discussed.

To "temper" color take a brushful of binder and mix with an equal quantity of water, or gouache binder ground pigment. Mix thoroly. It is even better to grind a small quantity of the pigment together with the egg, to insure thorough mixture. Tempera is one of the most economical media as to quantity of pigment used.

Try the binder-pigment mixture on a bit of the ground. If it uddies, ground is too fat for this kind of tempera. If it sinks in, and the brush dregs, as if dry, almost immediately, the ground is too lean for this media, and should be isolated, perhaps with thin shellack, to make it lessabsorbent.

The right ground and binder relation will permit a smooth brush stroke, with the paint spreading easily and varying richly to a very dull gloss. This means that the ground has absorbed a little of the binder, but not very much, and that enough of it remains on the surface with the pigment particles to hold them from "chalking off." This is the ideal ground-pigment relation for any kind of permanent painting.

Lab. Notes. Painter's Craft.
Tempera.

Painting methods.
~~For brushes,~~ the use of small sign painters quills of sable or other soft hair is recommended. So-called Japanese brushes, or Chinese, can be used. Any "rigger" shape brush is useful, perhaps the best of all are small, long haired "show-card"brushes. The classic method of tempera consists in a very fine cross-hatch building up of tone on tone. Brushes should be chosen accordingly, coarser for larger work.

Temper enough pigment only for one days work, as it hardens and becomes useless. Keep the color liquid and use the brush dry rather than very wet. To lay a flat tone do not lay a wash as in watercolor, but cover surface with quick, easy strokes like pencil shading, going back again at a slightly different angle if first tone is not deep enough. Tend to work thinner at first thicker at last.

No well tempered mixture is absolutely opaque; each mixture ordinarily contains a touch of white. Opacity is relative, conditioned by the values over which the tone is applied. Over a lighter ground the color appears transparent, as light is reflected through it. Any color laid thinly over a lighter ground will act as a glaze. But when the paint lies on a ground of equal reflecting power with itself, or on several such coats the effect is of opacity, as light is largely absorbed. Any color may look opaque after repeated coats are laid on.

If the color lies on a ground darker than itself it appearsdarker, takes on a cloudy, smoky quality which is known as opalescence, half way between opacity and transparency. This textural effect is paralleled in nature by sky, mist and smoke seen against dark objects.

The basic principle of rendering form and pattern in tempera is the control and relation not only of hues and values, but especially of the various degrees of transparency, opacity and opalescence or translucence. Opalescent quality is desireable over the whole half-tone, shadow and reflected light areas, transparence only in the lights and high lights.

Order of painting.
Distant planes are done first and overlapped by successive planes approaching foreground. This order is followed except where gilding or flesh painting are included. Flesh should be done last because it is easier to key it to the whole painting than to key the whole painting to it.

White may be worked into high lights and lights quite heavily, and glazed over.

Gold or Metallic areas.

These are either planned for dull gold or burnished gold, or gold embossed to make it scintillate. Palladium is used for silver effects, as silver leaf tarnishes.

For oil mordant gilding over tempera painting use commercial "quick gold size" or make your own.

Tempera

Gesso methods. Cennini.

Cover, stir every day for a month. Add clean water. Remove dirty water. At the end of the ~~month~~ month make up the slacked plaster into convenient cakes and dry.

When ready to use, soak some cakes in water and grind fine with muller on slab. Wring it dry in a cloth. Shave fine pieces into top of a double boiler and add 1:10 gelatin size, mixingtogether with fingers. Add size until gesso is like pancake batter. Keep it just warm enough to be barely liquid. Put , according to Cennini "at least eight coats" on the flats, less on ornaments and reliefs. This gesso follows, without clogging, carved ornament, etc., This delicate gesso is not ground with pumice, but dusted with powdered charcoal andscraped.smooth.

This produces the finest possible fround for painting and gilding, but less certain and more laborious for the beginner than the first formula for ground given. Often gesso sottile can be used so finely with the brush for partiglia ornament that no carving or tooling is necessary afterward.

Matte gilding. Is used mainly on frames, and can be done with water or oil methods. This is the water method:
Finish frame as for burnish gilding, gild once in same way. Burnish desired areas. Paint areas desired matte thinly with 1:25 gelatin size with one third part of alcohol. This is called the "clear coat". For best effect this should now be regilded, but it may be left as is. Either way the gold is protected at the finish with clear lacquer in a thin coat.

Antiquing is a fake process, but is sometimes necessary to harmonize old pictures with new frames, or to otherwise bring clashing frames into relation with a picture. Dry color is applied in gelatin size and transparent colors in shellac. Gamboge or dragonsblood in alcohol will deepen the gold. The work with the dry colors in size is done first, allowed to set and then the shellac and dye is used. Finally a light coat of wax will protect the "antiqueing."

Painted Frames.
A straightforward painted frame is better than a tricky one. Mix the colors withgelatin size and wax them with beeswax dissolved into a paste with trupentine. Gesso may be waxed directly or painted with titanium white and then waxed for a durable white finish. Dark colors may be scumbled over white. Thin shellac and ~~wax~~ wax is a good final finish for all these.

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Tempera

Gilding

Mordent Gilding: Oil. Formula.
Japan gold size too thin alone. Fat-oil gold size too slow drying.
Chrome yellow ground in Japan mixed with fat-oil size with a drop
or two of strong copal var nish will make a fine line without spreading.
For very fine work boil the mixture and cool it repeatedly until almost
ropy. An ounce or two will go a very long way.

Applying: Brush a little glair(Glair formula: Beat one egg white to
stiff foam. Add four tw ounces cold water on it. Let stand overnight
and pour off liquid, throwing away sediment. This is glair,
has several uses in gilding.) thinly over the places to receive oil
mordent gilding to protect paint from adhering to gold where adhesion
is not desired. Glair is then applied on areas desired and let
dry until tacky.
Test on the mordent and on the varnish. It
may not dry tacky for several days, or may dry in eight hours. It must
and be sticky, even in the thinnest parts. Lay gold leaf
and press down to it of cotton. Don't dust off excess gold until
mordent is dryer.

Handling Gold Leaf.
Gilding is a process requiring skill and experience
rather than a great degree of skill. The necessary tools for handling
leaf are a cushion for cutting, which is covered with chamois or
wash leather, a straight edge steel knife about ten inches long, not
too sharp, and a tip. The tip is a very thin longhaired brush with
a cardboard handle. The length of hair is chosen according to the
size of leaf it is desired to handle. The beginner can learn more
about handling gold by watching someone do it than by any description.
The essentials seem to be:
1. Gold leaf will catch and stick to anything even slightly damp and
greasy.
2. Dry bolus powder or French chalk are rubbed on places to keep gold
leaf from adhereing. The cutting cushion is thoroly dressed with it.
So is the knife.
3. Do not try to manipulate the gold by poking it into place. It must
always be floated on air and worked in comparatively still air.
Spill the desired leaf out of the gold book without touching
it, onto the cushion.
4. Always spread out gold leaf that is crumpled by lifting gently
with the knife. First, top cushion with knife. This will give to
enough draught to raise edge of leaf so knife can be inserted
gently, close against cushion, till knife blade protrudes out on
other side of leaf, without puncturing leaf. Second, raise gold
clear from cushion rocking gently to cause it to unfold. Third
turn knife over slowly, so that leaf floats down onto cushion
other side up and spread smooth. Always handle crumpled leaf this
way. Now blow straight down on cushion to remove some wrinkles.
Cutting leaf is accomplished by laying knife straight across leaf,
bringing edge down firmly with very light pressure, and drawing it first
a little away and then toward the worker.
To place gold on panel use the tip. The tip must be given a thin
coating of oil from the skin and hair by pressing it against forehead
several times on both sides. Repeat this often while working.

Tempera

Gilding

Use of tip

To pick up gold with tip, hold tip over the leaf so that edge of tip is parallel to edge of gold. Press down steadily to test tip leaves about an eighth inch of leaf protruding beyond the hairs of the tip. If gold starts to pull away from tip push it harder against the cushion. If it still does not adhere the tip is not greasy enough.

Preparing surface for gilding.

Gold leaf may be laid on gesso or half-chalk grounds, on slate, metal, wood or stone. But each of these materials takes preliminary preparation. The formula here given is for work on gesso-like materials. Commercial red burnish gold size will serve.
To prepare your own:
Bole: Bole or Bolus is a clayey red, grey or yellow. Considered best is "Armenian bole" which is "fat" and warm in color. "Miller's Grey Clay" is even easier to burnish, but grey flecks showing through, if gilding is not perfect are not considered so pleasant as the warmer colors.

Keep all gilding supplies most meticulously free from dust. Dust particles under the gold leaf will cause it to tear when burnishing.

Dissolve ½ oz. gelatin in 10 oz water and add a small quantity of bole, just to give it a little color.

Wipe panel with slightly damp cheese cloth to remove all dust.

Coat with the thin bole mixture, lapping over the outlines of the gesso marked for gilding. Lay bole very smooth, no drops or trickles. Don't go back to touch up imperfections while wet. Let the first coat dry, then touch up.

The brush will have carried some dust from the surface into the thin bole, so throw the first batch away. With brush, mix a new batch of bole and gelatin this time with more bole, making a thickish creamy, but not pasty liquid. Keep the size a little warm so it stays liquid. Strain through chiffon.

Apply four coats, letting dry out entirely between coats. Smoothness is very important. If coats are thin more than four are all right.

When last coat is dry gilding may begin, or, if high polish is desired, bolue coat may be polished with very fine emery paper. After this panel should be carefully dusted with lintless linen cloth and then given another bole coat.

To begin gilding: polish bole quite hard with an old soft linen cloth. An old burnisher, which will be a little scratched by the bolue, may be used to give it a preliminary burnish at this point.

Order of gilding.

Gilding

Order of Gilding

Gold is picked up with tip as described. Gilding proceeds as follows: Four ounces of water is mixed with one ounce of ethyl alchol, stirred with a fair sized sable brush. With the brush wet a section of the bole ground somewhat larger than the piece of gold to be laid. Wet, don't scrub the bole. Then bring the tip of the gold close to the desired position till edge of gold touches wet surface, withdraw tip with a slight jerk so it is not wet. Practice is necessary, but gold will, if properly handled, spread itself on the wet surface.

If the panel is tipped, a skillful gilder will flow the liquid under the leaf as he lays it, causing the water which flows out from under the leaf to draw out wrinkles. If water cannot flow out from under leaf due to drying up of its channel it may burst through the surface.

Continue gilding by wetting the next area, wetting just a little ahead of the gilding, running a hairs breadth over the gold already laid. Each leaf is pressed down with cotton soon after it is laid, after no more water is flowing under it and before ground is entirely dry.

Cover area, overlapping edges all the same way, following some planned order. Little omissions or breaks can be fixed later by breathing heavily on fault spots and getting down scraps of gold with lightly moistened absorbent cotton wrapped on a brush handle.

Burnishing.

Agate, flint, and large hematite tooth-edge burnishers are available. Animals teeth make good burnishers. The small point burnishers used by china painters are good only for very small work. The straighter the burnishing surface the more metallic solidity is achieved in the appearance of the finished leaf.

Panel must be covered with a clean cloth and allowed to dry thoroly, but not in hot air directly on its surface. When tapped with the burnisher it should not emit the sharp click of complete dryness, nor should it emit the dull sound of a newly wet surface. Begin burnishing carefully and lightly to avoid damage to any dampspots you may find.

Work lightly with a very slight circular pressure at first. Wipe gold over gently with a little beeswax on chamois. Burnish harder with strokes running other way, following a system. Imperfections can be still patched, as described.

Stamping and Graining.

Small bright punches can be made and tapped into the burnished gold to give it a texture. This will cause the puch decorated area to shine more than the dark burnished smooth surface. Haloes, etc. were done this way.

Frames can be gilded as described. Usually the tips of moldings were gilded first and the lower parts after. Sometimes tips only are burnished.

Gilding

Variations

Combinations of palladium and gold leaf. Low relief in "pastiglia".

Designs in combination silver and gold may be carried out, burnished and tertured or untertured, over flat or base-relief surfaces. Combined with tempera painting. Such work is perfectly possible, but rarely seen in modern times.

For combining gold and palladium leaf. the already laid and burnished leaf, with the bolus uncovered where the next metal is to adhere, is protected with rubber cement up to the proper edge. Then the second metal is laid, somewhat overlapping the protective rubber cement. The parts overlaying the rubber cement will rub off easily, leaving the desired edge between the combined metals.

A solid coat of opaque color, or transparent color, tempered with egg, may be laid over leaf, and the color scraped away with a wooden point, such as an orangewood manicure stick. Then fix the remaining color twice with charcoal shellac fixative. Lettering, or designs in gold surrounded by color may be accomplished in this way.

Gesso low relief. Pastiglia. Thisconsists in building up relief on the panel or frame with warm gesso mixture applied with a brush in successive coats. Under gilding it will produce repousse effects. Since it will shrink it should be built up deeper than finish effect desired. As each coats sets the next may be applied.

Frames

Frames may be fastened to prepredwood panels, and prepared with ground at the same time as is the panel. Much better effects are achieved if the frame and the picture are treated together as a design unit. Mouldings can be run to order at the lumber yard, can be gessoed, left rough, finished with pumice templates, decorated with pastiglia, gilded, painted. Cheap bronze powders are perhaps the most disagreeable of frame finishes.

Cennini's Gesso.

The basic formula described employs whiting, zinc white and gelatin glue, with admixtures of boiled linseed oil for specific purposes. This is in reality not the gesso described by the early Italians. Their gesso always contained calcium sulfate, which is gypsum, alabaster or plaster of paris, depending on its form and preparation. Hard setting plaster of paris may approximate the effects of the ancient gessoes when used as follows.

Gesso grosso. This was used for coarser work, and is often used under gesso sottile.

1:10 gelatine-water. Plaster of Paris(very fine) mixed to stiff paste. Applywith a "slice", smooth as possible on panel, rubbing into its surface. Then go over the whole with the same mixture warmed, two or three times. Dry two or three days.

Gesso sottile

Slake Plaster of Paris by sprinkling it into a tub of water, one pound to each gallon of water. Stir every fifteen minutes for two hours to keep from forming large crystals.

Binders and Binding Media:

Fatty oils, drying.

Linseed.

Free acids may form in oils of this class...they are then said to be rancid. This happens especially when the oil dries slowly. Oil which is rancid should be stirred with 5% of its weight of Sodium Bicarbonate which has been freed from water by heating. Rancid oils will cause hardening in tubes, etc. Letting the oil stand after being shaken up with white lead also de-acidifies it.

Linseed oil is nowadays the chief oil used in grinding colors. It normally dries in three or four days into a thin film, influenced by the pigment with which it is mixed and by the ground on which it is placed. <u>Pure linseed oil colors should be put on in thin layers and new coats not applied until the preceding ones are thoroly dry</u>.

2% wax added to linseed colors gives an opaque quality.

The smooth way of painting of the old masters depended upon the thoro drying of the successive coats of oil.

<u>Sun-thickened oil</u>

The best painting medium is sun thickened linseed. The oil is poured into a flat container such as a dinner plate, not more than a quarter inch deep covered with a piece of glass and left in the sun. Air must get to the oil. It thickens in a few days and should be stirred to keep a skin from forming on the surface. This thickened oil dries somewhat like dull finish varnish , since it is already partly oxidized it

dries quicker than un-thickened oil, and without the aid of artificial and dangerous driers. It should be kept in small bottles full to the cork and a marble should be dropped in every time oil is used, to keep it up to the cork, or else it will harden in the bottle.

Boiled oil dries quickly, but is dark and has other undesirable qualities. It is useable mainly in the making of grounds, which we will discuss later.

PAINTER'S CRAFT: LABORATORY

To prepare linseed oil for painting purposes.

PURIFICATION OF OIL: It is much more important to remove water and mucilage and other foreign substances from the linseed oil than it is to bleach it, although partial bleaching may be sometimes desirable. This is particularly true of ordinary, hot-pressed oils.

By simply letting the oil stand in a full bottle for a long time, well corked, the oil will purify itself to an extent by settling out impurities, but this process can be hastened and made more thorough by mechanical means.

Take one tablespoonful of baryta white (barytes) powder. Heat in gas flame until the spoon is just beginning to be red hot. One quart of oil is in a widemouthed bottle. Pour in the hot Barium white (barytes) powder and shake the bottle after corking, until the powder and the oil are thoroughly mixed. The oil will then appear a cloudy yellow. Let the oil flask stand in hot water until the barium powder has settled to the bottom. The hot water is only necessary if the weather is cold and the oil shows reluctance in clearing.

Clean, dry sand, chalk and similar substances have been used to carry the impurities in the oil to the bottom. Filtering through charcoal was the method recommended by Durer, but the described method has been found modernly convenient.

After the bottle of oil is honey-clear, with a flocculent precipitate in the bottom, pour the clear oil off into a series of small bottles of about 2 oz. capacity, filling them to the cork, so that as little air as possible remains

in the bottle. As the oil is used from one of these small bottles drop in a glass marble to keep it filled to the cork, so that it is never exposed to too much air. A half filled bottle will become sticky and partly dry. In cold countries oil can be purified by freezing. The watery constituents form ice and are taken out, but this method is not so reliable as the above.

After purifying the oil is best left standing for some days.

INDIRECT OIL AND GLAZE PAINTING

Plan a painting which will utilize the effects seen in study of El Greco, or the Venetian Painters, or Rubens.

This should be done on a ground with some tooth, not too lean. Canvas texture is good.

This problem will utilize sun-thick linseed, damar ethereal varnish and cherry gum.
Opaque colors used will be oil-tempera, which is made by grinding together regular tempera and oil paint. The oil paint may be tube paint. The tempera will be medium fat, made according to the standard medium fat tempera formula.

Medium fat tempera: 1 egg, both white and yolk.
1 egg shell of sun-thick linseed
2 eggshells of water.
Shake and use as grinding medium for pigment.
Drop of xylol will preserve it for a time.
This is an artificial emulsion because oil is added to the natural emulsion of the egg. Similar emulsions may be based on casein solution instead of egg. The casein mixture will be tougher.
In these emulsions the oil or glue content may be varied within wide limits, to produce desired effects.

For this problem it is possible to begin on a half-chalk ground (1which is white, in which case it will be painted over with oil tempera burnt sienna, raw umber, or terra verte, or Indian or Venetian Red, opaquely.
(2) or, transparently with a lean glaze such as 1 part cherry gum sol. 1 part damar ethereal varnish, with similar dark earth colors.

(3 or, it is possible to tone ground by substituting some pigment for zinc white in the last coats of the ground on the carrier.

The color of the ground will decide the tonality, warm or cold, of the painting.

Painting will begin with the oil-tempera opque white, which is made by grinding together to a paste one part of tempera white zinc oxide and one part oil paint.

Form is modelled just as in drawing with chalk on dark ground. Never cover ground entirely. It should show through, and rule color scheme everywhere. Very light accents can be put in last. Places where a relatively pure color, very different from the ground, is desired, should be scumbled more thickly with white.

Glazes may now be applied: They should be flowed on, not brushed, so as to not disturb white underpainting. They should be made of color gound either with the fat glaze media or the lean glaze media, according to final effect desired. Lean glaze will produce less shine, more like Venetian wall painting.

After the glaze has been applied all over, as one coat of color, or in several patches of different color, it may be painted into

Glaze Painting.

with opaque again as soon as it is tacky enough to not mix. Glazes may be again applied over this next improvement of the pattern and form with white, and so on to thirty or forty coats. Lean glazes admit of more coats than fat ones.

This method may be varied in several ways, but it is best to begin the study of indirect painting by using only one opaque and several glaze colors.

Pigments useful for glazes, being naturally transparent, are lakes, Prussian Blue, Siennas, Viridian Green, Aureolin Yellow.

If the effect of Flemish painting, such as that of the Van Eycks is desired, the opaques used may be leaner, and applied with the point of the brush, instead of broadly. The technic then lends itself to tempera like refinements. In this case the glazes may be somewhat fatter. The fine brush work goes better on a smooth Gesso panel and does not need to dwell itself of the rough texture of canvas for its half tones. The halftones in such work are acheieved by cross-hatches, using the white tempera. Pure egg yolk can be used as a medium. If it refuses to take on the ground the glazes and ground are too fat. Egg yolk will go over lean oil paint, or over lean varnish.

The essential difference in the Venetian method is that the opaques are fatter, can be scumbled and smeared broadly, over the rough canvas texture to make grey tones with dark ground showing through. The Venetian method is quicker, better for large scale work.

See lecture notes for various glaze formulae.

After some experience more opaque colors may be added to the palette and the local color of forms may be considered, as well as their shapes, in the first modellings. Opaques should be kept lighter than desired finish, as every glazing brings down value.

These methods emphasise the importance of Painting by means of overlapping planes.

Give the painting a coat of damar clear varnish to finish. Wax emulsion may be applied over to dull the shine. If it is desired to seal the painting for ever against restorers, put a coat of hard copal on first, then the damar. The damar may be easily removed when it becomes discolored and dirty without disturbing the paint underneath, which is protected by the hard varnish. The hard varnish keeps better, discolors less, under the damar and wax.

One should not bother with this richest of all painting medis if one does not know what to do with its effects. Study Rubens, Rembrandt and El Greco and Titian, Tintoretto and the Van Eycks, Durer and Breughel also owe their effects to glaze painting. Each had his own particular method, but all utilized the broken "optical greys" made by glaze over ground, glaze over scumbled or cross-hatched opaque, or glaze over glaze. Hardly any other

kind of painting was considered seriously before Monet, though [illegible]

90

[illegible] deterioration of craft spiri

Making an ethereal varnish. Damar.

Most resins are soluble in hot oil, but the resulting varnish is dark colored and very hard. Some resins are soluble in warm oil, and some soft resins, such as damar and mastic are soluble in essential oil such as turpentine. Such solutions are called ethereal varnishes.

Put one part by weight to two parts by weight of turpentine of damar gum
in a widemouthed bottle. Put the gum in a little porous sack so that impurities in the gum will remain in sack when it dissolves. Hang the sack in the liquid so that most of it is above the surface, as the vapors dissolve the gum, not the liquid. This also holds true for dissolving shellack in alcohol.

Recommended for making lean varnish with cherry gum is 1:2 proportion
also for adding to painting media, such as tempera emulsions.
-for picture varnish 1:3 proportion is better.
-for best pastel fixative 2% by weight in benzine.

Making resin-oil medium for enamel like painting.

Resin ethereal varnishes such as mastic and damar dissolved in essence of turpentine make color transparent and luminous, but are too brittle used by themselves. They have a fast drying effect, and when mixed with sun-thickened linseed or poppy-fatty oils. they make it possible to paint over before coats are entirely dry. The mixture of resin ethereal varnish 1:2 with fatty oil and turpentine in equal parts produces the best resin oil medium, considered better than the colors ground in hard resins, or mixtures with hard varnishes.

Oil Painting Media drying rates. (Dependent, of course, on weather and on pigments mixed with medium. Generally speaking, lakes dry slow, raw earths fast.
Turpentine in a few minutes. Kerosene in a few hours.
"Dryers" such as Japan accelerate drying with danger to durability due to increased brittleness. Boiled linseed dries 6 to 12 hours. Hard varnishes such as coach varnish, amber varnish, 14 to 36 hours. Mastic and dammar, 1 to 2 days. Venice turpentine, thin layers, 1 to 2 days. Thick layers 3 to14 days. Linseed raw, not sunthick, 3 to 4 days. Poppy oil 5 to 6 days. Stand oil, 5 to 8 days. Oil of cloves is the slowest of all. 40 days. Japan is saturated with lead and manganese and is dangerous to color and binder. In emergency use no more than 2%, and then keep it to the underpainting. Light cool colors, especially, yellow from the use of siccatives.

One should think of these separate types of binders:

(1 watersoluble gum, which is lean-varnish-like, but not strong enough to support many layers without scaling off, as: cherry, arabic.
cold
(2.watersoluble glue, such as vegetable glue, starch, dextrin

(3.cold water soluble animal glue: casein
coldwater soluble animal glue: egg } natural emulsions.
(4.hotwater soluble animal glue: gelatin

(5.essential oil soluble gums as balsam: Venetian Turpentine
gum resin as: damar

(6.essential oil soluble oils and fats: vegetable: linseed
animal :stearin

(7. Ammonia soluble wax: beeswax emulsified with water by ammonia salts.
glues,
(8. Soaps: the union btween the acidic oils and fats and the alkalis. Usually watersoluble, as aluminum stearate, calcium arabinate. calcium cascinate. This process known as saponification, and always produces a base for an emulsion of sorts. These will be artificial emulsions.
(9. Emulsions made possible between any of the above by:
a. the use of a natural emulsion as a base. (eg. casein)
b. the use of an artificial emulsion such as beeswax emulsion
c. the use of artificial emulsifiers as oleic acid, which will allow a direct emulsification of oil with water.
d. the use of soaps.

Unless special circumstances call for these complex mixtures the simplest are the best and the more natural the emulsion the more reliable for painting purposes.
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Fresco.

Prepare one square foot of large scale design in earth colors. (fresco-safe colors are those which will stand lime test without changing)
Sketch can be done in gouache.

Procure a hollow tile, or a promenade tile, or prepare a surface with steel lath for plastering. A brick may be used for experiment.

Plaster as directed in lecture, and execute.

To fully profit by the problem the student should prepare a full sketch to small scale of a painting planned for a definite place and then enlarge one square foot of it to actual planned size and then execute this one square foot on the hollow tile and plaster.

Color ground for gouache may be used, just as it is.

Student may combine mosaic terserae and sgraffito effects in this problem if he wishes.