Paint and Varnish Facts and Formulae

Paint and Varnish Facts and Formulae

BY

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A Hand Book for the Maker, Dealer and User of Paints and Varnishes

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PAINT AND VARNISH FACTS AND FORMULAE.

CHAPTER I.

WHITE PAINTS AND PIGMENTS.

White Lead.

THIS is the most important of all paint forming dry material, from the standpoint of general, indeed universal use, it answering most of the requirements demanded.

Its production cost and selling price is moderate, it can be used as a base to combine with other pigments, has great opacity, so-called covering power, mixes readily with linseed oil and turpentine, aids the drying properties of the paint of which it forms a part, works easily under the brush when properly mixed, and has reasonable durability. The last-mentioned property is governed by the quality of the oil used and the conditions to which the painted surface is exposed. White lead or basic carbonate of lead of average quality contains approximately,

Oxide of lead,	86.72
Carbonic acid,	11.28
Water,	2.00
	100.00

As met with in commerce, it is a heavy pigment of varying degrees of whiteness, depending upon the method of manufacture and the care exercised in its production.

Sometimes a trace of Prussian Blue is added to increase its appearance of whiteness.

The processes of manufacture in practical operation may be divided into the slow or so-called Old Dutch Process, with its modifications, and the various quick process methods whose name is legion, few of which, however, are in practical use.

The Old Dutch Process consists in casting the metallic lead, free from impurities, in the form of buckles or thin strips of spiral formation; the lead thus formed is placed in earthern ware pots so that it is held or suspended above vinegar or acetic acid which covers the bottom of the vessel. These pots are arranged in rows and covered with planks and a layer of dung or spent tan bark. Row upon row is built up in this manner to form what is termed a stack. The fermentation of the dung or tan bark produces sufficient heat to volatalize the acetic acid, the fumes of which, with the assistance of the oxygen of the air, converts the lead into basic acetate of lead, which in its turn is converted into basic lead carbonate by the carbonic acid resulting from the fermenting manure or tan bark.

The process of conversion requires about three months. The resulting product is removed, separated from the metallic lead which may still remain to some extent, washed, ground and dried, if it is to be sold in that form. When to be ground in oil at the place of manufacture, the drying process is usually eliminated. The wet or pulp lead in this case being passed, after screening, into a pulper. Linseed oil, in proper quantity, is introduced and the mechanical action is such, that the oil displaces the water contained in the pulp lead and the now finished product is run into kegs.

This is pulp lead in contradistinction to mill ground lead made in the old way by grinding dry lead with linseed oil in stone mills of various types.

Mill ground lead appears to have some favorable points to those unacquainted with the pulp process, but the latter method is so perfect as to produce lead practically free from water and in such condition as to "break up" in oil or turpentine much more quickly and easily than will the mill ground product. Excess of moisture is the essential point to guard against.

The English method of making white lead is to convert the metallic lead into litharge, which is done by oxidizing the metal in a furnace. The litharge in a finely divided state is moistened with lead acetate solution, placed in closed troughs into which carbonic acid gas is driven, the litharge being continually agitated by suitable machinery; white lead is the resulting product. This lead covers well, and is considered good. Of the other quick process methods, the one most largely used in this country, subjects the metallic lead in a finely divided state to the action of carbonic acid gas and acetic acid, in large revolving cylinders.

Another method is to dissolve the lead in acetic acid, forming a solution of basic acetate of lead and precipitating this lead in the form of white lead by introducing carbonic acid gas into the solution.

The physical properties of white lead produced by the various processes differs in opacity, fineness, density, and color.

Quick process leads have, as a rule, a crystalline formation, giving a tendency to transparency, while slow process lead (Dutch Process), on account of the amorphous condition of the substance, is denser, more opaque, and masks or covers better. This opacity is heightened by the pigment being coarser in grain than the precipitated leads.

Slow process leads are apt to be more or less off color and to contain impurities unless very carefully prepared. The quick process leads, in which the methods are under perfect control, produce a product, when complete, excelling in whiteness and fineness of texture. This latter property, the fineness of the particles, makes the lead bulkier and hence it requires more oil in producing a workable paint and is another reason why it seems to cover poorly, The proportion of lead being less and oil greater.

Of all dry materials used as pigments, white lead has probably the most action on linseed oil, the hydroxide of lead combining with a portion of the oil, to form lead soap, which helps to hold the carbonate of lead in suspension and accounts for the smooth working qualities and the tough elastic coat it produces. Too much action between the particles of lead and oil produces the chalking tendency of white lead. This is sure to occur eventually, because the natural tendency of the lead is to aid the oxygen in the air to oxidize the oil until the binding properties are entirely destroyed. When white lead is used, however, the surface left is in better condition for repainting than that left in the use of most other pigments.

White lead is sensitive to the action of alkalies, acids, and many substances containing sulphur, such as sulphuretted hydrogen, which occurs in coal gases. The sulphur in coal gases causes white lead to turn black, due to the formation of lead sulphide. The drip of rain water from trees or other foliage also tends to make lead blacken in spots and mildew, particularly where the shade is dense and little sunlight penetrates. Tinting colors containing sulphides, or linseed oil which is impure, or which has been bleached and clarified with certain chemical agents also exercises a bad effect on white lead, under certain conditions. What appears to be a dirty blackened condition of the paint may also be due to dust particles adhering to the surface of the paint. In this case, washing with a very weak solution of sal soda will renovate the surface, the paint underneath being found to be in good condition. In a small way, the blackening can be removed by the use of a strong solution of Hydrogen Peroxide with 5 per cent. of ammonia water added, applied with a sponge. This chemical converts the blackened lead into lead sulphate which is white. Sunlight also tends to bleach darkened white lead paint.

White lead is adulterated with lead sulphate, (a poorly covering white, which mixes badly with oil), chalk, clay, barytes, gypsum and silex.

These adulterations, in most cases, being neutral pigments, rather increase the durability of the paint. The objection to these substances is that they detract from the covering power of the paint, give it a tendency to crack, and are very much cheaper than the white lead you are paying for.

Indeed, in the writer's experience, a case was noted where pure lead and oil were used and mildew and blackening occurred, whereas, on part of the same work, the same lead and oil, with 50 per cent. paris white added, was applied at the same time the pure lead was used. The latter work showed a white, glistening and perfect surface when the pure lead paint was in a deplorable condition. The only favoring condition given the adulterated paint, was its exposure to the direct sunlight, while the other painted work was shaded by surrounding trees.

It is likely that the neutralizing action of these cheap pigments do reduce the chemical action of the white lead on the oil, preventing the binder of the pigment from perishing so soon as it would without them, but producing brittleness and lack of elasticity.

Tests.—Subject the suspected sample of lead to the blow pipe flame on charcoal. Pure white lead is readily reconverted into metallic lead without residue. Any residue present in the form of white powder is likely to be sulphate of lead or barytes. Pure white lead is perfectly soluble in dilute nitric acid and the addition of caustic potash solution should not form a precipitate. A residue in the nitric acid solution indicates gypsum, barytes, or lead suphate.

Oxide of Zinc.

White zinc as a pigment is next in importance to white lead. It is made by strongly heating metallic zinc in fireclay retorts in a reverberatory furnace. The heat vaporizes the metal, which vapor is brought into contact with air heated to 300 degrees Fahrenheit. Oxidation results. The oxide is a very loose flocculent material and is carried by the hot air into condensing chambers where it is deposited ready for use.

Zinc white is often prepared directly from its ores. The roasted ores are pulverized and heated in a furnace on a bed of coal, and when fully ignited are submitted to a current of air from beneath the grate. The vapors formed are kept strongly heated along with a current of air and led into condensing chambers. Zinc made direct from the ores varies in whiteness, but is, for the most part, a good commercial product, the off grades produced being sold for other purposes where color is not an object.

It is also produced by the action of lime water on a solution of zinc chloride. Zinc white takes much more oil than white lead to make a suitable paint and, hence, will cover more surface, but is more transparent and, therefore, requires more coats to produce the same dense covering given by white lead. It is practically a neutral pigment in the sense that there is little chemical action between it and linseed oil, and zinc has the great advantage of not being darkened or discolored by sulphur gases or sulphides as is lead, and is less injurious to workmen, being non-poisonous. It dries with linseed oil to a hard glossy surface, and is less likely to blister when exposed to the sun and withstands changes of temperature better. In hot climates it is very suitable to use. Its chief fault is a tendency after a time to crack under certain conditions when used alone, and its poor covering (masking) qualities. When zinc is used, instead of lead, more dryer is needed as it does not assist the oil in this function.

Oxide of zinc has the property of combining with the gum resins, and this property is taken advantage of in the manufacture of enamels in which, for this reason, and because of its whiteness and the sharper, clearer tints it gives with colored pigments, makes it particularly useful.

A combination of zinc and lead in the proportion of 75 per cent. lead to 25 per cent. zinc, gives a paint of great durability, good body and covering power, and less likely to be acted upon by external influences than pure white lead.

Such has been the experience of many who have carefully tested this combination. In passing, it might be stated that zinc oxides produced by the French process direct from pure metallic zinc or spelter, particularly the imported article, is superior in whiteness. The terms green seal and red seal French zinc were originally used to designate first and second grade oxides, but at the present time the designation means little or nothing and in purchasing oxide of zinc, one must depend upon the reputation of the grinder or distributor as a guarantee of the quality represented.

The advantages and drawbacks of both white lead and zinc oxide have been plainly stated. It is simply a matter of judgment as to using the one or the other or a combination of the two according to the requirements of the paint to be used.

Tests.—The purity of zinc oxide is easily determined. If pure, it will dissolve completely without effervescence in boiling dilute nitric or hydrochloric acid. If it does not completely dissolve, barytes is likely present. If it effervesces while dissolving, it contains whiteing, white lead, or zinc carbonate, which is an inferior pigment.

If, on heating in a tube, the sample turns yellow and gives off vapor, white lead is present, as pure oxide of zinc undergoes no change when heated.

SULPHIDE OF ZINC, is a white pigment of considerable body, sometimes used as a paint. On account of the sulphur it contains, it may exert a detrimental effect when mixed with some pigments.

Lithophone, which is sulphide of zinc in modified form, has replaced the pure sulphide as a paint pigment. It is composed of sulphate of barium, (barytes), containing about 30 per cent. of zinc sulphide. This is frequently used in place of zinc oxide and, for some purposes, is equally as good, having the same general properties and being cheaper.

SULPHATE OF LEAD is a neutral lead pigment of crystalline structure and poor covering power. It is sometimes mixed with or substituted for white lead. It is found as a by-product in the preparation of aluminum acetate from alum and sugar of lead, or in obtaining acetic acid by the action of sulphuric acid upon lead acetate. It is also found in an impure state as a deposit in the lead chambers of sulphuric acid works. Lead sulphate is but slightly soluble in water and in dilute acids and is non-poisonous. The fact that it covers poorly, has a tendency to crack or "alligator," and does not mix well with oil, work against its general use as a paint pigment.

SULPHATE OF BARIUM.—Barytes is a natural mineral prepared for use by simply drying and grinding. Enormous quantities are used as an adulterant, in almost all pigments. It is crystalline and does not deaden the color with which it may be combined. In grinding, it takes very little oil, and is the universal cheapener. Its use is to be deplored when introduced into pigments which, in themselves, are marked *pure*.

The reader should understand that many colored pigments are of such great strength and of such a nature that the use of some reducer, as barytes is necessary to improve their mixing and paint forming qualities.

Artificial barium sulphate is also produced and differs only in being finer, whiter and free from admixture with other substances, in other words, a chemically pure product. While the covering power of barytes is poor, it is not altered by atmospheric conditions and is without action on other pigments. It does not work well in oil alone, but improves much when used in conjunction with other pigments, particularly white lead. A paint composed of two parts white lead and one part barytes is little affected by sulphuretted hydrogen, and is, therefore, much less likely to blacken or change color, than white lead alone.

Barytes is practically insoluble in hydrochloric or nitric acid, which easily distinguishes it from white lead or oxide of zinc.

WHITING AND PARIS WHITE, which is powdered chalk (carbonate of lime) is found in nature. It is ground, washed and floated through vats with excess of water, and allowed to settle. The best grades being those taken from the furthest vats.

The best quality of putty is made from whiting and pure linseed oil. Whiting requires about 23 per cent. of oil to form putty. This article is adulterated with barytes and marble dust, which take much less oil to form a mass of equal consistency and as oil is the expensive ingredient in putty, this saving is quite an object. In place of linseed oil, cottonseed oil, paraffine and neutral oils are used. The substitution of mineral oils is what causes the putty to strike through the paint and show yellow; why not insist on having pure linseed oil putty and pay the price. Let us see what is the cost of pure putty:

80 lbs. whiting, at 3-4c. lb.....	$.60
20 lbs. raw oil, at 6c. lb.......	1.20
Package	.25
Labor, etc. 1-2c. lb............	.50
	$2.55

When you consider that most putty is retailed at $1.75 to $2.00 per cwt., it is readily understood why it *can not* be pure.

Whiting or Paris white is used as an adulterant in colored pigments, usually in connection with barytes. It counteracts the open texture and heaviness of the latter substance, and, being more opaque, increases the covering power. When used in colors, it dulls or destroys the coloring power of the pigment in which quality barytes is superior.

Whiting is the base of kalsomines and most fresco or water colors, where it finds extended use.

SILICA, or silicon dioxide, is a widely distributed mineral. It occurs in rocky masses of crystalline formation, clear, or partly opaque, and white in color when pure. It is prepared for use by grinding and removing the moisture by any of the usual processes.

In combination with white lead, this substance has been used for some considerable time as a paint base and some extravagant claims have been made for it. It resembles barytes in its working qualities, except that it is bulkier and requires more oil. Used as a paint, it dries extremely hard, is a neutral pigment, but covers poorly. It is extensively used in paste and liquid wood fillers, in which use its hard drying properties and transparency render it of considerable value.

Silica is of particular interest from the fact that water glass or silicate of soda (soluble glass) is prepared from it. This substance finds extended use in dyeing, color printing, in various cements, and in painting.

Water glass comes into commerce in the form of a thickly fluid transparent mass resembling sugar syrup in appearance. It is made by fuseing, in a crucible, 15 parts of quartz sand (silica), 10 parts of potassium carbonate and 1 part of powdered charcoal. When cold, the fused mass is pulverized and exposed to the air. The powder is washed thoroughly with cold water, and then boiled with 5 parts of water until dissolved. The solution is filtered and evaporated to the proper consistency; when exposed to the air, it dries to a transparent glass. Other methods of manufacture are in vogue, in a general way resembling the one described. It can be purchased very cheaply. Under formulae, in Chapter X. various water glass preparations are described.

CHINA CLAY, or silicate of alumina forms part of the composition of several minerals, notably feldspar, granite, porphyry and similar rocks. By the action of the carbonic acid in the air, aided by water, these formations disintegrate and become soft pliable masses of earthy matter.

In Devonshire and Cornwall, England, occur large deposits of disintegrated white granite, furnishing large supplies of fine white china clay. The crude material is properly disintegrated and washed to separate the mica and quartz present and the milk-like liquid is stored in tanks. The clay settles out and is first dried in the air, and then in ovens. It is used to some extent in paints, and particularly in wood fillers. Being very bulky, it holds up well in solution, and has a smooth unctuous working quality. Its principal use is in the manufacture of porcelain.

TALC, or silicate of magnesium, is a soft, white mineral, and soap stone is but another form containing aluminum. It is used, occasionally in paints, dry and mixed, as an adulterant, and in wood fillers. The soft, soapy nature of this substance is about the only advantage it offers.

GYPSUM, or terra alba is calcium sulphate containing moisture. It is found in a commonly occuring class of minerals, both crystalline and fibrous, and in the form of gypsum earth or land plaster.

Gypsum, from which all the water has been removed by burning, is termed burnt gypsum, or plaster of paris. It has the property of again combining with water to form a solid mass, which property is taken advantage of in many ways.

Unburnt gypsum, when treated with a dilute solution of potassium sulphate, or carbonate, will harden even more quickly than burnt gypsum with pure water. Thus, plaster, which has not hardened properly, can be made to do so by coating it with a solution of the potash salts mentioned, which will also assist in rendering mild or less alkaline any caustic lime which may be used with the plaster. Gypsum is used for building and decorative purposes, in stucco work and in some kalsomines and fresco paints.

Gypsum can be hardened in several ways. Burnt gypsum may be mixed with lime water or a solution of glue in water. A very good method is to mix the gypsum with a solution of alum water containing 3 to 4 ounces of alum to the pint of water used. This mixture hardens completely in a few minutes, and is known as marble cement. Borax water, containing 2 ounces of borax to the pint, will act in the same manner.

LIME, OR CALCIUM OXIDE is made by burning lime stone (calcium carbonate) which is a mineral of common occurence. It is found in the bones of all animals, shells and as marble, coral, chalk, and in other more or less familiar forms. Its uses are varied and well-known in the form of burnt lime, as calcium carbonate, and as chalk or whiting, which is an earthy form of the carbonate usually containing clay.

Burnt lime moistened with water, slacks with great violence. When slacked, one part of water to three parts of lime, it forms a soft white powder, hydrated calcium oxide. If unsufficient water is used the powder will be gritty and harsh. After slacking, a thin cream can be made by the addition of more water. Mortar is a mixture of sand with a thin cream of lime. The use of lime as white-wash is well known.

Hydraulic cement is composed of burnt lime, containing a large percentage of clay or silica, lime having the property of hardening under water in the presence of more than 10 per cent. of silica in its composition. Lime water is used in some forms of fresco painting on plaster. Slacked lime has good covering qualities and this property and its cheapness has impelled many experiments and attempts to use lime as a pigment in oil paints combined with lead, zinc and other whites. Its use in appreciable quantity, because of its alkalinity, destroys the binding quality of the oil, and leaves the paint to perish.

FLAKE WHITE AND CREMNITZ WHITE are carefully prepared forms of white lead, wherein the pigment is of superior whiteness and in a very finely divided state by rewashing and floating, whereby the bulkiest and finest portions are separated. It is used mainly by artists and is of no practical interest to the painter save in rare cases. It sometimes replaces white zinc in whole or part in some white enamels.

CHAPTER II.

THE OXIDES OF IRON.

METALLIC brown, natural indian reds, venetian reds, purple oxides, ochres, siennas and umbers come under this head, and are various combinations, consisting mainly of iron oxide and silica or clay found in nature.

Metallic brown, an iron oxide much used, is prepared after being mined by simple roasting and grinding. It contains from 50 to 75 per cent. of oxide of iron, the balance being clay and silica.

In the case of the ochres, raw siennas and raw umbres, the earth is simply dried, washed, ground and floated; whereas, burnt sienna and burnt umber is produced by first roasting the raw product to the desired shade, or depth of color, and subjecting it to the further treatment above described. Other red oxides are similarly treated. These natural earth pigments are very stable and permanent and should be preferred wherever possible, for tinting, or as bases where lead or zinc is not indicated.

Some of the strongest and best toned ochres are produced in England, but those most generally used in this country are imported from various parts of Europe. France, notably, sends us the so-called Rochelle ochres. These ochres vary in quality according to the locality from which they come, and the care given them in their preparation for the market. The difference between yellow ochre and the various red ochres, or red oxides is a chemical one. The color in every case is due to the iron they contain. The difference being that, in the case of the yellows, the iron oxide exists in combination with water, hence, these ochres are called hydrated iron oxides; while the red ochres are anhydrous, contain little or no water. If yellow ochre be roasted, therefore, it becomes red or dark brown, as the moisture is driven off. This is the case also in the formation of burnt siennas and burnt umbers. The various tones of yellow ochre depend upon the varying amount of clay or silica present, and the greater or less percentage of combined water they contain.

Yellow ochre has been used for centuries in painting and decorating. It is, to all intents, a permanent pigment, and has no appreciable effect on other pigments, except, perhaps, a few of the very sensitive lakes, which latter are too fugitive to be used. It is seldom adulterated because of its price, and the fact that there are vast quantities of cheap ochre obtainable. Its yellowness is sometimes artificially improved with turmeric or other vegetable yellows, or by the admixture of chrome yellow, notably in producing so-called golden ochre. By pouring ammonia water mixed with alcohol over the suspected sample, such adulterations can usually be detected. If pure, the liquid will not discolor, otherwise, it will be stained. Ochres ground in oil are largely adulterated with barytes to save linseed oil, as pure ochres are light and very absorbent.

Italy has famous sienna deposits of beautiful tone and texture, and the umbers come from Turkey and southern Europe.

We produce some very fair ochres and other natural pigments in this country, but, as a rule, they lack strength and brilliancy, and because of their careless preparation, are not widely used except for paints of a crude nature or in the arts where the paint forming qualities are not the factor. In truth, the average paint grinder prefers, when he has cheap goods to produce, rather to adulterate the imported pigments with barytes or some such substance, than to grind the native pigments straight; because he saves oil, and produces a better appearing and sometimes stronger color for tinting purposes, than had he used the native article pure. These earth colors, for the most part, take a great deal of oil in grinding, hence the use of barytes as an adulterant. When we consider that ochres take from 20 to 30 per cent. and barytes only 7 per cent. of oil to make a suitable paste, we can understand the great saving.

Venetian red, as originally used, was a natural ferric oxide or oxide of iron, free from water and varied much in shade, depending upon the amount of iron oxide and other substances such as clay or silica, which it contained. At present, the better grades of venetian red in point of strength, and tone, are produced by roasting copperas, which is sulphate of iron. Strong heat converts it into the oxide forms. It is cheaply produced, as copperas is a by-product from the large iron and steel works and the supply is very great. The production of copperas reds forms a convenient outlet for the copperas thus produced. Of course, you seldom get these oxides pure, being mixed with clay, silica or chalk, to improve their qualities, as paint forming materials and to cheapen the product, as in the case of low grade venetian reds artificially produced. Strength, as a rule, is not a requisite in pigments like metallic browns and venetian reds, which are used only secondarily as tinting colors, but principally alone with oil and suitable drying material as paint bases. Even tinting venetian red is not likely to be absolutely pure as it is more easily ground and better preserved in paste form when mixed or reduced with clay, chalk or barytes.

Copperas reds are permanent only when free from soluble salts and sulphates. When containing these substances or traces of acid are still present from the copperas, an injurious action is manifest on some of the vegetable pigments when used in conjunction, and when used alone on iron, corrosion or rust will result.

The indian reds are, for the most part, of natural origin, being another variety of ferric oxide, or red ochre of great purity and having a slightly purplish hue. Indian reds are imported and also to some extent produced in this country.

Metallic browns are similar to indian reds in composition, but may contain less iron and less care is taken in their production.

CARBON is the coloring agent in almost all black pigments. These pigments are of organic origin, being products of either animal or vegetable matter. In a general way, these pigments may be divided into two classes depending upon their manner of production—*charcoal blacks* and *soot blacks.*

Charcoal blacks include ivory, bone or drop black, mineral, cork and vine blacks. The soot blacks include lamp black, vegetable blacks and carbon or gas black.

Ivory and Bone Blacks are made by calcining bones in some form of retort or closed vessel, which can be subjected to great heat. The quality of the product depending upon the nature of the bones used, and the temperature at which the calcining process is carried on, together with subsequent treatment. The best ivory black was originally made from calcined ivory chips. It is a dense, brilliant black, quite permanent, but not so powerful as some of the vegetable blacks. It consists of bone earth stained with a certain percentage of carbon formed in the calcining process. When used alone, it is superior to most other blacks, but when combined with other pigments of organic origin, it is apt to exert a bleaching action on such substances, being an active decolorizer because of the phosphate of lime it contains. Its absorbent powers are also very great, rapidly taking up moisture.

Charcoal Blacks are produced by calcining in closed vessels, wood and woody fibre; such materials as cocoa nut shells, the stones from various fruits, particles of cork and the stems of grape vines. Frankfort black is made from wine lees. Charcoal blacks have the same decolorizing property as bone blacks, but in lesser degree.

Mineral black is made from certain bituminous shales or coals by calcination.

Lamp black is produced by burning rosin, rosin oil, fats, and fatty oils, coal tar oils, and petroleum residues with a restricted supply of air, whereby much of the carbon they contain is deposited in the form of soot. The best and finest grades of black are those which are condensed furthest from the condensing chambers. They contain from 80 to 90 per cent. of carbon, which substance regulates their strength. The strongest black is that made by condensing the products of combustion of natural gas; known as gas or carbon black. It has remarkable strength and must be thoroughly and finely ground to give good results. It is used to strengthen weaker blacks and in the manufacture of black paints.

We must not overlook graphite or plumbago, a natural form of carbon before mentioned. It is not affected by most chemicals and gases, takes a large amount of oil and makes a very superior paint for all metallic surfaces.

Ivory black is best for decorative effects, where pure color is to be used. Carbon black is indicated for tinting when brown gray colors are desired. Lamp black, when blue grays are required. Vegetable blacks do not make good paint for metallic surfaces.

The general rule may be laid down that metallic or mineral pigments are best on metal; mineral pigments, containing silica on stone work; and carbonaceous or vegetable colors on wood work. For this reason, white lead containing carbon black or lamp black seems to produce a more lasting coat on wood, than white lead alone.

CHAPTER III.

THE CHEMICAL COLORS.

CHROME yellows, in a general way, are produced by the chemical combination of potassium chromate and lead acetate, or by digesting lead sulphate with a warm solution of potassium chromate.

The so-called standard shades are produced, varying somewhat in tone, according to the process of manufacture and the amount and nature of the adulteration contained.

They are distinguished as light, medium, and dark or lemon, orange and red chrome.

Alum, barytes and lead sulphate are used in preparing the lighter shades, and lead oxide for the dark or red chromes. In passing, it might be said that all chemical colors are subject to more or less adulteration.

This has become a fine art born of the necessity for cheap colors adaptable to the requirements of certain branches of the paint trade.

There are other methods of producing chrome yellows, which need not be entered into.

Chrome yellows are not permanent, but will rapidly deteriorate, unless protected by varnish; even then, they are uncertain. Other organic pigments affect them injuriously, and when subjected to the action of sulphurous gases they darken, as does white lead.

When mixed with prussian blue, the latter color is, sooner or later, destroyed, a point well worth remembering.

CADMIUM YELLOW, or sulphide of cadmium, is made by combining some salt of cadmium with sulphur. It varies from pure yellow to orange red, and is a fairly permanent pigment.

BARIUM CHROMATE is a pure yellow, having good working qualities and is the most permanent of the chromates used in paint.

MARS YELLOW is artificially prepared yellow ochre. It may be made by precipitating ferrous sulphate, (green vitriol) solution and alum with caustic soda, potash, or lime. The amount of alum in the iron solution governs the depth of shade in the resulting precipitated pigment. It is bright in tone, and the shades vary from pale yellow to orange, and by heat various darker colors are produced including red and purple. It is almost as permanent as the siennas and works well in both oil and water colors. Gold and russet shades are readily produced by it, and herein it has much value as a pigment.

NAPLES YELLOW, or lead antimoniate is also a pigment used by artists. It has a fair degree of permanency, but it injures and is injured by some organic pigments, including many of the lakes and, hence, is unsafe to use in combination with them.

YELLOW LAKE, or Dutch pink, is a lake produced from several sources, principally, however, from quercitron bark, from several varieties of the oak tree. A hot water decoction of the bark is treated with a solution of alum and weak ammonia. The resulting precipitant is the lake.

It is used mainly in water colors, but is very fugitive.

CHROME GREENS are produced by a combination of prussian blue and chrome yellow. This is usually done, not by mixing the separate colors dry, but in the process of manufacture, chromate of lead and prussian blue solutions are combined in proportions to suit the shade required and precipitated together under proper conditions.

The ordinary green we meet with, both dry and ground in oil, contains only 10 to 20 per cent. of pure chrome green, the balance being adulteration. The pure color itself is too powerful and not suitable to form a good paint for ordinary purposes, nor will it lend itself well to being ground in oil without some admixture of adulterants.

Chrome greens thus prepared, are not permanent, fading after a time and losing all brilliancy of tone.

GREEN OXIDE OF CHROMIUM, or true chrome green is a permanent color produced by reducing bichromate of potassium with sulphur or starch by a suitable process. It is a greyish green powder and has considerable body. Its use is confined to artists.

It is found also in nature as chrome ochre containing a small percentage of oxide of chromium mixed with clay.

EMERALD OXIDE OF CHROMIUM is another permanent green color of deep bluish cast made from potassium bichromate and boracic acid. It has no action on other pigments and can be used in oil or water with equal facility. Its use should be more extended. It is employed mostly as an artist's color.

TRUE EMERALD GREEN is some form of paris green made from blue vitriol, acetic acid and white arsenic. While very beautiful in shade from its brightness and vivacity of color, its drawbacks are so many as to have caused its use as a paint to be practically discontinued. Though permanent when used as an oil color and so brilliant as to cause ordinary chrome green to appear dull and lifeless; it is very transparent, weak, and above all, extremely poisonous, as are all the copper arsenate greens. It is particularly adapted for use on surfaces exposed to the action of salt water, where it is quite permanent, and is, therefore, used in paints and anti-fouling compositions for ships bottoms.

Paris green is of interest mainly as an insecticide. Its purity can be tested by adding a little of the suspected sample to a boiling solution of dilute nitric or muriatic acid. It should dissolve perfectly and give no precipitate when a few drops of barium chloride solution are added. An undissolved residue indicates barytes or some similar adulterant.

BRONZE GREENS, BOTTLE GREENS AND QUAKER GREENS are combinations of chrome green with carbon black together with large proportions of paris white or barytes. Ochres combined with lamp black will also produce bottle greens rather dull in tone.

ULTRAMARINE GREEN is a modified form of ultramarine blue. Its use is limited to water colors in frescoing and similar work.

ULTRAMARINE BLUE occurs naturally in Lapis Lazuli and was formerly obtained from this mineral by a simple process of heating, cooling quickly in water and further careful washing and separation of the coarser particles. The natural ultramarine is very expensive and hence little used. Artificial ultramarine is prepared by heating together in closed crucibles, in a furnace, a mixture of china clay, silica, sodium carbonate, sodium sulphate, charcoal and sulphur. After cooling the mass slowly, it is powdered and gently roasted with the addition of a little sulphur.

The calcining or roasting process may be repeated until the proper color is obtained.

In color, it is pure blue and of brilliant tone when of good quality. It has, however, little strength. It has no influence on nor is it affected by other pigments; is not injured by heat or the alkalies, but is decolorized or modified by acids and cold alum solutions. Oriental blue is a form of ultramarine containing much silica.

PRUSSIAN BLUE, Berlin blue, or Chinese blue is a dark blue transparent, and very powerful staining color, used solely for tinting. There are at least three distinct kinds of Prussian blue depending upon the method of manufacture and the materials used. The ordinary prussian blue is made by adding ferrous sulphate (copperas) solution to a solution of yellow prussiate of potash. The precipitate formed is oxidized by dilute nitric acid or chloride of lime. After washing, it is treated with hydrochloric acid and again washed with water.

Prussian blue, when pressed or rubbed, should show a coppery hue in the lump. The best for painters and artists use, is the insoluble variety. This color is destroyed by heat and will not withstand the action of alkalies, moreover, sunlight will cause it to fade more or less. It is largely adulterated for the pure article is somewhat expensive.

CELESTIAL BLUE is occasionally used as a fresco color and by artists. It is made by combining oxide of tin or potassium stannate with cobalt chloride with further heating of the precipitate with silica. It is a permanent pigment of a greenish blue tone.

COBALT BLUE is a name applied to several blue pigments, the best known of these is a combination of alumina and oxide of cobalt. Another is made from phosphate of cobalt and still another from the arseniate. Cobalt blues work well in oil and water and are not affected by light, moisture or oxygen, and are practically permanent. They mix well and are unaffected by most other pigments.

INDIGO is of little interest to the painter, except from a historical standpoint. It is prepared from a shrub grown extensively in India. The plants are macerated in water, allowed to ferment and boiled. The blue precipitate is separated, pressed and dried. It is also prepared artificially. It is a rich transparent blue much used by artists, and in staining and dyeing. It is very fugitive.

RED LEAD or oxide of lead is made by heating metallic lead in furnaces of proper construction. Its tone depending upon the care in roasting the pig lead from which it is made.

ORANGE MINERAL is made by roasting white lead in the same way that red lead is produced from the metal. I have mentioned there substances here on account of their extensive use in the manufacture of vermillions.

TRUE VERMILLION is a sulphide of mercury found in nature and also made by combining sulphur and quicksilver under suitable conditions. While a brilliant red, it is very expensive. Heat destroys it and exposure to atmospheric influences causes it to turn dark. All work painted with vermillion should be varnished. The cheaper vermillions are mainly mixtures of red lead or orange mineral with eosine, a bright red aniline color, together with some base like barytes or terra alba. The amount of the latter substances used depending upon the price at which the vermillion must be sold. In some cases there is no lead present, being simply barytes, terra alba, or clay, tinted with eosine or red aniline dye. There are some special reds on the market, mixtures of various sorts, some containing iron oxides. None of these vermillions are absolutely permanent. The pinkish shades fade more quickly as depending on the aniline they contain for color, while those containing large percentages of lead or iron oxides are more permanent.

THE LAKES are insoluble pigments, made by precipitating organic coloring matter with metallic salts. For instance, yellow lake, before mentioned.

CARMINE is a brilliant red pigment prepared from cochineal, which is the dried wingless females of a species of coccus, a small insect found on several species of cactus. The coloring matter is extracted with boiling water to which alum or some other metallic salt is added to bring about precipitation. When washed and dried it is ready for use.

The various red lakes sold under the name of purple, crimson, or scarlet lakes are made from cochineal by precipitating cochineal extract with solutions of potassium carbonate and alum. Carmine lakes, while very beautiful, have a tendency to fade or turn brown, thus losing their brilliancy. They are used to some extent in oil and japan and as fresco colors.

THE ANALINE COLORS are obtained from coal tar or nitro benzole. If nitro benzole is treated with iron filings and acetic acid in the proper apparatus, aniline is produced. Various aniline colors are made from this product by treatment with chemicals. The processes are too complicated to be entered into and of little practical interest to the paint trade.

The various aniline colors have replaced the vegetable lakes in large part, and find extended use as stains; in improving the color and tone of cheaper pigments; and in the production of artificial vermillions before mentioned. Aniline colors find their chief use, however, as dye stuffs for all possible purposes where dyes are required.

CHAPTER IV.

CLASSIFICATION OF PIGMENTS
COLORS IN OIL, JAPAN AND WATER.

PIGMENTS are often classed according to their color, hue, brightness and purity. Their transparency and opacity must also be considered. The more important classification, however, is their permanency in oil or water paints.

In a general way they may be divided into mineral and organic, depending upon their origin. The mineral pigments, as a rule, are much more permanent than the organic, (vegetable or animal).

Pigments may also be soluble or insoluble, crystalline or amorphous, chemically active or inert.

The stability of pigments may be tested in various ways, either from the known physical and chemical make up of the various substances, by a study of the paints in which they have been used, and from various experimental tests for permanency. The following table indicates the various degrees of permanency as nearly as can be arrived at as applying to paints mixed with oil as a medium:

CLASS I.

Zinc White	Oxide of Chromium
Flake White	Cobalt Green
White Lead	Green Ultramarine
Yellow Ochre	Terra Verte
Raw Sienna	CobaltBlue
Mars Yellow	Ultramarine Blue
Cadmium Yellow	Raw Umber
Venetian Red	Burnt Umber
The Red Oxides	Ivory Black
Indian Red	Lamp Black
Burnt Sienna	Graphite

To which list might be added the silicious earths, barytes and paris white.

CLASS II.

Chrome Green	Vandyke Brown
Emerald Green	Prussian Blue

The various madder lakes used by artists also have fair permanence.

CLASS III.

Chrome Yellows	Carmine
Asphaltum	Crimson Lakes
Dutch Pink	Artificial Vermillions
Vermillion	Maroon Lakes

When water is used in place of oil as a medium, white lead, flake white, cadmium yellow, artificial vermillion and chrome yellow are very treacherous pigments to use. On walls or plaster, where the lime is fresh and still caustic or strongly alkiline, the colors inadmissable in water should not be used. In this class is prussian blue also.

In the selection of pigments to be used in paint, due care should be exercised that they have no injurious influence on the linseed oil, or other media with which they are mixed; that they absorb a large amount of oil which insures greater durability; that they are not fugitive or fading and that they are finely ground.

Inert pigments are those which have no chemical action on the vehicles with which they are mixed or on other pigments with which they are combined. Such pigments are barytes, silica, gypsum and the various oxides with some few exceptions.

Chemical pigments, on the other hand, the carbonates, chromates, those containing sulphur and those of organic origin, in many cases have a chemical action on linseed oil and act or are acted upon injuriously by other pigments with which they are combined. White lead, chrome yellow, prussian blue, vermillion and the lakes are good examples. The binding quality of the linseed oil may be injured or destroyed, or darkening, fading, or deleterious changes in the colors may occur.

The most satisfactory pigments for general use, from the foregoing, would be the ochres, raw and burnt sienna, raw and burnt umber, the oxide reds, copperas reds, ultramarine blue, cobalt blue, lamp black and drop black.

Pigments, such as white lead, zinc, the oxides of iron, the blacks and chemical colors are, as a rule, purchased by the painter in paste form, ground in linseed oil, when for use as bases, or as tinting mediums, in oil paint. In paste form they are more convenient for immediate use. The process of grinding with oil has made them finer in texture and in better condition to mix readily with oil and other pigments.

The white pigments are usually ground in refined or bleached linseed oil to obtain the maximum whiteness. In grinding most other pigments, ordinary raw oil is used, with the exception of some blacks, and other colors which dry poorly, in which case boiled oil, containing dryer, is substituted.

Very cheap oil colors are sometimes ground in adulterated oils. In the purchase of such materials, one must rely largely on the reputation of the maker producing them.

Coach Colors are carefully selected pigments, ground in turpentine and japan dryer to produce quick drying flat colors. Much care is used in their preparation, and frequently the color is reground several times to produce the requisite degree of fineness. During the process of grinding, the mills are cooled with water so that the heat generated in the milling process will not affect the brilliancy of the color used.

Colors Ground in Water are of interest to the fresco painter, and consist of various pigments ground in that medium into which, in some cases, a little carbonate of soda is added. A little glue size or glycerine may also be combined. The size to hold up the pigment from settling and the glycerine to prevent hardening and undue evaporation of the water.

Testing of Paints and Colors.

Under white lead and linseed oil we have given tests for the purity of these important substances. To make tests, it is always well to have samples on hand, if possible, of known purity for comparison. In testing colors for tinting; strength, tone and transparency are to be noted. First, determine the fineness of grinding which will influence the staining power to a marked degree. Then add equal parts of weighed samples of the colors to ten or twenty times by weight of white zinc or white lead in oil; use the same pigment for both samples, because the same colors have very different tinting power in different whites. Spread the reduced pigments on glass, side by side. Further reductions can be made; the extreme is usually fifty to one. Transparency and brilliancy can be judged by spreading thin layers of the samples side by side on glass, and judging by the eye.

The covering power of bulk paints, such as white lead, is a most important consideration as also is the density or opacity of the coat. These features depend upon the pigment used, its fineness, the amount of oil and turpentine or the proportions of each used in thinning and the manner of applying the paint. In comparing two white leads or other pigments ready for use, it is important that the same amount and kind of thinners be added and similar tools and methods be used to spread the paint to be compared.

The spreading power of a given quantity of paint or varnish depends, of course, largely on the kind and condition of the surface to be covered. Cement and other absorbent surfaces require much more paint than non-absorbent surfaces like the metals. A gallon of paint ready for use will cover from 350 to 500 square feet of planed boards, depending upon whether it be the priming or succeeding coats. The latter covering the greater surface. On metallic surfaces, from 600 to 800 square feet will be covered by the same amount.

Varnish of good body will cover somewhat more surface than paint, particularly when the work has been filled; 600 square feet to the gallon is a good average. Stains and other liquids of thin body will cover from 600 to 800 square feet to the gallon, except on very absorbent surfaces. A pound of floor wax should cover, under ordinary conditions, at least 1,000 square feet of surface.

CHAPTER V.

OILS AND SOLVENTS.

LINSEED OIL, of all vehicles used to form, with pigment, paint, linseed oil is the most important, and the painter cannot know too much about this substance, of which from 30 to 35 million gallons are produced and consumed annually in this country alone, mainly in the manufacture of paints, varnishes, oil cloths, and linoleums.

There are, of course, many other drying oils more or less adapted for paint, but with few exceptions, little used in general practice. We shall consider the exceptions a little later.

Linseed oil is obtained from the seed of the flax plant, cultivated sometimes for its fibre, otherwise for its seed, from which to produce oil. Flax is largely grown for the latter purpose in the region about the Baltic Sea, in Russia, in Egypt, India and North and South America. The domestic supply comes mostly from the southwest, middle west and northwestern States. Seed of average quality contains about 39 per cent. of oil, the residue being organic matter; cellulose, phosphates, etc. The quality and yield varies considerably, depending on the nature of the seed, the presence or absence of other seed, such as dotter and wild mustard, the conditions of ripening and the locality in which it is grown.

The process of manufacture is as follows: The seed is ground to a meal and pressed cold or hot, or the oil is extracted from the meal by the use of a suitable solvent, such as benzine or carbon bisulphide. The solvent process is used in producing the so-called new process oil; old process oil being simply meal hot or cold placed in bags and the oil obtained by hydraulic pressure. When heat is used, from 30 to 35 per cent. of oil is extracted, while by the cold process barely 25 per cent. of oil can be obtained. Cold pressed oil is, without question, superior to hot pressed oil for paints and varnishes and may account in part for the better wearing qualities of the paint appliėd years ago, when cold pressed oil was in general use. There is now practically none in the market. Cold pressed oil has a pale yellow color and a pleasant sweet taste, while hot pressed oil is darker and has a stronger, somewhat biting taste. Evidently more mucilage and substances of no value, of perhaps, some detriment, are produced when heat is used to increase the yield.

Linseed oil is soluble in turpentine and benzine in any proportion, but very slightly soluble in alcohol. It boils at about 446 degrees Fahrenheit. On boiling several hours, it becomes a thick syrup;

with dryers added, and moderate boiling, it becomes true boiled oil as met with commercially. It forms an emulsion with water on the introduction of a weak alkali and saponifies in stronger alkalies. The drying property is due to its power of absorbing oxygen from the air which causes the oil, when spread in thin layers, to oxidize and become a hard, neutral substance. Its specific gravity at 60 degrees Fahrenheit is 0.932. For ordinary paint it is used raw with the admixture of liquid dryers and is more durable than boiled oil, because the oil in being boiled has already been partly oxidized and when oxidization of oil is complete and the oil becomes hard, it tends to brittleness and eventually perishes, leaving the pigment to chalk off. Raw oil, likewise, works easier under the brush and is less likely to blister. Furthermore, boiled oil is likely to be adulterated with rosin, rosin oil, and oils of mineral origin.

Boiled oil is commonly produced by adding cheap heavy bodied rosin or oil dryer to oil cold, or slightly heated, so that you seldom get real boiled oil anyway, except from a varnish factory.

Raw oil is adulterated with cotton seed oil, mineral, rosin, and occasionally fish oil. Its low price, however, precludes much adulteration with other vegetable or animal oils. It takes fire at between 600 degrees and 700 degrees Fahrenheit. If mineral or rosin oil is present, it flashes at a lower temperature.

Pure linseed oil may vary in composition. It may contain a large percentage of foots, mucilage and other foreign and non-drying substances, and it may contain an excess of water, which hinders drying also. To be at its best, it should be tanked and well settled for a few months. Linseed oil is refined or decolorized by agitation with a small percentage of sulphuric acid, by mixing it with fuller's earth and filtration, and with the use of peroxide of hydrogen, bichromate of potash and in various other ways. Refined oils should not be used for outside painting, being adapted only for use in varnishes and similar products or for use in the arts, where paleness and freedom from mechanical and other substances is necessary.

Tests for Purity of Linseed Oil.

Place one drop of strong sulphuric acid on ten drops of oil. If pure, the oil will pass in color from orange through red to brown. Rosin oil, if present, gives a brown color at once turning to black. If it contains fish oil, the first color is violet.

Rosin oil may be detected by the increase in density of the oil and by the odor and general appearance.

If a sample of linseed oil containing mineral oil be spread on glass and allowed to dry, if much mineral oil is present, it will sweat out of the drying layer in drops or form a wet greasy surface on the drying oil and tend to turn the oil yellow.

Another test for mineral oil is to dissolve a small portion of the sample in glacial acetic acid. Linseed oil will dissolve, but mineral oil will not in this acid.

Much oil from Calcutta seed was formerly used in this country. The better grades of domestic oil as now produced have forced it from the market. For practical purposes it is not worth the difference in cost.

CHINA WOOD OIL, or tung oil is the best drying oil known. This is universally used in China in paints, lacquers, and water-proofing materials, and is now being used, more or less, among varnish makers, both here and in Europe, because of the excellent qualities it possesses.

It is expressed both cold and hot from the seeds of a tree growing in China and Japan. The seeds contain from 40 to 50 per cent. of oil. Its drying properties are remarkable in that, when spread, it dries throughout from top to bottom at the same time, not forming a skin as linseed oil, and some other of the drying oils. It has valuable water resisting qualities forming durable water-proofing and moisture resisting varnishes. It cannot very well be used in the raw state, as it dries opaque, but when boiled with or without dryer at about 230 degrees Fahrenheit it can be used the same as linseed oil and dries transparent, with a soft, velvety lustre. It is well adapted for oiling floors and in the preparation of floor paints and varnishes, and to impart drying qualities and elasticity to cheap varnishes. The average price at which it is sold is 60 cents to 70 cents per gallon, and merits the painter's careful examination. Its color is pale yellow and the oil has a tallowy or dripping odor. It is used also in soap making and as an illuminant.

POPPY SEED OIL is used in paint and varnishes to some extent in Europe, but in this country mainly in artists colors. It is expressed from the seed of the poppy plant which grows in the eastern countries about the Mediterranean Sea and in Asia and Africa, and is the plant from which opium is obtained. The seeds contain about 60 per cent. of oil. Its color is light yellow or white. The drying qualities are good, and it does not turn yellow so readily as linseed oil.

WALNUT OIL expressed from the fruit of the walnut tree, growing in Europe and America, is another drying oil used extensively in Europe. The fruit contains from 40 to 50 per cent of oil.

Of other drying oils might be mentioned Hempseed, Candle nut, Castor, and Cedar nut oils.

SPIRITS OF TURPENTINE is obtained from the resinous sap of several varieties of pine trees. The domestic supply comes from the southern pine, which grows profusely in all the south Atlantic and Gulf Coast States. The trees are boxed in March or April, that is, V shaped apertures are cut in the trunk, so made as to retain the sap, or oleo resin as it exudes. The resin is dipped up from time to time, and when sufficient is collected, it is placed in a copper still of large capacity. When heated, the turpentine is distilled off with water which is gradually introduced into the still to regulate the temperature. The resulting distillate separates into two layers, the lower one water on which the turpentine floats as the upper layer.

Turpentine has drying or oxidizing properties to a marked extent, and for this reason, is an excellent thinner for paints and varnishes. On account of this property it has a tendency to bleach or lighten paint or varnish as it dries, whereas, in using benzine for the same purpose, in fact, any of the lighter mineral spirits, yellowness is sure to follow either in white paint or varnish. Turpentine is used in all the better grades of oil varnishes, in the rubber industries and recently in the production of camphor. It is often grossly adulterated with benzine, kerosene, coal-tar naptha, rosin spirit and similar substitutes.

The specific gravity of turpentine is 0.864 to 0.868. By taking the specific gravity you can readily discover the purity. A simple test is to moisten a piece of white paper with the sample to be tested. If pure, it will entirely evaporate and leave no residue, while if kerosene, mineral oil, or rosin is present, an oily residue remains.

Let a small quantity evaporate in a cup. Rosin oil will remain as a sticky deposit and when ignited give the odor of rosin.

Concentrate by partial evaporation a small quantity of turpentine and note the odor of the concentrate. If petroleum is present, it can be detected in this way. Fill two deep glass vessels, one with pure, the other with the suspected sample. Hold the vessels over a piece of black paper and look directly down into the liquid. Petroleum or benzine is indicated by a blueish yellow bloom or cloud.

Shake the sample in a small bottle; if pure, the bubbles formed should at once disappear. The specific gravity is also changed by adulteration.

Ten barrels of crude turpentine produce two barrels of turpentine spirits and six barrels of rosin. Bear in mind that turpentine assists paint and varnish to dry, while benzine and other light mineral oils, having no oxidizing properties, cause paint and varnish to dry more slowly and tend to produce yellowness.

The residue in the turpentine still is common rosin or colophony; this varies in color from transparent white to almost black. The first season's crop of rosin is pale. Each succeeding year that the trees are tapped the rosin residue becomes darker. The trees seldom admit of tapping for more than four or five successive seasons.

Careful methods in the process of distillation will produce a lighter rosin than otherwise, in particular, if pains are taken not to push the distillation too far, but rather to allow a little turpentine to remain behind with the rosin.

Rosin is graded according to its color. The usual brands are:

WW	Water White
WG	Window Glass
N	Very Pale
M	Pale
K	Low Pale
I	Extra No. 1
H	Standard or No. 1
F	Extra, No. 2
E	Standard, No. 2
D	Extra Strained
C	Dark Strained
B	Black Strained
A	Black

All these grades are strained, freed from dirt and impurities, except the A grade.

ROSIN OILS are produced by distilling rosin.

Large cast iron stills are used for this purpose and a fair grade of rosin gives the best results. The addition of 5 per cent. of paraffine oil to the rosin to be treated will ensure lighter and better products and increase the yield of lightest colored oil.

The products of distillation are, first, resin spirit (pinolin) which can be used as a solvent. It closely approaches turpentine in its general characteristics save that the resinous or slightly tarry odor is present unless it has further treatment to deoderize it. It is sometimes used in place of turpentine and is somewhat cheaper.

Second, pale rosin oil, or so-called first run, a light colored oil, of bluish cast and moderate body.

Third, blue rosin oil, or so-called second run, rather dark and heavy.

Fourth, green rosin oil, or so-called third run.

Fifth, the residue, which is a more or less solid pitch, suitable for iron varnish, shoemakers' pitch and like purposes.

Pale, or first run rosin oil is most suitable for refining. This is done by boiling it with direct steam, washing with hot water and treatment with soda lye and further boiling and washing.

The oil is bleached and further deoderized by heating it with indirect steam and passing a current of warm air through it by means of a blower.

The resulting product is an oil free from resins and acid, and will dry without cracking or stickiness. It is, therefore, suitable as a paint oil and in the manufacture of varnishes and lacquers.

Refined rosin oil is also used in printers' ink, lubricating oil and in the manufacture of preservatives, soap and medicinal preparations.

VENICE TURPENTINE is an oleo resin from the European larch tree and resembles very closely the crude turpentine of our southern pine. The crude resinous sap is prepared for use by simply driving off the moisture (water) by the aid of heat and straining. In this form it is found on the market, of pale yellow color, transparent and about the consistency of strained honey. The odor is somewhat the same as turpentine. Venice turpentine, unlike ordinary turpentine resin, does not fluoresce or turn white. It is used to some extent by decorators in sizes to give elasticity and adhesiveness and, likewise, in shellac varnishes to counteract the brittleness of that gum; also in the manufacture of sticky fly paper.

PETROLEUM SPIRITS are the lighter products obtained in the distillation of crude petroleum or mineral oil. Similar products are obtained in distilling bituminous shales, natural asphaltums and crude gas tar.

When crude mineral oil is subjected to distillation, the resulting products are, first, the gasolines, as they boil and volatalize at low temperatures. There are three gravities of gasoline in common use. The lightest is so extremely volatile as to be rather unsafe. It is used to enrich gas for illuminating and alone in gas machines and also as a solvent. It is known as 84 degree gasoline.

The next gasoline is commonly called stove gasoline, or 76 degree gasoline and is the one most in use in gas engines, gas stoves for domestic purposes and in cleaning and renovating.

The so-caled 71 degree gasoline is used for similar purposes, but is not sufficiently volatile, especially in low temperatures, to readily gasify.

After distilling off the gasolines, the benzines come over. The one best known and generally procurable is styled 62 degree benzine, or naptha, which name is applied to gasolines also. This is used as a solvent and is largely substituted for turpentine in the manufacture of varnishes and in thinning paint. In the manufacture of turpentine substitutes, this product is largely employed. It can be made almost odorless by chemical treatment and redistillation.

The next product is kerosene, or illuminating oil, which is serviceable, not only in the production of light and heat, but is used to a limited extent in paints and varnishes for special purposes. A good kerosene oil should be free from any unpleasant or marked odor and should not flash (take fire) under 150 degrees Fahrenheit.

A somewhat heavier oil suitable for illuminating purposes called 300 degree or solar oil is used to advantage in preparing signal oils.

The further products of crude oil which come over at higher temperatures or remain in the still as residues to be further treated are paraffine oils, the heavier lubricating oils, vaseline, paraffine wax and a dark residue used as a coarse lubricant and in cheap heavy axle greases. All these products from the crude petroleum, after distillation, are subjected to further treatment in order to deodorize and clarify or refine them suitably for the purposes intended.

Coal tar naptha is the light product distilled from coal tar. It resembles benzine, but has a tarry odor. As a solvent in paints and varnishes, it can often advantageously replace turpentine where cheapness is an object.

GRAIN ALCOHOL is produced by fermentation and distillation from all grains, potatoes, beet root residues and, in fact, from any substance containing starch or sugar in appreciable quantities.

The first step in the production of alcohol from starchy substances, such as grain or potatoes, is to form a mash with water and allow this to be acted upon by malt. The diastase in the malt converts the starch into sugar. The next step is to add yeast, whereby the fermentation produced causes the sugar to become alcohol.

The alcohol is distilled off, together with some water and concentrated by further distillation.

In a general way, this is the method used in the production of all spiritous liquors. Whiskey and similar spirits contain about 50 per cent. alcohol. Pure alcohol, spirits of wine or proof spirit, contains 95 per cent. of alcohol.

Alcohol and other liquors require purification after being distilled, to rid them of fusel oil, which is ill smelling and very poisonous.

Amyl Acetate is made from fusel oil and finds useful application in the production of various collodion varnishes, lacquers and bronzing liquids. Grain alcohol has varied uses. To the painter, it is of importance in the manufacture of shellac and spirit varnishes, stains, etc.

WOOD ALCOHOL is obtained in the dry distillation of wood. When wood is thus treated in closed retorts, the products yielded are acetic acid, tar and wood spirit.

The tar readily separates from the watery liquid containing the other products.

The watery liquid, or wood vinegar is distilled. Crude wood spirit first passes over and then acetic acid. The crude wood spirit is further purified by rectification. Wood alcohol is suitable for all purposes where grain alcohol is used in the paint and varnish industries, and can be substituted for it with advantage. The ordinary spirit is 95 per cent. pure.

Absolute wood alcohol is placed on the market under several names and differs from the ordinary article in that, the little remaining water has been removed and the spirit deodorized. The only real advantage it possesses is the absence of odor and the fact that it dissolves resins somewhat quicker than when the ordinary spirit is used.

CHAPTER VI.

VARNISHES.

The term varnish is used to designate any solution, which, when spread with a brush in a thin layer on the surface of an object, dries with a smooth, lustrous, transparent film.

The principal ingredients used are gum resins, linseed oil, turpentine, benzine and suitable dryers for oil varnishes; and gums, resins and alcohol for spirit varnishes; the latter, as a rule, are simple solutions of gum in spirits, and while quick drying and of fair utility, are necessarily brittle and not able to stand wear and tear.

When gums or resins are dissolved by the aid of heat with the addition of prepared or boiled linseed oil, and thinned with turpentine or benzine to the proper consistency, we have, in a general way, defined oil varnishes, which, because of the oil entering into their composition, have added elasticity and increased durability over spirit varnishes.

Two essentials are needed to produce good varnishes; suitable materials of good quality and skill in making, to adapt the varnish to the purpose for which it is intended.

The gums or resins in common use are known as zanzibar, angola, sierra leone, benguela, kauri, manilla, damar, (both Batavian and Singapore) shellac and rosin.

Zanzibar, kauri, and manilla copals enter into the great bulk of the oil varnishes, except the cheaper grades which are made from rosin.

Zanzibar and other copal gums, as well as kauri are fossil or semi-fossil resins, which had their origin in resin producing trees long extinct. These gums, having been in the ground, hardened in the course of time. The same gums are still being produced from similar species of trees in the various localities from whence the fossil varieties are obtained.

Manilla copals come from several species of trees growing in the Philippines, the principal source being from the Bread tree. Varieties are also met with in Mexico and Brazil. This gum resin is soft, in fact few degrees removed from ordinary rosin save from the fact that it has some elasticity.

Batavia and Singapore demars are soft gums, used mainly because of their transparency and absence of color. The first is from the East Indies and the Phillipines, produced by the Amboyna pine tree, while Singapore demar comes from a somewhat different species of tree which grows in British India and the islands before mentioned.

Shellac comes from southern Asia and the East Indies. It is produced by an insect which lives on several varieties of trees and shrubs.

These insects puncture the trees and are covered by the exuding juices. The formation due to these burrowings is reddish brown in color and consists of coloring matter, wax and resin. This is crude shellac. The best qualities are those collected before the insects have escaped from their envelopment. The crude product is termed stick lac, being the crude shellac adhering to the twigs and branches on which it is formed.

The product is ground, cleaned and treated with weak caustic soda and then with alum which removes some of the coloring matter. It is then dried, melted, run into heated flat moulds, taken from thence hot, and spread over a hollow cylinder filled with warm water. The layer formed is smoothed, detached and dried in an airy place. It is a very brittle substance, softens with heat, and is inflammable. It is partially soluble in alcohol and fully so in alkalies and borax solutions. Shellac is marketed as stick lac, which is the crude shellac adhering to the twigs on which it was formed, button lac or melted shellac, free from woody fibre and other foreign matter, and the various grades of refined shellac. Of the latter, there are two principal divisions; the so-called native shellacs, prepared by crude methods, and characterized by their dark color and slight impurity, and the carefully treated shellacs graded according to quality under various brands ranging in color from pale orange to light brown. White, or bleached shellac is made by several processes. In a general way the treatment is as follows: The shellac is dissolved in a solution of carbonate of soda or other alkali, a certain proportion of chloride of lime is added, and, after standing a day or two, the gum is precipitated with hydrochloric acid, washed and dried.

Shellac is used largely in spirit varnishes and in the preparation of shellac japans. It is used for various purposes in the arts also.

Asphaltum, the base of most black varnishes, is a black pitch-like substance, found as a natural deposit in many localities throughout the world. It varies much in hardness, color and elasticity. A pitch of similar nature is left as a residue in the distillation of coal tar and from some kinds of crude petroleum. The hard asphaltums, because of their brittleness, make less durable varnishes unless a sufficient amount of linseed oil is added.

Certain cheap black varnishes are made by simply melting cheap grades of asphaltum and reducing the product with benzine. During the process of melting some black manganese is added as a dryer.

Rosin is produced as before mentioned, in the manufacture of turpentine.

Two other gums are used in spirit varnishes; mastic and sandarac. The best quality of mastic is produced by a tree of the cashew-nut order, growing in the islands of Greece. The rosin exudes from the bark where cut, in the form of tears. It has a pale yellow color and is brittle and fragile.

Sandarac is a pale yellow resin, produced by a conifer growing in Algiers. It is soft and brittle, somewhat like mastic. These gum resins are used in certain lacquers, but mainly in spirit varnishes prepared and used by artists.

The better grades of varnishes are made almost wholly from zanzibar and kauri gums, because of the hardness and durability of these resins. While not so hard as some others, kauri gum in particular, is easily worked and free from the objections found in many others.

Carriage varnishes, exterior finishes and the better interior varnishes contain these gums. Manilla copals are used mainly in the medium and cheaper grades for interior use. Damar varnish is usually a simple solution of the resin in turpentine or benzine prepared with or without the aid of heat. The cheaper grades of demar varnish are largely adulterated with white rosin which is easily dissolved in the same solvents.

The very cheap varnishes are made from common rosin treated in various ways, with the idea of hardening the rosin and rendering it, if possible, less liable to the action of dampness or moisture which causes rosin to fluoresce or turn white. The extreme brittleness of rosin and its likelihood to soften at a lower temperature than most other gums, compels special hardening treatment to be resorted to. Some very fair interior varnishes are now produced from rosin by processes too lengthy to describe here. There are a multitude of brands of varnishes adapted to various and special requirements in the arts. We shall only consider the ones of immediate interest to the painter.

The brands, names and kinds of varnishes for carriage and exterior and interior house work are legion, yet they admit of simple classification and in many cases, differ only in name and price. In the first class are varnishes containing from 20 to 30 gallons of linseed oil to the 100 pounds of gum. This includes the wearing bodies and all carriage and other exterior finishing varnishes; the so-called spars, marine and the better grades of inside finishing. They are made from zanzibar, kauri, or a mixture of the two in varying proportions. In a general way, therefore, any good grade exterior finishing is adaptable to practically all the uses for which the hundreds of outside finishings under many and divers names are recommended.

Interior finishes are usually made from lower grades of kauri, manila, and some rosin, with somewhat less oil. You, therefore, never go wrong in doing inside finishing on woodwork with a spar or exterior varnish, unless rubbed work is required. Hard oil finishes, interior coach, number one furniture, number one coach, and similar varnishes are made from low priced gum and rosin, with from 6 to 10 gallons of oil to the 100 pounds of gum, and the thinner used is apt to be in part, at least, if not wholly, benzine, for the price at which these varnishes are sold does not admit of anything else. These cheaper grades of varnish yellow with age, because of the benzine they contain, and turn white and perish easily, because of the small amount of oil and the nature of the gum used.

Under short oil varnishes are classed all rubbing varnishes, whether for carriage, furniture, or house use. The best grades contain gums similar to those used in the exterior finishes and from 6 to 10 gallons of oil to the 100 pounds of gum. The cheaper grades of rubbing contain cheaper gums, and some rosin. Floor varnish is a compromise between a short oil, hard drying varnish, and a varnish of the so-called long oil variety. It must have hardness and elasticity combined.

Cheap hard oils, furnitures, copals, ceiling, and sizing varnishes are made mostly from rosin or very low grade manila and rosin mixtures, thinned with cheap solvents. Some of these cheap varnishes are very good for the purposes intended, as the art of producing good cheap varnishes has been made a special study. The trouble is that the purchaser usually expects too much from cheap varnishes and is, therefor, disappointed.

What does it cost to make an ordinary gum varnnish?

100 pounds of ordinary kauri gum, at 32c.	$32 00
10 gallons prepared linseed oil, at 60c....	6 00
25 gallons turpentine, at 60c.............	15 00
	$53 00

The yield would be from 35 to 38 gallons and the cost of the raw materials entering into each gallon of varnish approximately, $1.40 per gallon, to which must be added the cost of manufacture and the dozen and one other items of expense which the manufacturer must bear. Manilla varnishes can be made somewhat cheaper. The bare cost of material in the making of a cheap pure gum varnish can hardly be brought under one dollar per gallon.

The linseed oil used in oil varnishes is boiled with the addition of certain so-called dryers, of which red lead and certain compounds of manganese treated in various ways are the most important. The drier is introduced into the oil, either direct or through the medium of the resinates or oleates of lead and manganese.

Liquid dryers are made by heating together some compound of lead or manganese with linseed oil or rosin and thinning the mixture after proper treatment with turpentine or benzine, to what is considered proper strength to be put on the market. They owe their drying power to the fact that salts of lead and manganese have the property of combining with oils and resins to form oleates and resinates of these metals, lead and manganese. These oleates and resinates are soluble in oil, turpentine and benzine and impart the drying properties to the oil in the paint into which they are introduced. They hasten the oxidation or drying of linseed oil by acting as carriers of oxygen from the air to the oil.

Linseed oil gains from 14 to 16 per cent. in weight in drying, due to the oxygen it absorbs.

Japan dryer and other heavy bodied siccatives are made in the same general way as liquid dryers and owe their body to the addition of gum resin or shellac and the use of less reducer.

In the fabrication of oil varnish, the gum resin to be used is carefully sorted and a definite amount, usually 100 to 150 pounds, styled a "batch," placed in a large kettle, preferably of copper. The capacity of such a kettle is usually from 75 to 125 gallons. The kettle of gum is placed over a hot fire of coke and the gum carefully melted, either with or without covering the top of the kettle. When no cover is used, it is styled an open melt; when the gum has properly melted, prepared linseed oil is added and the mixture further heated and stirred and dryer added if necessary. The kettle is then drawn from the fire, allowed to cool sufficiently and then turpentine or benzine is added in sufficient quantity to give a proper varnish body to the mixture when cool. The varnish is then carefully filtered and tanked for sometime, as ageing materially improves oil varnishes.

Cheap varnishes are simply filtered and are then ready for the market.

Many special processes have been introduced, and particular methods of procedure, but in a general way, the foregoing gives the processes in common use.

To test the quality of liquid and Japan dryers it is only necessary to add the dryer to pure, raw linseed oil in the proportion of one part of dryer to ten parts of oil. Mix thoroughly, and spread in a thin film on glass and allow the film to dry, observing the length of time required to cause the oil to become tacky, dust free and dry.

A good dryer should dry twenty parts of oil in 12 to 24 hours at the longest. Other features of the dryer can be observed also. The dryer should mix readily with the oil, otherwise if it separates and is insoluble, it can be put aside as of little value. The behavior in drying should also be noted. The film of oil should dry smooth and free from crinkles and striae or other imperfections. Comparisons between different dryers can be made easily by this method of adding fixed, accurately measured proportions of dryer to raw oil and observing the action of the mixtures side by side. A fluid ounce of liquid contains 480 drops. 24 drops of dryer to the ounce of raw linseed oil would be about 1 part to 20.

Varnishes can be tested by spreading them on glass and observing their action in drying and the nature of the surfaces they produce. Exposure to steam and the weather will develop their wearing qualities or lack of them.

CHAPTER VII.

READY MIXED PAINTS, KALSOMINES, ETC.

The use of ready mixed paints seems to be a thorn in the side of the average painter, and in some cases with reason. The market has been flooded with miserable, grossly cheapened and adulterated mixtures which, at one time, well nigh ruined that branch of the business, and prejudiced many, for all time, against their use. On the other hand, many good brands are on the market, which give excellent satisfaction, cover fairly well and are durable. They are carefully and scientifically prepared and have many of the merits claimed for them. None cover, *mask* so well as straight white lead and oil, because they contain, in practically all cases, 50 per cent. or more of other pigments than white lead; notably, oxide of zinc. These pigments do not have the opacity, or what the painter calls covering power, of white lead. The introduction of over 50 per cent. of white lead in a ready mixed paint would cause the pigment to settle or "bake" in the bottom of the can and interfere with the slight emulsification of the oil which aids in holding the pigment in suspension and making a good paint solution. The fact that zinc and other bases are used with white lead explains why ready mixed paints do not chalk so readily, being in this sense, more durable than white lead and oil. The cheaper ready mixed paints and most so-called best grades contain whiting, paris white, silica, lithophone, or barytes in various proportions, in addition to lead and zinc. They cover poorly and while the pigments used may not seriously affect the wearing qualities, except to cause cracking or peeling of the paint, yet the emulsion of oil and water is overdone to such an extent as to largely kill the binding quality of the oil, and just here is the serious fault in these cheap grades.

In the manufacture of the ordinary shades, a white base, composed of one or more of the pigments before mentioned, is ground and to this is added raw linseed oil, turpentine or benzine, dryer, tinting color, and usually, more or less solution to hold up the pigments properly. The following would be a good example of a first grade paint:

White lead	150	lbs.
White zinc	150	"
Raw oil	20	gallons
Dryer	2	"
Turpentine	2	"
Solution	2	"

Such a paint would cost for material, labor, packages, etc., over one dollar per gallon.

In a cheap paint, zinc and barytes would be the pigments and a larger percentage of solution and benzine. If you wish to make a cheap paint yourself, there is no reason why it can not be done by extending the oil with some solution which will combine and form an emulsion with it. The use of such paint is justified on cheap work, particularly interiors. Such solutions can be made as the following:

Dissolve 1-4 pound of the best glue, gelatine preferred, in sufficient hot water. Dissolve 2 pounds of sugar of lead in water and add these two solutions to enough water to make 12 gallons.

Another solution is made with 5 ozs. of silicate of soda; 2 ozs. of carbonate of soda; and 2 ozs. of borax in 2 gallons of water. Mix this solution with raw linseed oil to any proportion desired, or mix in pure linseed oil paint. This solution is best adapted to paints in which the pigments are neutral or the iron oxides such as ochre, venetian red, metallic brown, etc.

Some of the poorer or cheaper grades of ready mixed paints and metallics used for barn and roof work contain from 25 to 40 per cent. of solutions of the above nature.

Some few of the best ready for use paints now on the market are free from solutions or practically so.

KALSOMINES and cold water paints are of interest to the painter, even though he may still prepare his own with whiting, glue and hot water.

The ready made hot water kalsomines are similar in composition, in dry form, except that vegetable albumen replaces the glue in some cases. Terra alba or some other white may, in part, replace the whiting. The cold water varieties are of the same nature, except that the glue is rendered soluble in cold water, or they may be composed in the main of gypsum, or plaster of paris, with some additional binder added.

The exterior cold water paints, in fact, practically all of these preparations which are warranted to withstand moisture, owe that property to caseine and lime. The base is whiting or some similar white with from 8 to 10 pounds of caseine, and about an equal amount of lime thoroughly mixed with each 100 pounds of base.

The lime is necessary to dissolve the caseine in water, and on drying, the compound forms a binder which is insoluble and hence, resists moisture. Other alkaline salts can be used in place of lime.

Caseine is a glue like substance made from milk curds, free from grease. It makes a splendid wall size, but the price is more than that of good glue. In order to mix it for use as said before, the addition of an alkaline salt, such as ammonia, sal soda, or lime is necessary to make the solution.

GLUE AND GELATINE is the animal matter contained in bones, sinews, hide and similar substances, of animal origin. It is procured by boiling out the glue forming substances with the aid of water, or by dissolving, in the case of bone, the mineral matter with acid and further dissolving the residual gluey matter. These watery solutions of glue are evaporated to free the glue from moisture, as far as possible, without injury. The concentrated solution is run into moulds, cooled, cut into thin strips and dried. The cheap glue ground and in flake form is bone and offal glue made by simply boiling with water to dissolve out the glue, with the final treatment before mentioned. Such glues have, usually, very little strength. The stronger glues and gelatines are those made from hide, or gelatine glue made from bone by the acid dissolving process.

For any purpose whatever, good glue or gelatine should be used, for, while cheap glue will sometimes scarcely geletanize in 10 parts of water, good glues may geletanize in 30 to 50 parts of water. The white, or opaque glues owe their color to the introduction of zinc, barytes, or some like substance to whiten them. They rather detract, than add to the value.

Isinglass is that form of gelatine made from fish bladders.

BRONZES are made from the powders resulting from the forging metals, mainly copper, iron, zinc, and tin. The powdered metal in the course of preparation is ground and heated with a little oil, grease, wax, or paraffine, and the resulting superficial oxidation produces the bronze. Some bronzes are also made by a solution and precipitation of the metal in a finely divided state. Bronze powders are largely imported from Germany and England. Of gold bronze, there are but three varieties of consequence, but sold under a variety of names, and prices to correspond. Radiator, or cheap bronze, a medium grade, and leaf bronze. The better bronzes are usually more finely powdered and should be more brilliant. Bronze is judged by its color, lustre and fineness. For fresco work, brilliancy is the all-important feature, and may be present to a more marked degree in a cheap bronze, than in a better grade. Aluminum bronze has largely taken the place of the so-called silver bronze, as aluminum is less apt to tarnish than the metals used in making the ordinary silver.

GUMS.—The so-called gums used in varnish making are in reality resins in contra distinction to the true gums. Resins are but slightly, if at all, soluble in water, while the true gums are fully soluble in that substance.

Gum Arabic and dextrine are the most important outside of starch and flour, which, when boiled, present the gummy nature also.

Gum Arabic is a product of the Acacia, growing in some parts of southern Asia, the East Indies and northern Africa. It is a white, or light yellow, transparent gum, soluble in hot water. A standard solution consists of 1 oz. gum Arabic, dissolved in 2 ozs. of boiling water.

Dextrine, or *British Gum* is prepared from starch by treatment with acid and heat. It is less adhesive than gum Arabic.

Starch is made from grain, potatoes and some bulbous roots, mainly, however, from corn and potatoes. To make starch solution, the best plan is to mix the starch in powdered form in enough cold water to make a cream like paste and add this mixture slowly to boiling water of sufficient quantity to make a jelly-like mass, which can be thinned as desired.

WAXES.—The principal waxes of interest to the painter are bees' wax, carnauba, ceresin and paraffine.

Bees Wax is the best known. The crude wax is frequently bleached for use where whiteness is an object, by spreading it in thin layers and subjecting it to the action of sunlight. The melting point varies with the hardness of the wax. The average being about 140 degrees Fahrenheit.

Carnauba Wax occurs in thin films on the leaves of a palm growing abundantly in Brazil. It is hard, somewhat brittle, and melts at 183 degrees Fahrenheit.

Ceresin is a form of paraffine wax resulting from the purification of ozokerite or mineral wax found in nature.

Paraffine wax is obtained from tar in the destructive distillation of wood, coal and other bituminous formations and from crude petroleum. Very few chemicals have any action on it, as it contains several of the least alterable organic compounds. It is, therefore, superior to bees-wax or any vegetable wax for this reason. Its melting point varies from 86 degrees Fahrenheit to 176 degrees Fahrenheit, or thereabouts. The higher the melting point, the harder and denser is the wax. Waxes are soluble in turpentine, benzine and oils.

SMALT was originally glass and other vitreous mixtures containing oxide of cobalt. As found in the market at the present time, it is composed of coarse silica, or some silicious substance, which has been stained with pigments of various colors, mixed in a suitable medium, or by the use of analine.

CHAPTER VIII.

VARNISH AND PAINT TROUBLES AND THEIR REMEDIES.

It is of importance to observe the action of a drying oil, of which linseed oil is the most used, and can be taken as the best example.

It is seldom used alone, but mixed with resins as varnish, or with pigments to form paint. These mixtures, varnish and paint, are applied to a variety of surfaces, such as wood, metal, plaster and stone, substances differing materially in their physical characteristics.

While, of course, the decorative effect of varnish and paint is of great moment, the protective effect, in most cases, is the important feature, as the action of rain, moisture, heat and air, cause wood to discolor and become fibrous, or rot and mould. Unpainted metal, exposed to atmospheric conditions will rapidly rust or oxidize, particularly iron. The surface rust holds the moisture and the iron is rapidly corroded until it may be, in great measure, destroyed.

Plaster is very absorbent and quickly takes up moisture and though it will dry again, the numerous changes causes it to scale or disintegrate and thus be destroyed.

Stone surfaces, in some cases, through similar agencies, will scale or discolor and become unsightly. A layer of oil paint applied to these surfaces, by protecting them from external influences, will prevent all this in great measure, while the coating remains in good condition as a protective covering. With absorbent substances, such as wood and plaster, added protection is given in that some of the paint is absorbed by the pores, and becomes a part of the substance to which the paint is applied.

Now, what is the influence of atmospheric and other external agents on the protective coating of drying oil itself? In the first place, the drying oil, whether in varnish or paint, gradually hardens by the absorbtion of oxygen from the air and the action of heat, whether from the sun's rays or other sources, until at length, the coating loses its binding qualities, and the varnish or paint disintegrates and perishes.

The duration of the life of the coating will depend on the quality of the drying oil and the action or non-action of the resins or pigments with which it is combined, also by the proportion of oil used. The greater the proportion of oil, the more lasting the coating will be.

Metals, being non-porous, and having the paint entirely on the surface, the coating is shorter lived than on more porous substances.

Of the other agencies which work destruction to the oil may be mentioned rain, fog, and snow, air currents, dust, dirt, or sand, smoke gases and the nature of the pigment used. The practical life of paint on metal work exposed to the elements is scarcely more than two years, while on wood or plaster, five years is the most that can be reasonably expected. The action of rain, snow, and fog, aided by wind currents, can be readily understood by observing the side of a house which is exposed to the quarter from which prevailing storms come.

Wind will also drive dust and sand with more or less force against the protected surfaces and the mechanical action of such substances is much the same as that of the sand blast, though, of course, far less severe.

The action of smoke gases, as has been mentioned before, is of a chemical nature, due to the formation of sulphurous acid from the chemical action of the gases, and steam, which rapidly attacks the oil binder. The action of certain pigments on the oil is very marked and has been previously referred to.

Red lead forms a hard solid coating when combined with drying oil, due to chemical action of the pigment in causing a more rapid oxidation, or drying of the oil and the added fact, that in such paint, less oil is used than for most other pigments. Oil is the life of the varnish or paint.

The pigments in ordinary use require the following proportion of oil to form a substantial paste of about equal consistency before thinning:

White lead,	8 to 10 per cent.
Red lead,	6 to 8 per cent.
Oxide of zinc,	15 to 20 per cent.
Barytes,	8 per cent.
Chalk,	20 per cent.
Chrome green,	10 to 12 per cent.
Oxide of iron,	10 to 12 per cent.
Umbers,	20 to 30 per cent.
Ochres,	15 to 25 per cent.
Siennas,	30 to 40 per cent.
Chrome Yellows,	12 to 18 per cent.

These proportions vary some, however, as pigments of the same nature differ considerably. Crystalline pigments in general, take less oil than those of a clayey nature. Dried paint will be quickly destroyed by all alkaline solutions, such as potash, soda, or ammonia; acids will also destroy paint, especially those which fume or give off vapor. Heat is a destroyer of paint or varnish. The higher the temperature, the more rapid the action. The protective film becomes rapidly hard and brittle, loses all elasticity and pliability and when changes in temperature occur, causing expansion, or contraction of the substance coated, the covering, no longer elastic, cracks and scales. Thus, we account for much cracking on old painted woodwork and iron.

Heat also yellows white paint and darkens light shades, as it causes the oil to yellow or darken.

We have noted, in general, the destructive agencies to which varnish and paint is subjected. Let us observe the specific troubles met with, first in varnish, and then paint in its order; considering the necessary requirements to form varnish and paint of a satisfactory nature.

Varnish should be pale in color. It should be clear and transparent, and of such consistency as to be easily applied with a brush. The varnish when dry should have the appearance of glass. It should be flexible and elastic, and show no defects when dry. In applying varnish, many defects are observable, and their origin is often hard to trace. These defects may arise from faulty manufacture, defective surfaces on which the varnish is spread, changes in temperature, dampness, or by being improperly applied.

Sweating—This arises from two causes; either the varnish contains too much oil for the amount of gum and solvent used, or it is due to the varnish being applied to a surface not perfectly dry. To remedy this, allow the varnish to dry as perfectly as it will, so that it may sweat to the full extent. It is then rubbed down with a soft rag with or without fine pumice and a fresh coat of varnish applied. This trouble occurs mostly in the more durable exterior varnishes. When the varnish shells off, it indicates that too little oil has been used in its manufacture, or that the varnish coat is exposed to excessive heat. When the varnish does not contain enough solvent, the resulting layer is too thick and the surface yields a skin, while the layers beneath remain viscous and it forms folds and wrinkles. This may also occur fróm a sudden change of temperature, or second coating before the first is dry.

The appearance of striae, or air holes indicates that too much dryers have been used, and it has not been allowed to age properly.

Pinholes may be caused by mixing varnish of different qualities.

Varnish spots or chills, when applied at too low a temperature.

Varnish will draw or pull if the surface on which it is put has not been properly prepared.

A greasy surface causes unequal coating and a tendency to separate or crawl.

When under the influence of too much heat, varnish blows or blisters.

Blooming.—If moisture condenses on wet varnish, the surface is covered with a velvety covering called bloom. Sunlight and dry air should remedy this.

Gas fumes and rapid changes of temperature at the time the varnish is applied may produce the same effect.

Noxious gases and the use of too much benzine in reducing will cause varnish to turn yellow.

Varnish containing little oil and made from rosin will frequently turn white on exposure to dampness and atmospheric conditions.

Varnish will sometimes become dull or flat when applied. This flatting or deadening is due to excessive dampness, in the atmosphere, dampness of the surface to which it is applied, a porous surface, or an undue amount of dryer used in its manufacture. This deadening does not always occur immediately, but sooner or later after its application.

GOOD OIL PAINT should contain pure drying oil of known quality and only such pigments as do not act injuriously on the oil binder. It should cover and spread well and not pull under the brush, neither should it contain an excess of thinners. It should not contain an excess of dryer and when it is spread should dry to form an elastic coat, free from imperfections.

In painting, the first requisite is to have the surface to be coated perfectly dry, free from oil or grease and in proper condition to receive the paint.

Much trouble can be prevented by taking these precautions.

Crawling or separating of paint may be caused by a greasy or glossy surface underneath, or the chilling of the paint when applied at too low a temperature.

Paint will run or adhere poorly to a surface if an excess of oil has been used in its preparation. It will draw or pull if too little oil has been used, or when applied on a poorly prepared surface. Paints containing mineral colors and the so-called neutral pigments, do not work so smoothly under the brush as white lead paints. In the latter case, the lead forms a smoothly working compound with the linseed oil.

Paint will often lose its gloss if covered with frost or moisture before it has dried. When paint is applied too heavy, it is apt to crinkle or form folds in drying. It may also sag under these conditions.

Blistering may arise from several causes, the most common of which, is moisture, which existed on the surface of the work when coated, or which was contained in the wood from water getting behind the weather boards. The heat from the interior of the building or the heat of the sun will frequently drive or draw out the moisture and where such action occurs, the layer of paint, if still elastic, loosens from the wood and forms blisters.

Sappy resinous wood will act in the same way. The use of heavy boiled oil, or thickened linseed oil has a tendency to blister when exposed to the sun's rays before the coat is perfectly dry and hard. Paints which are too elastic and pliable are liable to this trouble.

Cracking, peeling, or alligatoring—these troubles may arise from moisture in the wood escaping after the paint has become hard, but is generally caused by the paint becoming so hard as to lose all elasticity. Change in temperature and the expansion and contraction of the wood or metal, you can readily understand, will cause all these conditions when the paint is no longer pliable. Lead paints, in drying, remain elastic for a long period, and hence, are not so prone to these troubles as zinc and other neutral pigments in which the paint dries hard. It must be said in all fairness, however, that these neutral pigments may not begin to crack or peel, until after a lead paint applied at the same time has chalked very considerably. Under coats of old paint frequently cause cracking and peeling. Putting a coat of paint which dries quickly over one which contains much oil or varnish, and which has not become thoroughly dry, produces cracking.

The use of too much dryer, or too little oil is a frequent cause of paint cracking and deserves special mention. The necessity of killing all knots and resinous or sappy places in the surface of wood, with a suitable coating must be born in mind, as this is a frequent cause of blistering. Raw oil is superior to boiled oil, as it is more durable, less likely to crack or blister and being more penetrating, enters into the pores of the wood better, forming a hard, tenacious filling, as well as coating.

Avoid the direct rays of the sun on fresh paint, as far as possible, as this is a frequent cause of blistering. The priming coat of paint is by far the most important and the best materials should be used for this. Raw oil and the earth colors, such as ochre (previously ground in oil) should be used. The addition of 25 per cent. of white lead will improve the coat. Never use *dry* ochre. Zinc white is a poor primer, because of its tendency to peel off. The priming coat should not be heavy.

CHAPTER IX.

PAINTING AND DECORATING.

Wood Work.

In General.—The surface to be treated, in all cases, should be sandpapered or rubbed with medium steel wool to give an even facing on which paint or varnish will spread easily, and must be free from dampness from any source.

For Exterior Work.—After the surface is in proper condition, apply shellac to all knots, prime or first coat the work with a paint somewhat lighter than the final color to be used. The priming, in fact, all under coats, should contain some turpentine, otherwise the last or gloss coat (which should be almost entirely free from turpentine) will not adhere well to the under coat. All puttying is done after the first or priming coat has been applied.

For exterior varnishing, two or three coats of any good outside varnish can be used, no other treatment being required, except to have a suitable surface for the application of same.

For Interior Work.—Prime, or first coat on the previously smoothed or properly prepared surface and putty in the usual way. A thin coat of shellac before priming will cause the paint to stand out better and is an advantage. Proceed as in the painting of exteriors. When a dead flat surface is desired in the finishing coat, mix the paint for that coat with thinners composed of 8 parts turpentine, 1 part linseed oil, and 1 part dryer. In repainting old work inside, it is well to coat the whole surface first with shellac to prevent the old color striking through and thus altering the shade or color of the newly applied paint.

In varnishing interiors it is usual to apply a coat of liquid wood filler as a primer on new work. Putty and follow with two coats of varnish. In fine work on hard woods, paste filler is used; rubbed when dry with fine steel wool, or sand paper, and then varnished. Shellac can be used as a primer in place of liquid filler and answers the purpose very well. When interior work is to be stained, the color is usually added to the filler or first coating, or an oil or turpentine stain applied previous to the application of the filler or varnish.

Work to be rubbed.—To produce the finest effect in varnishing, the final coat is rubbed and polished. This can be done with No. 0 steel wool, fine pumice stone mixed with water, or raw linseed oil, or with rotton stone mixed with the same mediums. Powdered pumice stone, or rotton stone is applied on a cloth and the dry varnish rubbed to a perfect finish. A final polish can be given with any of the polishing preparations recommended for such work in another part of the book. In producing a perfect surface, each coat of paint or varnish should be sand papered, or rubbed before the next coat is applied.

Painting on Plaster.—If the plaster is new, any caustic alkilinity should be corrected. This can be done by applying a coat of linoleic acid or boiled linseed oil. Linseed oil contains naturally linoleic acid in sufficient quantity. If linoleic acid is used, it must be applied warm. A wash of water containing carbonic acid gas will kill the caustic lime by converting it into lime carbonate which is neutral. A coating of liquid silicate of soda may also be used. This forms, with the lime, an insoluble silicate of lime. The above suggestions apply, whether the painting is to be done with oil or water colors.

White lead and raw linseed oil, with litharge dryer, mixed rather thin, is a good wall priming.

When perfectly dry, a second coat somewhat heavier in body can be applied. The second coat may contain 1-4 turpentine. If a third coat is required for very durable work, and a gloss is desired, use 2 parts oil to 1 part turpentine. If a flat finish is desired, use equal parts of oil and turpentine.

A priming of caseine mixed with cement makes a good surface on which to paint.

Fresco or Water Paints.—The best pigments for this work is for white; air slacked lime free from caustic action, so- called mild lime, or paris white. Yellow; raw sienna and the yellow ochres. Red; the red oxides of iron including the copperas reds. Green; green earth (terra verte), cobalt and true chrome greens. Blue; ultra marine and cobalt. Brown; the umbers; and for black; lamp black and ivory black.

The necessary colors for water color painting may be produced from yellow, red and blue. Almost all colors and shades can be produced by proper combinations. When brilliant colors are required, the yellow may be gamboge, red, carmine and the blue prussian; they are not permanent, however.

One part gamboge and one part carmine orange.

Two parts gamboge and one part prussian blue=yellow green.

One part gamboge and two parts prussian blue=blue green.

Two parts prussian blue and one part carmine=violet blue.

One part prussian blue and two parts carmine=red.

By changing the proportions 3 to 1, other shades are produced, and by dilution with water, lighter tints are formed.

In decorating interiors, the principal color used should be one which lights up well. It need not necessarily be a light one.

Positive colors should not be placed side by side, but separated by white, black or gold. The same colors in different shades may be used one upon another. The primary colors, red, yellow and blue, should be used sparingly. Give preference to neutral tints without glaring contrasts.

Dull greens, grays, and browns may be allowed to predominate. Remember that colors on light grounds appear darker by contrast and the reverse on dark grounds. In relief work, the ground should appear darker than the relief, unless gold be used. Let one color predominate over another, and remember that colors have compliments which add to or detract from the beauty of the adjoining color. The compliment of red is green; blue, orange; yellow, violet. Good contrasts are black and warm brown; violet and pale green; violet and rose color; deep blue and golden brown; chocolate and light blue; deep red and grey; maroon and warm green; deep blue and pink; chocolate and pea green; maroon and chocolate; claret and buff; black and green. The colors should blend with the furniture and carpet. If pictures are to be hung, choose low toned neutral tints. This applies also to wall paper. If the room is to be furnished without pictures, a brilliant paper, rich in color, may be chosen with white or pearl wood work and soft, white draperies.

Hanging wall paper.—The walls must be first properly prepared. The treatment varies, of course, depending upon the condition of the walls. If the walls are new, they should be perfectly dry, and if the lime is still caustic it must be treated with some neutralizing substance, as directed in another part of this book. If the walls are damp, they must receive a coating of shellac, or waterproof size, otherwise the new paper will soon discolor and mildew. A waterproof size of thin shellac varnish or shellac water varnish made as directed under shellacs, will answer all purposes. In all cases, walls should have a coat of glue size before being papered. Where very fine work is required, it is advisable to first apply lining paper to the walls which will give a smooth foundation to work upon and will protect the wall paper from stains striking through. In repapering, the old paper should be removed. If left on, it is unsanitary and will render it more difficult to produce a good job. Washing down the old paper with hot water applied with a brush soon loosens the paper so that it readily scrapes off. When the walls are very bad and uneven, battens may be nailed to the walls and burlap stretched over them. The wall paper can be hung on the burlap after it has been sized. If a whitewashed wall is to be papered, the white wash must be removed by moistening it with hot water and scraping.

To determine the number of rolls of paper needed: measure the circumference of the room in feet, deduct the width of the doors and windows and divide by three, which will give the number of rolls required for a room from 10 to 12 feet in height. When the wall is less than 10 feet high, after subtracting the width of the doors and windows from the room's circumference, multiply by two and divide by fifteen.

Light shades of paper make a room more cheerful.

Large figures make a room appear smaller. Low rooms should have a striped paper running up and down to give a heightened effect. If the room has many windows, use subdued tints. It is always best to use quiet colors which do not attract too much attention and which do not render the furniture prominent. Dirty wall paper may be cleaned by preparing a mixture of 4 pounds of wheaten flour kneaded into a stiff dough, with 7 pints of water. Wipe the paper all over with this.

Hints for Interior Decoration.

With antique oak or walnut wood work, the walls may be olive green with gold effects in the frieze. The ceiling may be in russet; the upholstery, red, and the draperies maroon or bronze predominating.

Ash wood work harmonizes well with sage green walls, with sage and dull yellow frieze and cornices; buff ceiling and dull green upholstery, trimmed with red, and draperies to match the wood work and walls.

Brown wood work may have dull red walls, blue frieze, buff cornices and warm yellow ceiling, old gold, red and blue upholstery, and grey draperies.

Cedar wood work blends well with terra cotta or red walls, frieze and cornices lighter reds, ceiling cream; upholstery red; olive and gold and old ivory draperies.

Chestnut wood work may have orange walls, deeper yellow frieze, and cornices toned with red and black; lighter yellow ceiling; upholstery, dull blue, and draperies dull blue and orange.

Cream wood work may have soft warm blue walls; ivory and blue frieze and cornices, ceiling of yellowish pink, and the upholstery, dull yellows.

Fawn colored oak wood work blends well with dull drab walls, blue or red in frieze and cornices, light drab ceiling; drab, mixed with blue and red in the upholstery, and blue and Nile green draperies.

Ivory enamel woo work may have warm ecru walls, old rose, chocolate and ecru in frieze and cornice, a light, warm yellow ceiling; upholstery old ivory, ecru and chocolate, and rich blue draperies.

Light golden oak wood work may have pale blue walls, frieze and cornices in golden yellows, and blue, ceiling a light golden yellow, upholstery, blue with light yellow, and pale blue draperies.

Mahogany wood work may have maroon or dull red walls and rich cornices, ceiling buff, with rich greens; reds and browns in the upholstery and drapery.

Pale green wood work may have deep green walls, greenish gray and silver in frieze and cornice, and gray ceiling, upholstery of dark green, and dull rose and light grey draperies.

Pearl grey wood work may have light blue or pink walls, deeper blue or pale red frieze and cornices, pearl grey ceiling, buff, silver and light pink or blue upholstery, and old rose and blue draperies.

Silver birch wood work may have medium yellow or silver walls, sea green frieze, silver cornice, pale yellow ceiling, dull yellow, silver and green upholstery, and pale green or pink draperies.

Yellow orange wood work may have lemon yellow walls, yellow orange frieze, pale yellow and gold cornices, light yellow ceiling, upholstery yellow orange, cardinal reds, warm browns and a little olive or blue, and draperies of blue and russet brown.

CHAPTER X.

FORMULAE.

BRONZING LIQUIDS in common use are of two kinds: collodion varnish, vulgarly known as "Banana liquid" and various thin oil varnishes containing gum or rosin and an excess of benzine as a reducer.

The first variety is composed of gun cotton (collodion) dissolved in amyl acetate which is made from fusel oil. This solution makes an excellent medium for bronzes, as it dries quickly, flows well and does not impair the lustre of the bronze, but rather brings it out more prominently. Furthermore, when dry, it is washable with soap and water without injury, which cannot be said of oil and resin liquids.

In order to cheapen the amyl acetate preparations, some gum is substituted in part to replace the more expensive gun cotton, and benzine is substituted in part, for amyl acetate. Such preparations are less durable. Any of the collodion varnish formulae will make satisfactory bronzing liquids.

Ordinary bronzing liquid can be made by combining one part of any pale medium to quick drying varnish of ordinary quality, with four parts of benzine. Add one-half part of liquid dryer if a very quick drying liquid is required.

Turpentine should never be used in bronzing liquid, as it attacks the bronze, injuring the color and lustre. It is best, therefore, to use a benzine varnish when possible. Bronzing liquid must be very thin in body. When radiators or other articles are bronzed while hot, the resulting coat will present the appearance of an enameled surface due to the varnish baking on them, if liquid made from gum varnish be used.

To prepare a cheap liquid, mix 1 gallon of heavy gloss oil or pale rosin copal varnish with 3 3-4 gallons of benzine and 1-4 gallon of pale liquid dryer.

CEMENTS, PASTES AND PUTTIES.

Cement for Steam Pipes and Iron Surfaces.

Mix thoroughly in powdered form,

Litharge, ...2 parts
Slacked lime, ...1 part
Sand, or Silex, ...1 part

Compound the above with sufficient linseed oil varnish (hot) to form a stiff paste. Use fresh and warm.

CEMENT FOR FASTENING METAL OR PORCELAIN LETTERS ON GLASS, ETC.

No. 1.

Good varnish, ...3 parts
Linseed oil, (boiled).........1 part
Turpentine, ...1 part
Glue, ...1 part

Dissolve the glue (pulverized) by heating the above mixture in a water bath; when complete, add 2 parts of slacked lime.

No. 2.

Compound white lead or litharge with enough dammar, or other gum varnish, to form a thin cement. The addition of 1 part of good liquid glue to each 5 parts of the above will improve the adhesiveness.

CEMENT FOR METAL LETTERS ON GLASS.

Litharge powdered, ...2 parts
White lead, ...1 part
Boiled linseed oil, ...3 parts
Demar varnish, ...1 part

Mix only enough for immediate use.

QUICK DRYING CEMENT FOR USE ON IRON, STONE, OR GLASS.

Mix powdered litharge with enough glycerine to make a paste. Mix only sufficient for immediate use.

TO PREPARE PURE CASEINE FOR CEMENTS AND OTHER PURPOSES.

Milk, carefully skimmed, free from cream, is curdled with the addition of a little vinegar, or by simply standing in a warm place.

Pour the curdled milk through filter paper, which will allow the curds or caseine to remain. Wash with pure water. To remove all traces of fat, the caseine may be tied in a cloth and boiled in water a short time, the latter treatment is not absolutely necessary. Allow the caseine to dry on blotting paper in a warm place. If well dried, it will keep a long time.

ORDINARY CASEINE CEMENT.

Caseine, ...12 parts
Slacked lime, ...50 parts
Fine sand, ...50 parts

Water, sufficient to make a paste.

For filling holes and interstice in stone.

CEMENT TO UNITE GLASS AND METAL.

Make a thin paste of alum and plaster of paris with water. Useful also for filling crevices, etc.

CEMENT FOR MARBLE AND OTHER MINERALS.

Portland cement, ...2 parts
Slacked lime powder, ...1 part
Litharge, ...1 part

Mix with enough silicate of soda to make a thin paste.

Crack and Crevice Filler.

Make a paste of 1 pound of flour and 3 quarts of water and 1 oz. of alum. Soak in this thin paste, enough newspapers or other unsized paper to form a thick putty. This is excellent for filling cracks in floors. It becomes hard and tenacious and will shrink very little.

Joiners' Putty—For Stone, Brick and Wood Work.

Mix 8 ozs. of dry clay or whiting and 1 oz. of powdered litharge with enough linseed oil to make a soft putty. Very durable.

Cement For Paper.

Dissolve 4ozs. of good glue or gelatine in 1 pint of water. Add 8 ozs. of brown sugar and 4 ozs. of gum arabic or dextrine. Heat the mixture to make a perfect solution.

Wall Paper Paste.

Make a thick paste with wheat or rye flour in cold water. Stir until no lumps remain. Add 1-2 oz. of alum to each pound of flour used. Then add slowly, with constant stirring, boiling water to the amount of one quart to each pound of flour. The addition of 15 to 30 drops of carbolic acid to each pail of paste will prevent its souring. A few drops of formaldehyde solution is even better if the carbolic odor is objectionable.

Rye flour makes a stronger and more tenacious paste.

Wall Paper Paste.

Make a flour paste by boiling flour with sufficient water. To each 5 pounds of the paste, add 3 ozs. saturated solution of alum and 5 ozs. solution of dextrine. Both solutions made with hot water.

Paste For Ordinary Purposes.

Dissolve dextrine in sufficient water to make a fluid paste. Add a few drops of carbolic acid to preserve it.

Caseine Cement For General Use.

Dissolve together, caseine and silicate of soda; use alone, or mixed with an equal quantity of chalk or silex.

To Render Dammar Varnish Clear.

Add to each gallon, 1 pint of pure grain or wood alcohol. This will also aid the drying qualities. Good dammar is simply dammar gum and turpentine, in about equal parts, by weight, dissolved together in the cold or with a little heat. Copal spirit varnishes are made in the same way. The addition of a little venice turpentine, 1 to 2 ozs. to the quart, gives any spirit varnish more elasticity.

LIQUID GLUE.

No. 1.

Dissolve good glue in vinegar. Add a little alum and mix alcohol to the amount of 1-4 the bulk of the mixture.

No. 2.

Dissolve 3 parts of glue (good quality) in 8 parts hot water. When cool, add 1-2 part hydrochloric acid and 3-4 part zinc sulphate.

No. 3.

Dissolve glue in vinegar so that when cool it forms a thick fluid; add 1 part nitric acid to each 20 parts of the dissolved glue.

WATER-PROOF GLUE.

Boil for 10 minutes a mixture of
Thick solution of glue in water, . .10 parts
Linseed oil, (boiled) . . . . .5 parts
Litharge, ...1 part
Use hot.

PUTTY FOR FLOORS AND TO FILL CRACKS OR CREVICES.

No. 1.

Caseine, ...1 part
Water, ...7 parts
Spirits of ammonia, ...1 part
Slacked lime, ...1-2 part

No. 2.

Glue,	2 parts
Water,	14 parts
Plaster of Paris,	4 parts
Litharge,	4 parts

TO ETCH GLASS.

Paint the entire surface except the design or part to be etched with good asphaltum varnish and allow it to dry. Place a rim of putty made of wax and starch about the design and pour hydrofluoric acid on the exposed surface. Allow to stand five minutes; pour the acid back into the flask and wash the entire surface, removing the asphaltum with turpentine.

FROSTING ON GLASS.

Rub the glass with a piece of marble dipped in fine glass cutters' sand or fine emery and water.

A chemical frosting is made by mixing together a strong hot solution of sulphate of magnesia and a clear solution of gum arabic; apply warm.

Or, use a strong solution of sulphate of sodium warm and when cool, wash over with gum water.

TO GILD ON GLASS.

Clean the surface carefully with whiting and then alcohol. Make a size by boiling 2 ozs. of best isinglass or gelatine glue in a little hot water. Add this to 1 quart of alcohol and enough water to make 3 quarts in all. Strain the mixture. Size the surface to be gilded and lay the gold leaf on it. Scatter precipitated chalk on the gold. When dry, polish with silk velvet, after brushing off the chalk. Back the gold with Demar or copal varnish.

In ordinary window work, use good prepared gold size. In case the isinglass size is too weak, add more isinglass. Test on glass before using.

GILDING IN GENERAL.—The first requisite is good gold leaf. It is well to select some well known brand.

For outside work in particular, and on all ordinary work, patent gold may be used. In this case, each leaf of gold has a piece of thin paper slightly adhering to it. The gold and paper can be easily cut to any size desired, and readily applied to the previously sized surface, the gold adhering to the size and the paper loosening from the leaf. Patent gold saves much waste and is a great convenience. Its cost is little above that of ordinary gold leaf.

Ordinary gold leaf may be applied in a similar manner. Lay the book flat upon a table and carefully open the first leaf; cut off the paper leaf just raised with a pair of sharp shears. Rub the paper, laid flat upon the hand, on your hair. Then lay the page back in its original position on the gold foil and press firmly with the hand; lift carefully and the gold will adhere; use this the same as patent gold. The usual method followed for ordinary leaf is to place the leaf on a flat cushioned board, or gold leaf cushion, by means of a small spatula, and after carefully spreading the leaf, cut it to the desired sizes by means of the spatula before mentioned.

A brush about 3 inches wide, made from paste board and camel's hair, called a gilder's tip, is used to apply the leaf. By rubbing the brush through your hair you generate sufficient electricity, or take enough grease from the hair to pick up the gold with the brush and thus apply it to the sized surface. It should be carefully applied so as not to overlap unduly. When finished and dry, the work may be burnished by rubbing with a piece of silk velvet or some similar soft cloth. Do not attempt to burnish until the work is perfectly dry. When gold leaf is applied to glass, it is customary to give it a protective backing of paint or varnish.

The tools required, then, are a cushion, a four-inch spatula and a gilder's tip, the brush before described.

Besides the patent gold and ordinary gold leaf, of which two shades are generally procurable, there are a number of artificial gold leafs known as composition leaf, Dutch metal, etc. They tend to tarnish quickly on exposure and, hence, are but little used, at least in this country.

Silver leaf is also procurable, but aluminum leaf has largely replaced it, because it is cheaper, and for the same reason that aluminum bronze has replaced so-called silver bronzes. Even silver itself, quickly tarnishes while aluminum does not.

GILDING ON IRON OR METAL WORK.

The articles to be japanned are cleaned of oil or grease with turpentine and a coat of japan varnish applied. When baking japan is used, the articles coated are dried in an oven at a temperature of from 120 to 250 degrees Fahrenheit, which gives a hard and smooth enameled surface. The parts to be gilded are now coated with gold size thinned with turpentine. If bronze is to be used, it is applied by being dusted on and the excess removed. In place of bronze powder, gold or other metal leaf can be used. After the gliding, a light coat of transparent lacquer or varnish is applied, and if possible, allowed to dry in the oven at a moderate temperature.

IN SIGN PAINTING, all roman capitals, as a general rule, may be the same height and breadth, except I, J, M, and W.

The breadth of I and J is equal to 1-2 the height, and M and W, 1 1-2 times the height.

Gilt letters are written with Japan gold size and before dry, the leaf is applied. Smooth gently with a piece of cotton.

GOLD SIZE, (oil size), add enough finely ground yellow ochre to varnish makers' boiled oil to make a thick, smooth paste and thin with turpentine.

No. 2.

WATER SIZE.—Mix a thick solution of gelatine dissolved in water, with dry yellow ochre. Thin with water to the proper consistency for application. Used for gilding.

A good Japan gold size may be prepared by mixing together, 1 part of good turpentine Japan, 1 part of ordinary gum varnish, and 1 part of turpentine. If too heavy, thin by the addition of more turpentine.

BACKING GLASS SIGNS WITHOUT SHADES.

After removing the superfluous gold, apply 2 coats of black paint made from the best drop black in oil. Cover the entire back of the glass and the letters with this.

BACKING GLASS SIGNS WITH SHADES.

Apply 2 coats of the same black, but leave the shades free.

When the black is dry, paint the places left for the shades with red, green or any other color oil paint desired.

DECORATIVE ENAMELS.—Zinc white is used as a base in the production of enamels, because of its whiteness, the bright tones it produces with colors and on account of the action this pigment has when combined with resin varnishes. The action is somewhat like that which occurs when white lead is mixed with linseed oil.

Zinc ground in demar is best, but that finely ground in poppy seed oil, or refined linseed oil will answer all ordinary purposes.

For all enamels the following must be observed; that the zinc and, in fact, all pigments be finely ground, that the enamel be carefully strained after it is made. That it be not too heavy in body, but about the consistency of varnish.

To prepare a good enamel, suitable for first-class work, make a liquid base by combining 4 1-2 parts of good Demar varnish, 4 1-2 parts of good pale rubbing varnish, with 1 part of turpentine, and add to each gallon, 1-2 oz. of sugar of lead, previously rubbed up in a little oil or varnish.

To each gallon of this liquid, 5 pounds of white zinc, ground in paste form, is thoroughly incorporated.

Exterior, weather-proof, and so-called marine enamel is made by combining 9 parts of the palest wearing body, or, preferably, white finishing varnish, (made from white Kauri gum) with 1 part turpentine and adding 5 lbs. of the best oxide of zinc, (zinc white) ground in oil, to each gallon. The addition of 1-2 oz. of sugar of lead, as before mentioned, will improve the drying. Strain after mixing.

No. 2.

Use 4 parts of No. 2 Demar varnish, 5 parts of any pale, low-priced quick drying varnish and 1 part turpentine, adding, as above, 1-2 oz. sugar of lead to each gallon of liquid. The same amount of zinc is used as in the first.

No. 3.

Use 9 parts Demar varnish, 1 part turpentine, with 1-2 oz. sugar of lead to each gallon.

The sugar of lead is prepared by triturating or grinding the powder with a little oil or varnish before adding it to the solution.

No. 4.

Use 10 parts of palest quick drying rosin varnish, 1 part pale liquid dryer and 1 part benzine. Add 5 lbs. of zinc white to each gallon.

To produce blue white, add a trifle of prussian blue or ultramarine in oil.

The above formulae are for white. Tints are made by adding sufficient oil color strained after thining slightly with turpentine.

The best white or porcelain enamel suitable for all decorative purposes, and which can be rubbed and polished to any degree desired, is made as follows:

25 lbs. Best French Zinc, (ground in Demar varnish)
2 gallons of palest rubbing varnish

2 gallons, best white Demar varnish
1 gallon turpentine
2 ozs. sugar of lead is added.

The sugar of lead is previously ground or rubbed down to a smooth paste in a little varnish.

The addition of 1-2 oz. of dry Prussian blue will produce the blue white or porcelain shade. In adding blue, great care must be excerised, lest too much blue be introduced.

The enamel, after thorough mixing, should be carefully strained to free it from all unmixed particles.

Black enamel.—Add 1-4 lb. of carbon black, ground in oil, to each gallon of any quick drying varnish which has been slightly thinned with turpentine.

Red enamel.—Add 4 lbs. of any good vermillion to each gallon of liquid made as above.

Flat White Primer.—Mix 1 part raw oil, 1 part dryer, with 8 parts turpentine. Add from 25 to 40 pounds of white lead in oil to each gallon to produce the body and covering power required. Zinc can be used in the proportion of 20 to 25 pounds to the gallon, in place of white lead, but does not cover so well.

Bath Tub Enamel.—Mix 9 parts pale wearing body varnish with 1 part turpentine. To each gallon of the above, add 5 pounds of a mixture composed of 1 part white lead and 2 parts zinc, ground in oil.

In making enamels, it is always well to carefully strain them before use, through cheese cloth.

Enameling Bath Tubs.—Clean the surface to be enameled with a strong solution of washing soda in water. After drying, it should be rubbed down with sand paper and all dust removed.

Three coats of enamel are necessary to make a good job, and plenty of time must be allowed each coat to dry thoroughly. Flat white primer may be used for the under coats. Finish with enamel.

To Enamel Paper.—Melt 1 pound of paraffine wax, withdraw from the fire; just before it begins to solidify, mix with 1 gallon of benzine or gasoline. The color is prepared by mixing 10 parts of whiting, paris white, or barytes and the necessary pigment to produce the desired shade, with 1 part of gelatine glue previously dissolved in a little water.

To each pound of the prepared color, add and mix 1-4 pound of the prepared paraffine. Strain before using. This will render paper waterproof.

THE TREATMENT OF FLOORS.

Floors, both soft and hard wood, admit of several methods of satisfactory treatment, depending upon their condition and the amount of wear they are subjected to. The object being to give them a durable, elastic, but hard coating, capable of resisting wear and tear, and to show in the least possible degree, scratches, or other marks from any of the ordinary conditions to which they are subjected.

If the floor to be treated is in too bad condition to show the natural beauty of the wood, a floor paint, made according to the floor paint receipt given in another part of the book, is the only practical method. Some color should be selected which is in harmony with the other decorations of the room, and at the same time, one which will not show dust or dirt readily.

If the natural or treated wood is in fair condition, the worn coating can be removed by the use of one of the varnish removers recommended, which will also remove the dirt, or it can be rubbed down thoroughly with steel wool. When this article is used, take off all superficial coats with steel shavings, and finally, finish with No. 1 or No. 2 steel wool. In very fine work, No. 0 steel wool can be used. When a natural finish is desired, proceed as follows:

No. 1.

Apply two or three coats of any good floor varnish, allowing each coat to dry thoroughly before the next is put on. No other treatment in this case is necessary. Let the varnish be thin in body and be sure to spread it carefully.

No. 2.

For Hard Wood Floors.—First apply a coat of good paste wood filler thinned with turpentine, when dry, rub with fine steel wool, or sand paper, after which, floor varnish can be applied as above. The most satisfactory method, however, is to apply two coats of good floor wax after filling, each coat of wax being thoroughly rubbed with a woolen cloth or weighted floor brush. When wax is used, a light coat can be applied once a month, which will serve to keep the floor always in good condition.

No. 3.

In place of wood filler, use grain alcohol white shellac and use floor wax over this coating.

No. 4.

After preparing the floor, apply in succession three coats of white shellac, giving each coat sufficient time to dry. This treatment is adaptable to hard wood and parquetry floors, and for such floors, is the usual treatment.

Liquid wood filler, when used, is best adapted to soft woods, and it is essential that the filler be composed of good gum varnish, otherwise, if subjected to the action of moisture and wear, the coating will mar, disfigure, and turn white.

On smooth hard wood and parquetry floors, prepared wax can be used as directed previously, without other treatment.

STAINING FLOORS.

Floors may be previously stained any desired color, with a good turpentine, or oil stain before applying the filler or shellac, varnish or wax, or a stain can be mixed with the filler as desired and thus save one operation.

It is best to apply first a thin stain which will penetrate the fibre of the wood, before other treatment, as by this method the color will be much more permanent, and not so easily worn off.

To Summarize:

Floors may be painted.

Varnished with, or without previous staining.

Coated with paste or liquid wood filler, or shellac and varnished or waxed.

Simply shellaced without other treatment, or wax may be applied alone. The last two methods are adapted to hard wood floors.

The quickest method to preserve the natural wood and obtain a fine finish is to shellac the wood (two coats) and apply one or two coats of prepared floor wax.

Floors may also be oiled without other treatment, but this tends to darken the wood and, after repeated coatings, it is apt to retain much dust and dirt. A floor oil, or polish is made by mixing four parts of raw linseed oil, one part of turpentine, and 1-2 part of orange shellac varnish. Shake well when using. In applying, rub this in thoroughly. It can be used to advantage as a polish on finished floors. Raw oil, to which a little dryer has been added, one part of dryer to ten parts oil, will also make a satisfactory polish for the same purpose.

The so-called floor oil in common use, sold under various names is similar to the folowing:

Take pale paraffine oil of light or medium body, (25 or 28 degree gravity) heat it gently, and to each gallon, stir in one pound of melted paraffine wax. Be sure that the wax and oil are thoroughly combined. This mixture makes an excellent furniture and bar polish also. It both cleans and polishes.

Paraffine oil, without the addition of wax, is also an excellent cleaner and polisher for all wood work.

PASTE WOOD FILLERS.—The base of these fillers is some finely ground substance which, when mixed with oil and dryer and thinned with turpentine or benzine and applied to wood, will fill the pores or interstices so thoroughly as to render the surfaces thus treated impervious or non-absorbent. Silex, talc, terra alba, whiting, china clay and barytes are largely used for this purpose. The more transparent and white the base is, the more satisfactory its use, as the object is to preserve the natural color of the wood, or, if a stain is used, the filler must not dull or injure the transparency of the color combined with it.

Starch, glue and dextrine may also be used, but are more perishable and, therefore, not so good.

A good paste filler is made as follows: Grind dry silex to a paste in a mixture of 4 parts raw linseed oil and 1 part good Japan dryer. The other mineral earths, talc, terra alba, whiting, china clay, or barytes are made into filler in the same manner.

To prepare for use, thin with turpentine or benzine to the required body.

Staining colors may be added when the base is being ground, or after thinning with turpentine or benzine for use.

Paste fillers are adapted for open grained and hard woods and require rubbing with fine steel wool or sand paper, before the finishing coats of shellac or varnish are applied.

LIQUID WOOD FILLERS.—For soft and close grained woods and on work where labor and material must be minimized, where cost is an object, and little sand papering or rubbing is to be done, liquid wood filler takes the place of paste filler.

Such ready-for-use fillers are usually so prepared as to save a coat of varnish and with this object in view, the liquid portion is, essentially, a quick drying varnish to which sufficient transparent white pigment is added to properly fill the grain of the wood.

The filler should be so prepared as to work smoothly under the brush, without pulling. It should be light in color, and comparatively transparent, so as not to discolor or mar the natural beauty of the wood. It should spread well, without showing laps and, in fact, possess the general characteristics of a varnish. It must be of fair body, and stand out well on the surface of the work to which it is applied. If the price admits, it should be composed of a varnish which will not turn white when exposed to dampness and, finally, the pigment should be of such nature that it will not shrink, which excludes the use of starch or vegetable matter of that nature.

When a smooth, unctuous pigment like clay is used, the working qualities of the filler is much improved. The pigment should not bake or settle hard in the can.

Such filler is made by mixing together 4 parts of a pale varnish, 1 part of turpentine or benzine, and 1-2 part of pale liquid dryer. To each gallon of the liquid so prepared, add and mix thoroughly, 2 pounds of talc, china clay or silex.

The quality and cost of the filler will depend upon the quality of varnish used.

For cheap work, a liquid may be substituted, composed of 9 parts of gloss oil or pale rosin varnish and 1 part of raw linseed oil, together with 1-2 part of pale cheap dryer. To 4 parts of this varnish mixture, add 1 part of benzine in place of turpentine and to each gallon use the same amount of pigment as in the first formula. The amount of pigment may be modified also.

A good, serviceable liquid wood filler is made as follows:

7 gallons of Pale varnish (quick drying),
1-2 gallon, Boiled linseed oil,
1-2 gallon, Pale liquid dryer,
1 gallon, Turpentine,
15 pounds, China clay, (perfectly dry),
1-4 gallon of Solution No. 1, or No. 2 given under ready mixed paints.

The addition of the solution is not necessary, but will prevent the pigment from settling so readily in the bottom of the can and the filler will require less stirring, enabling a more uniform coat to be applied.

Some fillers contain powdered pumice. Such a pigment is rather a disadvantage, in that it prevents the filler working smoothly and tends to leave the work rough, thus requiring more sand papering.

Liquid filler and stain combined is made by adding to the transparent or light liquid filler suitable pigments, the same in kind and amount as directed in the production of varnish or oil stains, or, by adding to the varnish stains, 1 1-2 lbs. of pigment to each gallon of stain.

GRAINING, or the art of imitating colored woods, while at one time very popular, is not so much in vogue at the present day, but yet is of sufficient moment to note carefully.

It is much more difficult than ordinary painting and necessitates the careful study of the grain, knots and coloring of the various woods to be imitated, as well as the careful observation of grained work done by others expert in the art.

The work first will, of necessity, fall far short of satisfactory appearance, but the art can readily be acquired by observing the foregoing, together with constant, painstaking practice.

The pigments used in graining are, white lead, and, in the main, the various earth pigments; umbers, siennas, vandyke brown, venetian red, yellow ochre, together with drop black, and for mahogany and rose wood graining, vermillion and crimson lake.

The first step is to produce a good ground work which must be in tint or color to match the lightest parts of the wood to be represented. All pigments used should be ground finely in oil and of known purity. This applies particularly to the graining colors proper, where transparency and bright tones are essential to well appearing work. If the colors used are not of this sort, the work will present a muddy unsatisfactory appearance.

The color for the ground work may be mixed with raw linseed oil, three parts, turpentine, one part, with sufficient good liquid dryer to produce a hard surface, more turpentine may be used if desired.

Two coats of the ground color are necessary and each should be carefully sandpapered after it is thoroughly dry.

The paint must not be too heavy in body, lest in drying it form a skin on the surface which, on manipulating the various tools on the graining color, will rub off and thus spoil the work.

When the ground work is dry and properly prepared, the real artistic part of the work begins. The tools needed are an ordinary paint brush, which may be a pound brush, or a flat brush three to four inches in width. Special brushes, called grainers are made for this purpose; this brush is used to rub in the graining color. Next, a set of steel graining combs, twelve combs comprise a set; three, one inch wide; three two inches; three, three inches and three four inches in width. Each comb in a set varies in the size of the teeth from its companions, there being three kinds, having each fine, medium and coarse teeth. A painter's duster is also needed and plenty of soft linen rags used in wiping out the color to produce the lights. For special and particular work a badger hair blender, which is used to soften the glazing coat.

An oak or top grainer is another brush used sometimes to soften and imitate more closely various oaks, and is manipulated on the grained work after the glazing coat is put on. It produces a dimly perceptible grained effect on this coat.

In working on marble graining, the piped maple or top grainer is used as well as a camel's hair cutter.

In mixing the graining color, use largely turpentine with only sufficient linseed oil, (boiled oil and no dryer), or (a little dryer with raw oil) to prevent the color from setting too quickly. Rub in the graining color, which is mixed rather thin and not containing too much pigment, with a rather stiff brush as previously mentioned.

In making dappled work, comb the surface before going further, in the production of veined work, comb after wiping out the lights. The rags are used with the assistance of the thumb nail to wipe out the color to imitate the sap or veined work before mentioned.

Allow the work to stand over night and apply a glaze of water color which must be very thin and transparent. The glaze is made from the same pigments ground in water, as are used in oil on the graining coat, mixed in proper proportions to produce the desired effect. The glazing coat may be dispensed with and the job finished by applying one or two coats of varnish.

GRAINING COLORS.

Light Oak.—Ground work is white lead tinted with raw sienna to the desired shade.

The graining color is composed of raw and burnt umber, and vandyke brown.

Dark Oak.—Ground work is white lead with golden ochre, or deep orange chrome yellow, and a little turkey red or bright red oxide.

The graining color is composed of the same pigments as in the case of light oak, except that the proportions are varied.

Ash Graining.—Both the ground work and the graining color is similar to those used in the production of light oak.

Chestnut Graining Color.—Ground work is white lead, yellow ochre and orange chrome to produce a decided yellow, which chestnut graining requires. The graining color is composed of burnt umber with a little vandyke brown and burnt sienna.

Mahogany.—Ground work venetian red, and white lead with a little crimson lake.

The graining color is vandyke brown.

The graining of mahogany is much more effective if two shades of vandyke brown are used in imitating the light and dark parts of the wood.

Maple.—Ground work similar to very light oak, white lead and raw sienna, with a graining color of oxford ochre, which is dappled, and when dry, pass a graining brush over the work in a wavering direction, using a mixture of umber and sienna to produce a softened grain.

Walnut.—Use yellow ochre, white lead and umber for the ground work and raw umber for the graining color.

LUBRICATING OILS.

Formerly, lubricants were compounds of the animal oils, such as sperm, lard and neatsfoot oil, and various vegetable oils, as colza, cotton seed, olive, palm, castor and others of the non-drying sort.

Mineral oil lubricants have, in great measure, supplanted all others at the present time. They are much cheaper and less likely to ignite from friction or spontaneous combustion and answer practically all the requirements, or, if they do not, the admixture of a small proportion of animal or vegetable oil of the nature required, imparts to them the necessary quality of viscosity in which animal and vegetable oils excel.

Lubricants have a wide range to cover and differ materially in density or body, viscosity or adhesiveness, congealing points, flash points and their behavior at various fluid temperatures. A good oil should have high viscosity, congeal at a low temperature and flash or ignite at a high one. It should not oxidize or volatalize at ordinary temperatures.

For compounding all the principal or staple lubricating and machinery oils, you need only the following:

Lard oil, sperm oil, Virginia black oil, or petroleum residue, filtered cylinder stock, red paraffine oil, yellow paraffine oil, neutral oil, colorless or debloomed neutral oil and tallow.

Ordinary heavy lubricating oil: Use Virginia black oil. If less body is required, thin with 300 degree solar oil or kerosene. Such an oil is seldom subjected to very high temperatures.

Cylinder oil, such as is sold under various names, of about standard quality, if, indeed, there be a standard, may be filtered cylinder stock. If too thick, it may be thinned with the addition of paraffine oil, using heat to perfect the mixture.

Standard machinery oil is red paraffine oil, or if a paler yellow oil is required, pale paraffine may be used.

A suitable oil for light machinery, including sewing machines, is pale paraffine or neutral oil, either yellow or white.

A light machinery oil of high quality is made by compounding one gallon of sperm oil, with four gallons of neutral or pale paraffine oil. This oil may be made more thinly fluid by the addition of some kerosene.

Motor oil is compounded as follows:

4 gallons, 25 degree paraffine oil,
3-4 gallon, cylinder stock,
1-4 gallon, sperm oil,

Gas engine oil:

4 gallons, red paraffine oil,
1 gallon, cylinder stock,
1-4 gallon, lard oil.

Spindle oils are No. 1 and No. 2, bloomless neutral oils. They are pure white oils of light body and should stand a high degree of heat.

To produce an extra quality of cylinder oil, add 25 lbs. of tallow melted, to each 50 gallons of cylinder stock.

High grade light cylinder oil can be made by adding 25 pounds of tallow melted, to 50 gallons of heavy paraffine oil.

Castor oil is used as a lubricant where great viscosity or adhesiveness is demanded and price is not an object.

A good substitute for castor oil is produced by compounding 25 pounds of tallow to each 50 gallons of No. 2 spindle or white neutral oil, and may be termed mineral castor oil. If greater body is required, add 50 pounds of tallow to each 50 gallons of oil to be prepared.

An excellent substitute for lard oil is made by mixing 30 gallons of 28 degree to 30 degree paraffine (pale paraffine), 20 gallons of pure lard oil, and 25 pounds of tallow.

In adding tallow to any of these oils, first melt the tallow in 5 gallons of the oil with which it is to be mixed, and when the fluid is clear and the tallow thoroughly dissolved, mix this with the balance of the oil to be compounded.

Signal or head light oil for illuminating purposes, of good quality, is produced by the mixture of 20 gallons of pure lard oil, and 30 gallons of 300 degree mineral oil, or (solar oil).

Wagon greases are compounds of rosin soap, petroleum residues, and vegetable tar.

Patent Wagon Grease.—Stir 90 parts of powdered slacked lime into 100 parts of rosin oil. Heat the mixture and stir until a uniform paste-like syrup is obtained. Then heat 550 parts of rosin oil one hour, with 2 parts of calcium hydrate, and allow to cool. Skim off and add with constant stirring 10 parts of the rosin soap, prepared according to the above. This grease may be colored by the addition of a small amount of any pigment.

Another.—Heat heavy paraffine oil, rosin oil, and tallow of each 60 parts, and oleic acid 30 parts. Saponify the mixture by adding 15 parts of powdered lime and 2 parts of 98 degree soda lye.

Powdered graphite mixed with tallow, or heavy petroleum residue in the proportion of 20 parts of graphite to 80 parts of grease is a useful lubricant for heavy work.

Pure graphite is used alone as a dry lubricant.

Prepare a rosin soap by melting 100 pounds of rosin in 200 pounds of soda lye of 15 degree Baume, heat until a clear paste is formed. If a heavier paste is desired, use 60 pounds of 35 degree Baume soda lye to 100 pounds of rosin. Compound the rosin soap with an equal amount of crude pine tar, heat, and mix thoroughly. This forms a suitable axle grease for all ordinary purposes.

LINEOLEUM should never be washed with soap and water, as this causes it to become brittle and crack. When to be cleaned, do it with ordinary prepared floor wax, which also protects the surface and beautifies it.

A mixture composed of equal parts of linseed oil and turpentine is also good. Apply at night and remove with a cloth in the morning.

The oil stains may be applied to linoleum to restore its freshness or change the color. When dry, a coating of prepared floor wax, or the oil, turpentine mixture may be applied as directed above.

BRONZE AND METAL LACQUER.—Dissolve 1 oz. of shellac in 8 ozs. of alcohol, and add 1-4 oz. gum camphor.

POLISHING WAX for Furniture.—Melt 8 ozs. of white bees' wax with 8 ozs. of turpentine, cool and add 2 ozs. alcohol.

Furniture and Floor Wax.—Melt together, 16 ozs. bees' wax, 1 oz. Venice turpentine, and 16 ozs. spirits of turpentine. Allow to cool. Apply with a cloth or rag and polish after 1-4 to 1-2 hour with a woolen cloth or weighted floor brush. More spirits of turpentine can be added if desired.

Good prepared floor wax, such as is in general use is made by melting together 3 pounds of ceresin wax and 2 pounds of Carnauba wax in 3 gallons of turpentine. The yield is about 26 pounds of floor wax, costing about 10 cents per pound and is equal if not superior to bees' wax preparations.

For restoring the color to weather stained and soiled floors, apply a strong solution of oxalic acid dissolved in water, at least 2 ozs. to the pint. This will clean and bleach the wood.

READY MIXED PAINTS.

In the preparation of ready mixed paints, it is customary, as mentioned before, to prepare a suitable base of white and to add proper amounts of prepared stainers to produce the required tints.

For dark colors, such as the reds, greens, and browns, a suitable base of dark pigments is made and thinned in the regular way.

Yacht white, ready mixed paint: mix thoroughly and after mixing strain.

25 pounds of white lead (in oil),
25 pounds of white zinc (in oil),
4 gallons raw linseed oil,
1 pint turpentine,
1 pint liquid dryer.

Add a trifle of Prussian blue to produce a pure white. This paint is suitable for all exteriors, and exposed places and stands moisture and salt air to a remarkable degree.

To prepare inside white of the same quality, change the 4 gallons of raw linseed oil to a mixture of 2 gallons of raw linseed oil and 2 gallons of turpentine.

One pint of solution, No. 1, mentioned under ready mixed paints, may be added to hold up the pigments and make the paint work more smoothly, without detriment.

Ordinary outside white ready mixed paint:

12 pounds of white zinc, (in oil),
4 pounds of white lead, (in oil),
2 pounds of Paris white, (dry),
1 1-2 gallons raw linseed oil,
1-8 gallon liquid dryer,
1-2 gallon solution, No. 1.

For inside white of the same quality, let the thinners be 1-2 raw linseed oil, and 1-2 turpentine, instead of all oil.

In the preparation of the various ready mixed tinted paints, first make a base of white, which will answer for outside white.

Base white number one is prepared by mixing thoroughly:

30 pounds of white lead, (in oil),
30 pounds of white zinc, (in oil),
4 gallons of raw linseed oil,
1-4 gallon of turpentine,
1-2 gallon of solution No. 1,
1-2 ounce of prussian blue, (in oil),
1-4 gallon of liquid dryer.

If too heavy, thin by adding a little more raw linseed oil.

Base white, number two is made by mixing as above:

10 pounds of white lead, (in oil),
10 pounds of white zinc, (in oil),
10 pounds of Paris white,
2 1-2 gallons of raw linseed oil,
1-4 gallon of liquid dryer,
1-2 gallon of solution No. 1.

Thin with benzine if too heavy. The Paris white must be finely bolted and allowed to soak in the linseed oil before adding the other pigments.

Coloring Matter:

Black:

50 pounds of lamp black (in oil),
3 gallons of raw linseed oil,
1-2 gallon of turpentine,
1-4 gallon of liquid dryer.

Red:

50 pounds of bright red oxide, (in oil),
7 gallons of raw linseed oil,
1-2 gallon of turpentine,
1-4 gallon of liquid dryer.

Yellow:

50 pounds of French ochre, (in oil),
8 gallons of raw linseed oil,
1-2 gallon of turpentine,
1-4 gallon of liquid dryer.

Lemon:

50 pounds of chrome yellow, lemon, (in oil),
5 gallons of raw linseed oil,
1-2 gallon of turpentine,
1-4 gallon of liquid dryer.

Green:

50 pounds of chrome green, med., (in oil),
5 gallons of raw linseed oil,
1-2 gallon of turpentine,
1-4 gallon of liquid dryer.

Blue:

50 pounds of prussian blue, (in oil),
10 gallons of raw linseed oil,
1-2 gallon of turpentine,
1-2 gallon of liquid dryer.

These staining colors are in reality, ready mixed solid colors, and can be converted into ready mixed paints of the same shade by adding an amount of barytes (in oil), equal to the amount of color used and doubling the amount of liquids, with the addition of solution No. 1—1-8 the amount of raw oil used, or if they are to be cheapened, 1-4 the amount of the oil used may be added of solution. No. 1.

Light Lead Ready Mixed.—Tint white with black, ochre and lemon color. Medium lead, black and ochre. Dark lead, black and ochre.
Light, Medium, and Dark Drab.—Ochre, red and black in proper proportions to give the respective shades.

Quaker Drab.—Ochre, black and green.

Stone.—Ochre and black.

Grey.—Ochre and black.

Light Brown.—Red and black.

Dark Brown.—Same as yellow staining color, substituting burnt umber, (in oil), for French ochre.

Light Buff.—Ochre and red.

Buff.—Ochre and red.

Colonial Yellow.—Lemon, ochre, red and black.

Dark Straw.—Ochre, green and red.

Light Straw.—Lemon, green and ochre.

Cream.—Ochre and lemon.

Tan and Light Tan.—Ochre, red, lemon and black.

Spruce.—Ochre and red.

Salmon.—Ochre and red.

Lavender.—Ochre, red and trace of blue and black.

Light Olive.—Ochre, green and black, with blue and red, a trifle.

Medium Olive.—Ochre, green and black.

Dark Olive.—Green, black and a little blue.

Apple Green.—Lemon and green.

Pea Green.—Lemon and green.

Bronze Green.—This ready mixed color is of great value to the painter and, therefore, a detailed formula is appended:

25 pounds of ochre staining color,
25 pounds of chrome green, (in oil),
6 pounds of black staining color,
1 pound of blue staining color,
2 gallons of raw linseed oil,
1-8 gallon liquid dryer.

Medium Green Stone.—Green, ochre, black, and lemon.

Maroon.—Same as red staining color, substituting Indian red for oxide, and darkening this with a little black.

Vermillion:

50 pounds of good American vermillion.
25 pounds of red lead.
25 pounds of Paris white,
8 gallons raw linseed oil,
1 gallon liquid dryer,
1 gallon turpentine,
1 gallon of solution, No. 1.

Light Blue.—White, tinted with blue.

Dark Blue.—White, with more blue.

From the foregoing it is understood that with the white base, before mentioned, and the staining colors prepared as directed, a simple tinting of the base, with the colors indicated, in proper proportion will give practically any of the many tints required, and the dark colors are formed from the tinting colors themselves.

FLEXIBLE PAINT.

Slice 2 1-2 pounds of good yellow soap and dissolve it in 1 1-2 gallons of boiling water and thoroughly mix the solution while hot with 3 1-2 gallons of good oil paint. Used to paint on canvas.

CHEAP WHITE PAINT FOR OUTSIDE WORK.

Slack 1 1-2 pounds of lime in just enough water to do this, add 6 1-2 pounds of skimmed milk. Add 1 pint linseed oil and 6 pounds of whiting or Paris white.

COATING FOR BLACKBOARDS.

To one quart orange shellac, add 1-2 pound of finest powdered emery, 1-2 pound of ivory black, and a little ultramarine blue. Apply three coats and rub when dry with fine sand paper.

Liquid Slateing for Blackboards.

Shellac, 8 ozs.; lamp black, 1 1-2 ozs.; ultramarine blue, 2 1-2 ozs.; powdered rotton stone, 4 ozs.; powdered pumice stone, 6 ozs.; alcohol, 4 pints. Dissolve the shellac in the alcohol, and the other ingredients and mix them well together. Apply quickly with a flat varnish brush.

Another:

1-4 gallon Japan dryer,
1-8 gallon turpentine,
1-2 pound finest emery,
1-2 pound drop black, (in oil),
2 ozs. ultramarine blue, (in oil).

Apply in the usual manner. In place of powdered emery, 1-2 pound of powdered pumice or 1-4 pound of rotton stone may be substituted.

FIREPROOF PAINTS.—Repeated coatings of liquid silicate of soda will render the substances coated, fireproof. Let the final coat be a thin wash of lime which unites with the silicate of soda, forming silicate of lime, an insoluble substance.

No. 2.

Mix 80 pounds of powdered silex, 40 lbs. of China clay and 20 lbs. of air slacked lime, intimately together, with 60 lbs. of liquid silicate of soda. Thin with water to the consistency of paint. Colors can be added, such as the ochres, umbers, earth reds and siennas. Two coats should be given.

No. 3.

70 lbs. of zinc white, 40 lbs. of air slacked lime, 50 lbs. of white lead and 10 lbs. of sulphate of zinc.

First mix the zinc and lime with sufficient linseed oil to make a thick paste. Then add 1 gallon of heavy liquid silicate of soda, together with the white lead and sulphate of zinc. Stir well. This is white. Colors can be made as in the previous cases. Thin with water, if too thick.

TRANSPARENT PAINTS FOR GLASS.—For blue, prussian blue; red, crimson lake; yellow, Indian yellow; brown, burnt sienna; black, lamp black; with mixtures of the above for other colors.

Rub them in a size composed of Venice turpentine 2 parts, and turpentine, 1 part.

Aniline dyes dissolved in shellac varnish can be used in the same way, but are more apt to fade.

Aniline colors dissolved in linseed oil or turpentine (the oil soluble variety of aniline) may be added to thin varnish to produce transparent paints for all ordinary purposes.

PATENT DRYER.

This is a paste dryer, composed of sugar of lead and litharge, as a rule, mixed in varying proportions with white lead or Paris white; sometimes sulphate of zinc is also added, the whole being ground in boiled linseed oil.

Calcined sugar of lead, 1-2 oz. to the gallon of paint is the most satisfactory solid dryer.

EXCELLENT FRENCH POLISH.—For carved work, furniture and cabinet work.

1 gallon alcohol,
3 ozs. powdered copal (Zanzibar or Kauri gum),
2 ozs. gum Arabic,
6 ozs. shellac.

Strain—coat the articles and polish in the usual way.

BLACK POLISH FOR IRON AND STEEL.—Boil 1 part of sulphuric acid with 10 parts of turpentine. Coat the article with solution and hold over an alcohol flame until the black polish appears.

PARAFFINE PAINT.—For use on surfaces exposed to dampness, damp walls, etc. Dissolve 1 part of paraffine wax in 2 or 3 parts of heavy coal tar oil, with moderate heat. Use the mixture warm.

PAINTING ON ZINC.—This process is made much easier by coating the zinc surface, first, with a solution composed of 1 part each chloride of copper, nitrate of copper and sal ammoniac in 64 parts of water and 1 part hydrochloric acid. After 12 hours, paint in the ordinary way.

METALLIC PAINTS for general use can be made from simple mixture of raw linseed oil, dryer, and suitable pigments in the dry state or ground in oil.

In general, the proportion of dryer to each gallon of oil is 1 to 10, except where white lead is used, in which case, very little dryer is necessary.

Metallic paints made from the dry mineral colors require about 6 pounds of pigment to each gallon of oil. If these colors ground in oil are used, a little more is usually required.

Cheap Metallic Paint.—Mix 2 1-2 parts ceiling varnish, 1 part raw oil, 1 part benzine, 1-2 part dryer. To each gallon of this mixture add 5 lbs. of dry metallic, Venetian red, ochre, or other earth colors. If graphite is used, only 4 pounds to the gallon is required, if the graphite is pure.

Red Metallic.—This gives a general idea of the compounding of cheap paints in general, which contain a mineral pigment base, such as ochre, venetian red, metallic brown and like substances.

25 lbs. Venetian red, dry,
10 lbs. Paris white, dry,
2 1-2 gallons ceiling varnish,
1 gallon raw oil,
1-2 gallon liquid dryer,
1-4 gallon solution No. 2 (under R.M. paints).

In the production of a high-grade metallic paint which will resist atmospheric conditions for a lengthy period and thoroughly protect the metal to which it is applied from corrosion, better materials must be used and the paint will of necessity cost more to produce.

Such a paint can be made as the following, to fulfill the foregoing conditions:

75 pounds of high-grade Venetian red,
5 gallons of raw linseed oil,
3 gallons of kauri mixing varnish,
1 gallon of liquid dryer,
2 gallons of turpentine,
1 gallon of solution, No. 1.

Other colors are produced by substituting French ochre, metallic brown, or other oxide of good quality, and which must be finely ground. Colors ground in oil before mixing should be used as dry colors do not give as good results. If the paint is to be used at once, the solution need not be added. Finally, benzine may be substituted in place of turpentine, without affecting the wearing qualities of the paint. Such a mixture will stand a high temperature very well.

MACHINE PAINT for covering castings and various machines is frequently required. It should resist grease and stand a certain degree of heat without showing defects. Such as the following steel color.

25 pounds of French zinc, (in oil),
1 pound of lamp black, (in oil),
5 gallons of good Japan dryer, (gum base).

To reduce the body, if too heavy, add a little turpentine.

Paste paints to be used on machinery and various iron and steel articles are made from a base consisting mainly of barytes and Paris white, with the addition of 1-4 to 1-3 of white lead and zinc, colored to suit. The pigments should be ground in a mixture of 1-2 raw linseed oil and 1-2 liquid dryer as such paints are used flat.

Various asphaltum varnishes are largely used as metallic paints, and if properly prepared, give good results. Ordinary asphaltum paint is simply asphaltum dissolved in benzine, or melted and reduced to a paint or varnish body with this diluent. Such a paint has little virtue, except that it is very cheap.

Good asphaltum paint should contain plenty of linseed oil, which adds greatly to its weather resisting and protective qualities. Ordinary asphaltum prepared for use may be much improved by the addition of 2 gallons of raw linseed oil and 1-4 gallon of good liquid dryer to each 10 gallons of the paint in question.

POLISHING AGENTS.

Furniture Polish.—Linseed oil, 6 fluid ounces; alcohol, 3 fluid ounces; shellac, one ounce; butter of antimony, 1 1-2 fluid ounce; hydrochloric acid, 1-2 ounce; turpentine, 5 fluid ounces.

Dissolve the shellac in the alcohol, and mix with the linseed oil and turpentine. Then, having mixed the hydrochloric acid and butter of antimony, add them to the mixture and shake thoroughly. Apply with a soft cloth.

Cabinet Work Polish.—Mix 1-2 pint of raw linseed oil, 1-2 pint of ale, the white of an egg, and 1 oz. of muriatic acid (commercial), shake well before using. Apply with a woolen cloth.

Egg Shell Polish.—Dissolve 3 parts white shellac, 1 part mastic and 1 part sandarac in 40 parts of alcohol. Apply with a rag.

Furniture Polish.—Mix 4 ozs. shellac varnish, 16 ozs. raw linseed oil, 2 ozs. turpentine and 2 ozs. bees' wax. Dissolve the wax in the oil and turpentine by the aid of a little heat. When cool, add the shellac.

Polishing Fine Wood Work.—Mix shellac cut in grain alcohol, 2 parts, and raw linseed oil, 1 part. Shake well before using. Rub briskly until hard and bright.

Marble Polish.—Mix 2 ozs. soda with 1 oz. pumice stone and 1 oz. chalk, both finely ground, and enough water to make a paste. Rub marble well with this and wash with soap and water. A fine polish should result. Bad stains can be removed by the use of dilute muriatic acid rubbed with pumice.

Wax Finish for Wood.—Boil 4 ozs. of white wax with 1 oz. of pearlash in 1 quart of water. Stir thoroughly while boiling, and until cold. Apply with a paint brush and rub until dry.

Furniture Polish.—Pale paraffine oil, add a few drops of mirbane oil to disguise the odor. Apply with a soft rag and rub vigorously. The addition of one pound of paraffine wax to each gallon of oil will improve the polish.

Floor Paints are not as fully understood by the painter as they should be. Ordinary paint, made with a strictly linseed oil base, does not dry sufficiently hard, or present, when dry, the proper appearance or the necessary surface. A special paint is, therefore, necessary. The colors are usually those which are dull and neutral in tone and such shades as do not readily show dust or imperfections. The most satisfactory pigment base is composed of equal parts of white lead and white zinc ground in oil. The liquid base is made by mixing the following:

3 gallons boiled linseed oil,
6 gallons of quick drying *gum* varnish,
3 gallons of Japan dryer,
3 gallons of turpentine or benzine,
60 pounds of white lead, (in oil),
60 pounds of white zinc, (in oil).

Dark yellow floor paint is made by adding to the above:

20 pounds of red staining color,
40 pounds of ochre staining color,
60 pounds of green staining color.

Staining colors mentioned under ready mixed paint formulae.

Dark grey floor paint:

5 pounds of black staining color,
5 pounds of lemon staining color.

Light yellow floor paint:

20 pounds of ochre staining color,
30 pounds of lemon staining color.

Lead floor paint is similar to dark grey with more staining color added.

Red floor paint: use Indian red in place of white lead and white zinc, otherwise, proceed the same as preparing the base.

The addition of 4 pounds of blue staining color will improve the shade.

Dust color floor paint:

2 pounds of black staining color,
4 pounds of red staining color,
20 pounds of ochre staining color,
10 pounds of green staining color.

In a general way, prepare the liquid base as directed and add sufficient white lead and white zinc with coloring pigments to give the required shade, and body which must be rather thin.

Three gallons of solution may be added to the liquid base formulae if the paint is to be cheapened.

POLISHING CARVED WORK.—Dissolve 1 part of shellac and 1 part or rosin in 9 parts of alcohol. Apply warm and polish.

POLISHING POWDER FOR GLASS.—Moisten calcined magnesia with benzine and use with a rag. This mixture should be used quite thin.

PAINT AND VARNISH REMOVERS.

It is often necessary or desirable to remove old paint or varnish before applying new.

In extreme cases it may be burned off with the assistance of a painter's torch, which renders the paint or varnish soft enough to be scraped off with a putty knife.

When the natural beauty of the wood is to be retained, and the new coating is to be varnished, this process cannot be used. In such cases, recourse must be had to some liquid solvent, which dissolves or softens the oils and resins which bind the paint or varnish coatings. Strong alkalies and some of the best or most active liquid solvents will do this more or less satisfactorily.

No. 1.

A wash of 26 degree ammonia water will very quickly soften paint or varnish so that it can be readily scraped or washed off.

A strong solution of caustic soda, or caustic potash, or carbonate of soda will answer the same purpose.

When paint or varnish has been removed by means of an alkali, the wood should be afterwards washed with dilute vinegar to neutralize the alkali and prevent further action on the new coating to be applied.

No. 2.

A mixture much used, is composed of pearlash, 1 part, and lime, 3 parts. Slack the lime with water and add the pearlash, making a cream the consistency of paint. Apply with a brush.

No. 3.

Carbonate of soda, 2 pounds; lime, 1-4 pound dissolved in one gallon of water. Allow to remain on the work 15 or 20 minutes. Scrape off the softened paint and wash the surface with weak vinegar.

Recently, there has appeared on the market various new liquid and paste paint and varnish removers of decided merit, and possessing none of the objectionable features of the old style alkaline removers, such as potash, soda, lime, and ammonia. These newer preparations are almost entirely free from odor and have no caustic action on the skin or clothes, which is a marked advantage. They are composed of such substances as readily and quickly soften and dissolve the resins and solidified oil or dry varnish and the oil binder used in the various paints.

The principal solvents used are analine oil, amyl acetate and fusil oil, in connection with benzine. The paste removers can be made from aniline oil to which is added sufficient starch paste to give the finished product a thin, pasty consistence. Paste removers usually contain potash.

For general use, a liquid remover is best and may be made as follows:

No. 1.

Make a mixture of equal parts of aniline oil and benzine: or compound one part of aniline oil, one part of amyl acetate and two parts of benzine.

Compound one part of aniline oil, one part of fusel oil and one to two parts of benzine. Aniline oil, if purchased in quantity, (the commercial grade) can be bought cheaply and such mixtures as will rapidly and energetically remove paint or varnish can be produced at from 50 cents to $1.00 per gallon, depending upon the quantity of raw materials purchased at one time. Such mixtures usually retail at $2.50 per gallon. With the above suggestions, the reader should have no difficulty in producing his own preparations at a material saving, or on such a basis as to be sold very profitably.

REMOVERS AND PRESERVATIVES.

To Remove Spots from Varnished Surfaces.—In general, rub the spots carefully with a rag moistened slightly with a mixture containing equal parts of raw linseed oil, turpentine and alcohol. When the spots disappear, polish with ordinary blotting paper.

To clean paint, use a piece of flannel dampened with warm water and dipped in dry whiting. Apply to the painted surface and rub, which will remove grease and dirt readily.

To Remove Spots From Ceilings, Caused By Rain or Moisture.—Take unslacked lime, dilute with alcohol and paint the spots with it. The lime forms a layer through which the stains will not again appear.

Removing Stains From Marble.—Boil together for 15 minutes, 1-4 pound of soap, 1-4 pound of whiting and 1 ounce of washing soda. Rub this over the marble while hot. Wash off the next day and polish with a coarse flannel.

To remove grease and stains from boards, use a paste of clay and water spread over the surface to be cleaned. A mixture of 5 parts fuller's earth and 1 part each, of pearl ash and soft soap boiled together with enough water to make a paste, applied and allowed to remain a few hours, then washed off with soap, will remove dirt and grease readily.

Ink can be removed with muriatic acid. After applying the acid, wash with water.

To Preserve Iron.—Clean the iron from rust and go over the surface with hot, raw linseed oil, or, if the article is small, heat it before applying the oil. Apply the paint on this as soon as the oil becomes tacky. Wood exposed to dampness can be treated in the same way.

To remove rust: use a mixture of paraffine oil and powdered emery, rubbed on with a cloth.

A protection to the iron is given by applying a varnish made of 1 part of paraffine wax dissolved in 15 parts of benzine.

To Remove Iron Rust.—Mix salt with lemon juice and rub on the rusty article. Soak the article to be cleaned in kerosene oil or wrap it in rags saturated with that liquid. Allow the oil plenty of time to loosen the rust, at least one or two days. Then scour the rust spots with brick dust or pumice stone. If much rust is to be removed, use hot commercial sulphuric acid diluted with water, to which add salt. Scour well, and wash with clean boiling water and polish, if desired, with some sweet oil applied to a flannel rag.

PAINT BRUSHES.

Every paint shop should be supplied with a brush keeper, which is a receptacle into which brushes may be so suspended that their bristles are immersed while their points are not allowed to come in contact with the bottom of the vessel. The liquid in the brush keeper may be raw linseed oil, thin varnish, kerosene or water. In no case must the bristles be immersed above the binding. Flat brushes in which the bristles have loosened, may be tightened by being squeezed in a vice where the wire fastening squeezes the bristles. New brushes should be kept in a cool, damp place before use, as both the bristles and wood will shrink in a warm, dry atmosphere. Brushes should be cleaned before being used. Work out the dust and loose hairs by whirling the brush back and forth through the hands. When free from loose hairs, dip the brush in water a few minutes, shake out the water, and, when dry, it is ready for use.

Remember that twisted bristles and misshapen ends cause the paint or varnish to cover poorly and will deface the surface with brush marks.

Brush marks are frequently the result of poorly applied under coatings. Each coat requires particular care and the surface must be properly prepared before you begin. If the paint or filler is too heavy, brush marks and imperfections are almost certain to show. Better have the under coats somewhat thin, therefore, that they may flow out or be brushed out smoothly.

Varnish should not be rubbed smooth, but should be allowed to flow out. Use the brush enough to make it even and to prevent it running or sagging. If too thick, thin your varnish with turpentine.

Paint Brushes, Care of—The bristles of a brush frequently come out because the brush is not used in the kind of liquid it is intended for. For distemper colors and all water paints, use a shellac or cement set brush. For oil paints and varnishes, glue and cement set brushes are best; while for shellacs and spirit varnishes, cement or glue set brushes can be also used. No brush should be placed in lime, alkaline, or acid solutions to the extent of allowing such substances to attack the composition used to hold the bristles in place, nor should a brush be allowed to be immersed in water up to the butt for any length of time.

Paint Brushes, To Clean—Suspend the brush in a vessel containing a solution of 1 part washing soda, dissolved in 3 parts water. Do not immerse the butt of the brush in the solution. Allow to remain in the solution several hours. The paint will become so soft as to be readily washed out with soap and water, no matter how hard it has become.

Kerosene oil is an excellent medium in which to clean brushes which have been used in paint, or varnish. Also to keep brushes soft, immerse the bristles in this liquid. The bristles will remain soft and pliable, whereas, benzine used for the same purpose tends to make them harsh.

WATER STAINS FOR WOOD.

Oak.—Make a solution of annatto, picric acid or quercitron and wash the wood with the solution.

Antique Oak.—Dissolve 1 part of permanganate of potash in 30 parts of water, wash the wood successively, after each coat is dry, until the desired shade is obtained, then wash with clean water.

Walnut.—Use the same solution as for antique oak, and when the required shade is produced after washing with water, go over the surface with a solution of acetate of iron.

Dark Mahogany.—Digest in 4 ozs. of pure grain or wood alcohol, 1 drachm of powdered alkanet root, 2 drachms of aloes and 2 drachms of dragon's blood. Shake occasionally. After standing 2 or 3 days, filter or pour off the clear liquid free from sediment. First treat the wood to be stained with a thin coat of dilute nitric acid, and when dry, apply the stain until the desired color is produced.

Light Mahogany.—Use the same stain as for dark mahogany, but apply less stain or dilute it with alcohol.

Mahogany.—After rubbing the wood with dilute nitric acid, and allowing it to dry, apply with a soft brush, a stain composed of 1 oz. of dragon's blood, 1 pint of alcohol and 1 oz. carbonate of soda dissolved in 4 ozs. of water. Stain until the shade is as desired. Be sure to have no sediment in the stain.

Cherry Stain.—Boil 2 ozs. of annatto in one quart of soft water. When dissolved, add 1-4 oz. of caustic potash; allow this to dissolve, after which, it is ready for use. Coat the wood in the usual way.

Grey Stain.—Apply a wash made of 1 part of nitrate of silver in 50 parts of water. Next, wash with dilute hydrochloric acid, and finally, with ammonia water. Allow to dry and finish as desired.

Maple Stain.—Dissolve 2 ozs. of orange shellac, 1-2 oz. of pearl ash and 1-4 oz. dragon's blood in 1 pint of grain or wood alcohol.

Ebony Stain.—Wash the wood repeatedly with a concentrated solution of actate of iron.

No. 2.

Wash with a solution made by dissolving 2 ozs. of sulphate of iron in one pint of hot water, after several applications, when dry, apply a wash made by dissolving 1 oz. extract of logwood in 1 pint of hot water to which a little alum is added.

No. 3.

Into 1 quart of boiling water put 1 1-2 ozs. of copperas and 1-2 oz. extract of logwood. Apply hot. When dry, coat the surface with a solution made of 2 ozs. of steel filings in 1-2 pint of strong vinegar.

WATER AND SPIRIT STAINS FOR WOOD.

Blue.—Indigo in water.

Blue Black.—Extract of Logwood dissolved in alcohol to which sufficient Indigo is added.

Brown.—Mix equal parts of solution of Logwood extract and solution of saffron, dilute with alcohol and add some tin solution.

Brownish Red.—Mix a decoction of Brazil wood with some solution of tin.

Crimson.—Solution of cochineal in alcohol. Dragon's blood dissolved in alcohol gives more of a mahogany tone.

Dark Grey.—Use first, extract of gall nuts, then, solution sulphate of iron, and, finally, dilute solution of Indigo.

Greenish.—Extract of saffron with addition of some Indigo solution.

Green.—Same as above, with more Indigo.

Greenish Grey.—Decoction of gall nuts, sulphate of iron and fustic with some Indigo solution.

Yellowish Gray.—Decoction of Persian berries, mixed with solution sulphate of iron.

Cherry Red.—Decoction of Brazil wood diluted with alcohol to which some solution of tin is added.

Orange.—Annatto or saffron dissolved in alcohol.

Red.—Solution of cochineal mixed with saffron solution.

Rose Color.—Cochineal and alum water.

Straw Color.—First, decoction of Persian berries, then weak solution of tin.

Solution of gall nuts is made by steeping powdered gall nuts in alcohol and straining after standing a day of two.

Sulphate of iron solution is made of copperas dissolved in alcohol. Extract of Logwood dissolved in alcohol gives the Logwood solution.

Solutions of Brazil wood, fustic, and Persian berries are made by steeping in hot water.

Cochineal solution is made by boiling cochineal in double its weight of ammonia water until the ammonia smell is no longer present. Mix the residue with alcohol and filter. Use a gentle heat when treating the cochineal with ammonia.

Indigo solution is made by dissolving indigo in four times its weight of strong sulphuric acid. Allow it to settle, and dilute with water.

Solution of Tin.—Dissolve 50 parts of tin in 50 parts of hydrochloric acid by boiling.

Various aniline colors, both soluble in oil and water can be purchased at a reasonable price, considering their great strength or staining power. The stain is made by simply dissolving the aniline in the linseed oil, turpentine, water, or alcohol, and applying at the desired strength. Such stains can be made at a cost of little more than the actual cost of the oil or turpentine, or from water, at a cost of a few cents per gallon. Varnish stains can be made by dissolving the aniline colors in a little turpentine and stirring the varnish with the color. Many varnish stains on the market are produced in this way. By making your own, you can get the exact color and strength desired, and be sure of having a good grade of varnish, whereas, in purchasing the ready made article, it is often uncertain, and the price is always about four times what you can produce the same article for.

The anilines give clear brilliant tones, and while some fade a little, for the most part, they are fairly permanent, especially when protected with varnish.

For absolute permanency, the earth pigments are best, but the brilliant clear effects are more difficult to procure.

We give a list of the most satisfactory pigment stains which cost, in oil, about 60 cents per gallon, and in varnish, from 40 to 75 cents, according to the varnish used.

Yellow Brown and Red Brown Stains.

A solution of 1 oz. of commercial alizarine in 20 ozs. of water, to which solution ammonia is very slowly added until the ammonia odor is perceptible, will give to oak, a yellow brown color, and to maple, a red brown. If the wood is then treated with a solution of barium chloride (2 drams to the pint of water), the first named wood becomes brown, and the latter dark brown. If calcium chloride is used in place of barium chloride, fir wood becomes brown, oak, red brown, and maple, dark brown.

If a solution of magnesium sulphate be used (4 drams to the pint of water), the fir and oak become dark brown and the maple, a dark violet brown.

Alum produces on fir a light red, and on maple, and oak, a blood red.

Chrome alum colors maple and fir reddish brown, and oak, a rich brown; manganese sulphate renders fir and maple a dark violet brown, and oak, a dark walnut brown.

VARNISH AND OIL STAINS.

These are made by the addition of tinting colors to definite quantities of varnish or oil, with the addition of liquid dryers. In selecting colors for these stains, it is important that those of the greatest tinting power, transparency and brilliancy be selected, and care should be exercised in selecting such pigments as are unfading and permanent. The tinting mediums can be increased or diminished to suit the shade or color required and the nature of the material on which they are to be used. The varnish used may be low priced, or of good grade, to suit the class of work they are intended for. In a general way, however, it should be hard and rather quick drying. If too heavy, reduce with turpentine or benzine. This will be necessary.

Oil stains can be produced by substituting this medium in the same proportion as the varnish, with the addition of 1-2 pint each, of good liquid dryer and turpentine to the gallon.

Cherry Varnish Stain.—To each gallon of varnish, add 1-2 pound of burnt sienna, and 1-2 pound of yellow ochre, both ground (in oil).

Dark Cherry Varnish Stain.—Add 1 pound of burnt sienna in oil to each gallon of varnish.

Walnut Varnish Stain.—Add 1 pound of burnt umber in oil to each gallon; or tint the varnish with asphaltum varnish.

ANTIQUE OAK VARNISH STAIN.—Add 1 pound of ochre and 1-4 pound of burnt umber in oil to the gallon.

OAK VARNISH STAIN.—Add 1 pound of ochre in oil to each gallon.

MAHOGANY VARNISH STAIN.—Add 1-2 pound of maroon lake and 1-2 pound of burnt sienna in oil to each gallon.

ROSEWOOD VARNISH STAIN.—Add 1 pound of rose pink and 1-2 pound of burnt sienna in oil to each gallon.

GREEN VARNISH STAIN.—Add 1 pound of pure chrome green in oil to each gallon.

These shades can be varied also by the addition of other colors to produce special colors as desired.

SHINGLE STAINS.—These stains must be made from permanent unfading colors mixed with some medium which readily penetrates the wood, and which is indifferent to the effect of weather.

A good cheap base is 3 gallons of water white, 150 degree test petroleum oil, 2 gallons of crude creasote oil, and 1-2 gallon of good liquid dryer, tinted the desired color.

For a better grade of shingle stain, use 2 gallons of raw linseed oil, 2 gallons of turpentine, 1 gallon of creasote oil and 1-2 gallon of dryer, tinted as above.

The creasote used should be clear and not too dark or heavy. Crude carbolic acid can be substituted, and is lighter and clearer than ordinary creasote or dead oil.

Shingle stain need not contain creasote, but may be made in the usual way from raw oil, turpentine and dryer. Linseed oil stains tend to turn black after exposure, when used on shingles.

SHELLAC VARNISH so easily made and so subject to adulteration, should claim the painter's special attention. The many cheap shellac varnishes on the market are adulterated with rosin or cheap gum resins, which detract seriously from the hardness and general wearing qualities. Such shellac varnishes tend to flake off or blister and soon perish. When you prepare your own, you know just what you have and your results when applied to work are certain.

Grain Alcohol, White Shellac.—To 10 pounds of white shellac granulated, add 2 gallons of grain alcohol in a closed wooden or earthenware vessel. Agitate occasionally. Costs from $2.50 to $3.00

per gallon, according to the price of the raw materials. The yield is 3 gallons.

Orange grain alcohol shellac is made in the same way, using orange shellac of good quality. The cost is a trifle less than the white.

Wood alcohol white and orange shellacs call for the same general treatment substituting wood alcohol for grain. Average cost $1.50 to $1.80 per gallon.

As both alcohol and shellac are usually sold on a very close margin of profit, you can readily see that shellac must be adulterated to sell at the prices frequently met with.

A good cheap orange shellac is made as follows:

Dissolve in the usual way with occasional agitation, 5 pounds of orange shellac and 5 pounds of pulverized rosin in 2 gallons of wood alcohol. Costs about $1.00 per gallon and will answer very well as a knotting or priming shellac.

All of these formulae give shellacs of extreme body and they admit of much reducing with alcohol.

The addition of 1 pint of Venice turpentine to each gallon of cheap shellac will much improve the elasticity.

Spirit Varnish for Floors.—Dissolve 5 pounds of gum sandarac and 8 pounds of orange shellac in 4 gallons of wood alcohol. Yield 6 1-2 gallons. This mixture reduced one-half with wood alcohol makes a splendid polish for furniture.

Grain alcohol can be used in its preparation also.

Shellac Water Varnish.—Dissolve 1 pound of borax in 2 1-2 gallons of hot water and add to this little by little, 3 pounds of white shellac. Allow to stand, add more shellac if too thin.

No. 2.

3 pounds of orange shellac, 1 pound sal ammoniac and 1 gallon of water shaken together and allowed to stand 12 hours. Then heat until dissolved. Thin with water if too heavy. This makes an excellent primer or filler for many purposes. It dries hard and is little affected by moisture. A very cheap spirit varnish can be made by dissolving 20 pounds of powdered rosin in 2 gallons of wood alcohol with the addition of from 1 pint to 1 quart of Venice turpentine. This dries hard and entirely on the surface, and is useful as a quick drying filler or wall surfacer.

SPECIAL VARNISHES.

Colorless Varnish or Lacquer.—Dissolve 4 ozs.

gum sandarac and 1 oz. Venice turpentine in 1 pint of alcohol. A good spirit varnish and lacquer for general use.

Transparent Brilliant Varnish.—Dissolve 10 parts of mastic, 5 parts of camphor, 5 parts sandrac and 5 parts of kauri gum in 100 parts of alcohol. This is a durable spirit varnish.

Waterproof Varnish.—White shellac gum, 30 parts; borax, 8 parts; carbonate of soda, 2 parts; glycerine, 2 parts; water, 320 parts.

Dissolve the borax and carbonate of soda in half the water warmed, and add the shellac ground. Heat, agitate and filter. When cool, add the glycerine and the balance of the water. Use the clear varnish, free from sediment.

Waterproof Paper Varnish.—Dissolve with little heat, 1 part of gutta percha in 40 parts of benzine. Gun cotton dissolved in amyl acetate, so-called collodion varnish, is also used for the same purpose.

To lighten shellac varnish which has become dark with age, add 1-4 oz. of oxalic acid to each gallon of shellac to be treated. Shellac varnishes should never be kept in metallic vessels any length of time.

Collodion varnish used as a bronzing liquid, and for other purposes can be made as follows:

Gun cotton, (dry), 1 1-2 pounds,
Acetone, 10 pounds,

Dissolve the gun cotton in the acetone, then add:

Acetate of amyl, 20 lbs.,
Benzine, 20 lbs.

Allow to settle out and pour off the clear solution or filter, if desired.

No. 2.

Amyl acetate 1 gallon,
Benzol, 1 gallon,
Gun cotton, 10 ozs.

These varnishes can be made more flexible by the addition of 4 ozs. of castor oil to each gallon of varnish.

Frequently a varnish is required which, when dry, will present a flat or dead surface, instead of the usual gloss, or which will present the appearance of having been rubbed without the labor and expense of that operation. Various ''flat varnishes'' are on the market. They owe this quality to the fact that they contain wax and are very thin in body.

Such a varnish is produced by heating together at a temperature just sufficient to melt the wax, 2 ozs. of bees' wax, paraffine or ceresin wax to each quart of any rubbing varnish and thinning with 1-2 pint of turpentine. Hard oil finish may be treated in the same way. Apply as a final coating to the surface previously varnished in the ordinary way. The amount of wax may be varied to suit circumstances.

Dead surface varnishes are also prepared by compounding mixtures of resin solutions with liquids in which they are insoluble. A solution of gum sandrac in ether, when mixed with 1-4 of benzole, gives a surface resembling ground glass, as does damar dissolved in benzole when ether is mixed with it.

Dead Finishing Varnish.—Dissolve 10 parts of gum sandarac in 34 parts of ether; when dissolved, add 34 parts of benzole.

SUBSTITUTES.

Paint Oils and Boiled Oil Substitutes.

The necessity often arises for a cheap oil for use in paint where rough work is to be protected, and the price of pure linseed oil would preclude its use. In such a case, substitutes are allowable. If, however, they are to be mixed with pure oil as adulterants to cheapen the product and defraud the purchaser, their use is to be deplored.

The ever-increasing demand for cheap paints has brought many substitutes for linseed oil on the market, few of which can compare in any particular with the qualities of the oil they are intended to replace.

The other vegetable drying oils are excluded on account of their price, (at one time cotton seed oil was used), and from it an excellent substitute can be produced. Animal and fish oils are also excluded for the same reason; price.

We have left then, to choose from, the various substitutes prepared from rosin, rosin oil and the mineral oils which, in most cases, need the addition of linseed oil to give them any degree of goodness.

The rosin and rosin oil substitutes are apt to dry extremely brittle and friable and the great difficulty with mineral oil, if combined in large proportion with linseed oil, is that the mineral oil, especially if of the heavier variety, will not dry, but, on the other hand sweat out on the layer of drying oil and be of no value.

When mineral oil is combined with linseed oil in moderate amount, it may be used as a fair paint oil.

The various resinates made by dissolving rosin in an alkali, forming rosin soap, and precipitating the rosin with some metallic salt, such as sulphate of zinc, sugar of lead, or chloride of manganese, produces metallic resinates which, when dissolved in benzine or turpentine form acceptable substitutes.

Rosin oil is refined, boiled and a proportion of manganese or lead dryer is added to give it more hardness and better drying qualities.

Oxidized linseed oil, which is oil boiled until it becomes a thick viscid substance, thinned with benzine or kerosene to a proper body is, perhaps, one of the best substitutes in use.

All these oils require apparatus and skill for their preparation.

To make substitutes without the aid of heat or apparatus, the following mixtures are recommended as being equal to, or the same as many of the so-called roof oils and cheap paint oils on the market.

Paint Oil from Rosin Oil.—For this purpose use for light colored oils, first or second run rosin oil. The third run can be used for darker oils.

No. 1.

Rosin oil, 30 gallons,
Raw linseed oil, 15 gallons,
Strong manganese dryer, 5 gallons.

Mix thoroughly. Less linseed oil can be added, which reduces the quality of the resulting product.

No. 2.

Rosin oil, 45 gallons,
Strong manganese dryer, 5 gallons,

The odor of rosin oil is often objectionable. Rosin oil is sometimes called bright varnish. It must be remembered that rosin oils and rosin, when mixed with white lead, have a tendency to liver, or thicken. Zinc white will act in the same way if the oils are not largely linseed. Such oils, at best, should only be used with the earth pigments, as ochre, iron oxides, graphite, etc.

Paint oil substitutes may be made also by substituting gloss oil, (rosin varnish) for rosin oil. In this way, the objectionable odor in rosin oil is eliminated as rosin varnish is free from it.

Gloss oil, 30 gallons,
Raw linseed oil, 15 gallons,
Strong manganese dryer, 5 gallons,

or,

Glass oil, 40 gallons,
Raw linseed oil, 10 gallons,
Strong manganese dryer, 5 gallons.

Liquid, or Japan dryer made with litharge or other lead compounds may be used in place of manganese dryer.

A dryer, containing both lead and manganese, is much more powerful than dryer composed of either of these substances alone. Oil of mirbane is used to disguise the odor of strong smelling oils.

TURPENTINE SUBSTITUTES.

They consist, generally, of benzine, kerosene, rosin spirit, or coal tar naptha, mixed with various proportions of turpentine, to which is added also some substance to disguise the odor of the substances used, and simulate the odor of turpentine.

None of them replace turpentine in its peculiar qualities, but they serve a purpose where cheap solvents or diluents are called for. While these substitutes dry rapidly by evaporation, it will be found that pure turpentine, when used in the same proportion, causes more rapid drying of the paint or varnish to which it is added, than when benzine or similar substances are used, as turpentine absorbs oxygen and these substitutes do not have any influence on the paint.

No. 1.

Turpentine, 20 gallons,
Benzine, 20 gallons,
Kerosene, 10 gallons,
Camphor oil, 1-4 gallon.

No. 2.

Turpentine, 10 gallons,
Benzine, 20 gallons,
Kerosene, 20 gallons,
Camphor oil, 1-2 gallon.

No. 3.

Turpentine, 10 gallons,
Benzine, 30 gallons,
Kerosene, 10 gallons,
Camphor oil, 1-4 gallon,
Raw linseed oil, 1 gallon.

Oil of lemon is also used in the proportion of 1-2 oz. to the gallon, in place of camphor oil. The use of oil of lemon is excluded, because of the price, whereas, oil of camphor is very cheap.

Other turpentine substitutes:

Pinoline, or resin spirit, 20 gallons,
Benzine, 20 gallons,
Kerosene, 10 gallons,
Camphor oil, 1-4 gallon.

Pinoline, or resin spirit, 10 gallons,
Turpentine, 10 gallons,
Benzine, 30 gallons,
Camphor oil, (if necessary), 1-8 gallon.

Finally, it might be added that deodorized or varnish makers' benzine should be used, as having less odor.

WATER GLASS, (SILICICATE OF SODA) PAINTS.

For Coating Rough Walls.—Mix one part of commercial water glass with three parts of water. Apply this with a brush. The lime in the mortar forms with water glass, silicate of lime and a coating of glassy appearance results, solid, hard, and resistent to the action of the weather.

By painting whitewashed walls with water glass, the coating is rendered much more durable and will not rub off.

Zinc white 2 parts, and Paris white 1 part, mixed in water glass gives a beautiful white color.

Water glass is well adapted for painting metal, either alone or mixed with pigments.

Such a coating resists moisture and prevents rust or corrosion of the metal.

To each gallon of water glass, add 4 pounds of earth pigment and apply in the usual way. The addition of 1-4 pound of caseine, or 1-2 pound of dextrine to each gallon of water glass used, will render the coating more elastic and prevent scaling of the paint.

Wood is rendered fireproof by a simple coating of this substance.

PERMANENT WHITEWASH.—Slack 1-2 bushel of lime with boiling water in a covered vessel. Strain through a fine sieve, add 7 lbs. of salt, previously dissolved in warm water, 2 lbs. of ground rice, boiled to a paste and stirred in boiling hot, 1-2 lb. of powdered whiting, 1 lb. glue, previously dissolved. Add 5 gallons of hot water to the mixture, stir well, then let stand a few days, well protected from dust and dirt. Apply hot. Coloring matter may be added.

Whitewash.—Mix up the lime and water in the usual way, add a little salt; then add 1 lb. of flour, previously mixed with hot water, to each pailful of whitewash.

Whitewash.—Slake 30 pounds of lime in a suitable vessel, by covering it with water. Dilute the mixture, and add 2 pounds of sulphate of zinc, and

1 pound of salt; or in place of the zinc and salt, add 1 pound of good Portland, or other hydraulic cement to each 10 pounds of lime used.

IN KALSOMINING or applying water or fresco colors it is often required to point up or fill cracks and crevices in the surface to be covered. For this purpose, make a mixture of plaster of Paris and whiting, equal parts, formed into a paste with weak glue size.

The wall should then be sized with some suitable substance; either with ceiling varnish or some quick drying varnish containing little oil, with a solution of caseine dissolved in borax water, or mixed with an equal portion of slacked lime thinned to the consistency of thin paint, or with silicate of soda thinned with water.

The ordinary size is made by combining the following:

Good white glue, or gelatine, 1 pound,
Alum, powdered, 1-2 pound,
Ordinary soap, 1-4 pound,

Dissolve separately in boiling water. Mix the soap and glue solutions and add the alum water slowly to the above with stirring. Thin with cold water to the consistency of thin paint or size.

To prepare kalsomine, mix to a thick paste with water, Paris white, and add 1 oz. of good glue or gelatine dissolved in hot water to each two pounds of Paris white used. Whiting can be substituted for Paris white. Colors can be added before the glue solution has been mixed with the Paris white. Mix the colors, if dry, with a little water and add them in thin paste form. If much color is added, use additional glue in the same proportion as used with the Paris white. As Paris white, and similar white pigments when used alone tend to turn yellow, the addition of a little ultramarine blue is advisable to give a satisfactory white when dry.

Whiting is graded according to its fineness, and sold as extra gilders, gilders and common bolted whiting. The best should be used in all cases. This applies to Paris white also. These materials are too cheap to experiment with and much loss is entailed by the use of other than the finest grades.