WORKSHOP RECEIPTS.

Drawing Paper.—The following table contains the dimensions of every description of English drawing-paper.

	Inches.		Inches.
Demy	20	by	15
Medium	22	„	17
Royal	24	„	19
Imperial	31	„	21
Elephant	27	„	23
Columbier	34	„	23
Atlas	33	„	26
Double Elephant ..	40	„	26
Antiquarian ..	52	„	29
Emperor	68	„	48

For making detail drawings an inferior paper is used, termed Cartridge; this answers for line drawings, but it will not take colours or tints perfectly. Continuous cartridge paper is also much used for full-sized mechanical details, and some other purposes. It is made uniformly 53 inches wide, and may be had of any length by the yard, up to 300 yards.

For plans of considerable size, mounted paper is used, or the drawings are afterwards occasionally mounted on canvas or linen.

Mounting Drawings or Paper on Linen.—The linen or calico is first stretched by tacking it tightly on a frame or board. It is then thoroughly coated with strong size, and left until nearly dry. The sheet of paper to be mounted requires to be well covered with paste; this will be best if done twice, leaving the first coat about ten minutes to soak into the paper. After applying the second coat, place the paper on the linen and dab it all over with a clean cloth. Cut off when thoroughly dry.

To Fasten Paper on a Drawing Board.—The stretched irregular edges of the sheet of paper are cut off against a flat ruler, squaring it at the same time. The sheet of paper is laid upon the board the *reverse* side upwards to that upon which the drawing is to be made. It is then damped over, first by passing a moist clean sponge, or wide brush, round the *edges* of the paper about an inch and a half on, and afterwards thoroughly damping the whole surface, except the edges. Other plans of damping answer equally well; it is only necessary to observe that the edges of the paper should not be quite so damp as the other part of the surface. After the paper is thoroughly damped, it is left until the wet gloss entirely disappears; it is then turned over and put in its position on the board. About half an inch of the edge of the paper is then turned up against a flat ruler, and a glue-brush with hot glue passed between the turned-up edge and the board; the ruler is then drawn over the glued edge and pressed along. If upon removing the ruler the paper is found not to be thoroughly close, a paper-knife or similar article passed over it will secure perfect contact. The next *adjoining edge* must be treated in like manner, and so on each consecutive edge, until all be secured. The contraction of the paper in drying should leave the surface quite flat and solid.

Cutting Pencils.—If the point is intended for sketching, it is cut equally from all sides, to produce a perfectly acute cone. If this be used for line drawing, the tip will be easily broken, or otherwise it soon wears thick; thus, it is much better for line drawing to have a thin flat point. The general manner of proceeding is, first, to cut the pencil, from two sides only, with a long slope, so as to produce a kind of chisel-end, and afterwards to cut the other sides away only sufficient to be able to round the first edge a little. A point cut in the manner described may be kept in good order for some time by pointing the lead upon a small piece of fine sandstone or fine glass-paper; this will be less trouble than the continual

application of the knife, which is always liable to break the extreme edge.

Erasing Errors.—To erase Cumberland-lead pencil marks, native or bottle india-rubber answers perfectly. This, however, will not entirely erase any kind of German or other manufactured pencil marks. What is found best for this purpose is fire vulcanized india-rubber; this, besides being a more powerful eraser, has also the quality of keeping clean, as it frets away with the friction of rubbing, and presents a continually renewed surface to the drawing; the worn-off particles produce a kind of dust, easily swept away. Vulcanized rubber is also extremely useful for cleaning off drawings, as it will remove any ordinary stain.

For erasing ink lines, the point of a penknife or erasing knife is commonly used. A much better means is to employ a piece of fine glass-paper, folded several times, until it presents a round edge; this leaves the surface of the paper in much better order to draw upon than it is left from knife erasures. Fine size applied with a brush will be found convenient to prevent colour running.

To produce finished drawings, it is necessary that no portion should be erased, otherwise the colour applied will be unequal in tone; thus, when highly-finished mechanical drawings are required, it is usual to draw an original and to copy it, as mistakes are almost certain to occur in delineating any new machine. Where sufficient time cannot be given to draw and copy, a very good way is to take the surface off the paper with fine glass-paper before commencing the drawing; if this be done, the colour will flow equally over any erasure it may be necessary to make afterwards.

Where ink lines are a little over the intended mark, and it is difficult to erase them without disfiguring other portions of the drawing, a little Chinese white of flake-white, mixed rather dry, may be applied with a fine sable-brush; this will render a small defect much less perceptible than by erasure.

Whenever the surface of the paper is roughened by using the erasing knife, it should be rubbed down with some hard and perfectly clean rounded instrument.

Buying Drawing Instruments.—Persons with limited means will find it better to procure good instruments separately of any respectable maker, W. Stanley of Holborn for instance, as they may be able to afford them, than to purchase a complete set of *inferior* instruments in a case. With an idea of economy, some will purchase second-hand instruments, which generally leads to disappointment, from the fact that inferior instruments are manufactured upon a large scale purposely to be sold as second-hand to purchasers, principally from the country, who are frequently both unacquainted with the workmanship of the instruments and of the system practised.

Inferior instruments will never wear satisfactorily, whereas those well made improve by use, and attain a peculiar working smoothness. The extra cost of purchasing the case and the nearly useless rules, would, in many instances, be equal to the difference between a good and an inferior set of instruments without the case. Instruments may be carefully preserved by merely rolling them up in a piece of wash leather, leaving space between them that they may not rub each other; or, what is better, having some loops sewn on the leather to slip each instrument separately under.

Drawing Board.—The qualities a good drawing board should possess are, an equal surface, which should be slightly rounded from the edges to the centre, in order that the drawing paper when stretched upon it may present a solid surface; and that the edges should be perfectly straight, and at right angles to each other.

In Using a Drawing Pen, it should be held very nearly upright, between the thumb and first and second fingers, the knuckles being bent, so that it may be held at right angles with the length of the hand. The

handle should incline only a very little—say ten degrees. No ink should be used except indian ink, rubbed up fresh every day upon a clean palette. Liquid ink and other similar preparations are generally failures. The ink should be moderately thick, so that the pen when slightly shaken will retain it a fifth of an inch up the nibs. The pen is supplied by breathing between the nibs before immersion in the ink, or by means of a small camel-hair brush; the nibs will afterwards require to be wiped, to prevent the ink going upon the edge of the instrument to be drawn against. The edge used to direct the pen should in no instance be of less than a sixteenth of an inch in thickness; a fourteenth of an inch is perhaps the best. If the edge be very thin, it is almost impossible to prevent the ink escaping upon it, with the great risk of its getting on to the drawing. Before putting the pen away, it should be carefully wiped between the nibs by drawing a piece of folded paper through them until they are dry and clean.

To Test the Accuracy of a Straight-edge.—Lay the straight-edge upon a stretched sheet of paper, placing weights upon it to hold it firmly; then draw a line against the edge with a needle in a holder, or a very fine hard pencil, held constantly vertical, or at one angle to the paper, being careful to use as slight pressure as possible. If the straight-edge be then turned over to the reverse side of the line, and a second line be produced in a similar manner to the first at about the twentieth of an inch distance from it, any inequalities in the edge will appear by the differences of the distances in various parts of the lines, which may be measured by spring dividers.

Another method will be found to answer well if three straight-edges are at hand; this method is used in making the straight-edge. Two straight-edges are laid together upon a flat surface, and the meeting edges examined to see if they touch in all parts, reversing them in every possible way. If these two appear perfect, a third straight-edge is applied to each of the edges already tested, and if that touch it in all parts the edges are all perfect. It may be observed that the first two examined, although they touch perfectly, may be regular curves; but if so, the third edge applied will detect the curvature.

In Using the Plain Parallel Rule, one of the rules is pressed down firmly with the fingers, while the other is moved by the centre stud to the distances at which parallel lines are required. Should the bars not extend a sufficient distance for a required parallel line, one rule is held firmly, and the other shifted, alternately, until the distance is reached.

Using Dividers or Compasses.—It is considered best to place the forefinger upon the head, and to move the legs with the second finger and thumb. In dividing distances into equal parts, it is best to hold the dividers as much as possible by the head joint, after they are set to the required dimensions; as by touching the legs they are liable to change, if the joint moves softly as it should. In dividing a line, it is better to move the dividers alternately above and below the line from each point of division, than to roll them over continually in one direction, as it saves the shifting of the fingers on the head of the dividers. In taking off distances with dividers, it is always better, first to open them a little too wide, and afterwards close them to the point required, than set them by opening.

Pencilling.—If a drawing could be at once placed to the best advantage on the paper, and surely made without mistake and with all its lines correctly limited when first drawn, it might be made in ink directly on the blank paper. To avoid the errors inevitable in the first copy of any production, even when made by those most practised, drawings are first pencilled and then inked. The whole theory of pencilling, then, is, to lay out correct *tracks* on which the pen is to move, leaving the

mind, during the inking, free from all thought of *accuracy* of the *construction*, that it may be given to *excellence* in *execution*. Therefore, the whole of the pencil-construction should be *most accurately* made in the *finest faint* lines with a hard pencil.

Finishing a Drawing.—While "Finish a drawing without any error or defect," should be the draughtsman's best motto, he should never be in haste to reject a damaged drawing, but should exercise his ingenuity to see how far injuries done to it may be remedied. "Never lose a drawing once begun," should be his second motto; and since prevention is easier and better than cure, let him always work calmly, inspect all instruments, hands, and sleeves, that may touch a drawing, before commencing an operation; let the paper, instruments, and person *be kept clean*, and when considerable time is to be spent upon a portion of the paper, let the remainder be covered with waste paper, pasted to one edge of the board.

For the final cleaning of the drawing, stale bread, or the old-fashioned black india-rubber, if not sticky, is good; but, aside from the carelessness of ever allowing a drawing to get very dirty, any fine drawing will be injured, more or less, by *any* means of removing a considerable quantity of dirt from it.

Another excellent means of preventing injuries, which should be adopted when the drawing is worked upon only at intervals, is to enclose the board, when not in use, in a bag of enamelled cloth or other fine material.

Lettering.—The title to a drawing should answer distinctly the four questions— *What*, *Who*, *Where*, and *When*—*What*, including the use and scale; *Who*, both as to designer or inventor, and draughtsman; *Where*, both as to the place, institution, or office where the drawing was made, and the locality of the object drawn; and *When*.

If the drawing is perfectly symmetrical, its title should have the same axis of symmetry as the drawing. If the drawing is unsymmetrical, the title may be at either of the lower corners.

These principles do not apply to horizontal views, as maps of surveys, where the title may be wherever the shape of the plot affords the best place.

One quite essential element of beauty in a title is its arrangement, or the *form of its outline* as a whole. It should embrace such variations in the length of its lines of letters that the curve formed by joining the extremities of those lines would be a simple and graceful one, having also a marked variety of form. Also the greatest length of the title should generally be horizontal; or its proportions, as a whole, like those of the border of the drawing.

When the occupation of the paper affords only narrow blank spaces lying lengthwise of the paper, the title looks well mostly on a single line at the bottom, the principal words being in the middle, and the subordinate ones at the two sides.

Moreover, horizontal lines should prevail in the direction of the lines of words in the title. Indeed, the title may be arranged wholly on horizontal lines with good effect, though an arched or bow-shaped curve for the principal words may be adopted when the drawing includes some conspicuous arching lines.

The size of the title should be appropriate to that of the drawing. In particular, the rule has been proposed that the height of the largest letters in the title should not exceed three-hundredths of the shorter side of the border. Also, the relative size of the different portions of the title should correspond to their relative importance, the name of the object and its inventor being largest, and that of the draughtsman, his location, and the date of his work being considerably smaller.

Geometrical drawings are *most* appropriately lettered with geometrical letters, which, when neatly made, always look well. Any letters, however, having any kind of sharply-defined and precise form, as German text, are not inappropriate to a geometrical drawing; but vaguely formed "rustic" or other

free-hand letters are in bad taste on such drawings.

Letters should correspond in conspicuousness or body of colour with the rest of the drawing, not being obtrusive from great heaviness of solid black outline, or unobservable from excessive faintness. Also, violent contrasts of heaviness among neighbouring portions of the title should be avoided; though there may be a gradual change, both of intensity and size, from the most to the least important words of the title.

This should, first of all, not exceed in elaborateness the draughtsman's ability to execute it with perfect neatness and clearness. Then it should agree with the character of the drawing. Plain and simple letters look best on a similar drawing, while a complicated and highly-finished drawing may receive letters of more ornamental character.

Borders.—For line drawings the border should be a geometrical design, in lines, with curved or angular corners, or with combinations of straight or curved lines, forming geometrical corner-pieces. These borders may vary in complexity from a rectangular border in single lines to borders which, though geometrical, may be elaborate and elegant. Thus: a plate of varieties of straight horizontal lines may have a plain rectangular border; one including oblique lines may include oblique lines in the border, either as a little tuft in each corner, a truncated corner, or a square set diagonally, &c. Plates embracing curve lines may have quarter-circle borders, either convex or concave inwards—of which the former have most decision. Such plates may also have little circles for corner-pieces. Borders may sometimes conform in a pleasing manner to the general outline of a drawing. Thus, an arched bridge may have a semi-oval upper border and a square-cornered border at the base of the drawing; and an ornamental device may crown the summit of the border.

When the drawing is a shaded one, containing, therefore, some free-hand work, the border may be partly free-hand also; but should still be largely geometrical in its design, and should represent a real border of substantial materials, corresponding to the subject of the drawing. Thus, the mouldings and ornaments should represent ornamental metallic castings, carvings in wood, mouldings in plaster, or scrolls and leaves of rolled metal; but garlands, tassels, and tendrils, &c., should not be introduced.

The border to a geometrical drawing should be like the drawing itself in being executed with the drawing pen and brush, as well as with the mapping pen. Free-hand pen borders, representing the products of the soil, with cornucopias, little pen sketches of scenery, or similar agricultural or landscape devices, worked in as corner-pieces, are more appropriate on topographical drawings.

As to colour, *primary* colours should not be largely introduced into the border; *first*, since they, when obtrusive, are adapted to ruder or less impressible tastes than the secondary hues, shades, and tints, which are more gratifying to delicate tastes; and *secondly*, from the impertinent conspicuousness which they may give to the border.

Drawings which are shaded only in sepia or ink, or any dark neutral tint, may have the border done in the same, or in a dark complementary colour. Tinted ink drawings are best finished with a plain ink border.

Indian Ink is used for producing the finished lines of all kinds of geometrical drawing. Being free from acid, it does not injure or corrode the steel points of the instruments. The genuine ink, as it is imported from China, varies considerably in quality; that which answers best for line drawing will wash up the least when other colours are passed over it. This quality is ascertained in the trade, but not with perfect certainty, by breaking off a small portion. If it be of the right quality it will show, when broken, a very bright and almost prismatic-coloured fracture. Indian ink should be used immediately after it is mixed; if re-dissolved it becomes cloudy and irregular in tone,

but with every care, it will still wash up more or less.

Colours.—For colouring drawings, the most soluble, brilliant, and transparent water-colours are used; this particularly applies to plans and sections. The colour is not so much intended to represent that of the material to be used in the construction, as to clearly distinguish one material from another employed on the same work.

The following table shows the colours most employed by the profession:—

Carmine or Crimson Lake	For brickwork in plan or section to be executed.
Prussian Blue	Flintwork, lead, or parts of brickwork to be removed by alterations.
Venetian Red	Brickwork in elevation.
Violet Carmine	Granite.
Raw Sienna	English timber (not oak).
Burnt Sienna	Oak, teak.
Indian Yellow	Fir timber.
Indian Red	Mahogany.
Sepia	Concrete works, stone.
Burnt Umber	Clay, earth.
Payne's Grey	Cast iron, tough wrought iron.
Dark Cadmium	Gun metal.
Gamboge	Brass.
Indigo	Wrought iron (bright).
Indigo, with a little Lake	Steel (bright).
Hooker's Green	Meadow land
Cobalt Blue	Sky effects.

And some few others occasionally for special purposes.

In colouring plans of estates, the colours that appear natural are mostly adopted, which may be produced by combining the above. Elevations and perspective drawings are also represented in natural colours, the primitive colours being mixed and varied by the judgment of the draughtsman, who, to produce the best effects, must be in some degree an artist.

Care should be taken in making an elaborate drawing, which is to receive colour, that the hand at no time rest upon the surface of the paper, as it is found to leave a greasiness difficult to remove. A piece of paper placed under the hand, and if the square is not very clean, under that also, will prevent this. Should the colours, from any cause, work greasily, a little prepared ox-gall may be dissolved in the water with which the colours are mixed, and will cause them to work freely.

Shading.—For shading, camel or sable hair brushes, called Softeners, are generally used: these have a brush at each end of the handle, one being much larger than the other. The manner of using the softener for shading is, to fill the smaller brush with colour, and to thoroughly moisten the larger one with water; the colour is then laid upon the drawing with the smaller brush, to represent the dark portion of the shade, and immediately after, while the colour is quite moist, the brush that is moistened with water is drawn down the edge intended to be shaded off; this brush is then wiped upon a cloth and drawn down the outer moist edge to remove the surplus water, which will leave the shade perfectly soft.

If very dark shades are required, this has to be repeated when the first is quite dry.

To tint large surfaces, a large camel-hair brush is used, termed a Wash-brush. The manner of proceeding is, first, to tilt the drawing, if practicable, and commence by putting the colour on from the upper left-hand corner of the surface, taking short strokes the width of the brush along the top edge of the space to be coloured, immediately following with another line of similar strokes into the moist edge of the first line, and so on as far as required, removing the last surplus colour with a nearly dry brush. The theory of the above is, that you may perfectly unite wet colour to a moist edge, although you cannot to a dry edge without showing the juncture. For tinting surfaces, it is well always to mix more than sufficient colour at first.

Colouring Tracings.—It is always best to colour tracings on the back, as the ink lines are liable to be obliterated when the colour is applied. Mix the colours very dark, so that they may appear of proper depth on the other side. If ink or colour does not run freely on tracing cloth, mix both with a little ox-gall.

Cutting Stencil Plates.—The perforations are made through the metal, either by engraving, by etching with nitric acid diluted with about one-third water, or, what is better, by both methods combined. If engraving only is employed, the force necessarily applied to the graver will sometimes stretch the plate unequally, whereas by etching alone, the edges of the perforations are left rough, and the corners imperfect; but if the line be lightly etched, and afterwards cleared with the graver, it may be rendered perfect without any risk of cockling the plate. If the back of the plate is smeared with a little oil, the cuttings will come out clean. A good ground for the etching of these plates is made by rubbing on them, slightly heated over a spirit lamp, a cake of beel-ball.

Copper is much better than brass for stencil plates: the metal being softer, it lies closer to the paper upon receiving the pressure of the stencilling brush. This close contact is a very important consideration, as it prevents the hairs of the brush from getting under the plate, and producing rough edges.

Plain stencil alphabets will not be necessary to a draughtsman, if he is a good writer, as they will only save him a little time. A greater saving may be effected by the use of words which are constantly recurring; as Ground plan, Front elevation, Section; or of interiors, as Drawing-room, Kitchen.

For railway or public works, headings of plans may be cut in suitable character and style; also words which are frequently repeated on any particular works, as the name and address of the architect or engineer.

Besides letters and words, there are many devices by the use of which a superior effect may be produced, and much time saved; of these may be mentioned, north points, plates for the representation of surface of country, as plantation, wood, or marsh, corners and borders for finished plans, and many other devices.

Using Stencil Plates.—The brush requires to be squarely and equally cut, and to be kept moderately clean. If indian ink is used, the largest surface of the cake should be taken to rub the moist brush upon, to get it equally diffused and softened with colour. A cheap kind of ink is sold with stencil plates, which answers better than indian ink, as it runs less upon the drawing and presents a larger surface to the brush.

After the plate has been in use some time, the fine lines and corners become clogged with ink, which may easily be removed by soaking the plate a short time in warm water, and afterwards lightly brushing it upon a flat surface until quite clean. It must be particularly observed that a cloth should at no time be applied to the plate either to clean or to wipe it, as this would be almost certain to catch in some of the perforations, and probably spoil the plate.

If the plate by improper use becomes cockled, it may be flattened, if laid upon a hard flat surface, by drawing a cylindrical piece of metal, as, for instance, the plain part of the stem of a poker, firmly across it several times on each side of the plate.

In using the stencil plate, hold it firmly to the drawing by *one edge* only, in no instance allowing the fingers to cross to the opposite edge. The general method is, to place the fingers of the left hand along the bottom edge. When the brush is diffused with ink, so that it is just moist, lightly brush it upon a book-cover or pad, so as to free the points from any excess of colour. In applying the brush to the plate, it should be held quite upright, and moved, not too quickly, in small circles, using a constant, equal pressure, as light as appears necessary. The stencilling should be commenced at one end of the plate and proceeded with gradually to the other, moving onwards as the perforations appear filled with colour, being particularly careful not to shift the fingers placed upon the plate during the operation. If the plate is very long, after each word the fingers may be shifted, if the plate be held down during

the time firmly by the other hand. Should there not be quite sufficient ink in the brush to complete the device, the plate may be breathed upon, which will moisten the ink attached to the plate. If, after the plate is removed, the device appears light in parts, the plate may be replaced and the defects remedied, if very great care be taken to observe that the previous stencilling perfectly covers the perforations.

In stencilling words or numbers with the separate letters of the alphabet, draw a line where the bottoms of the letters are intended to come, take the separate letters as required and place them upon the line, so that the line just appears in the perforations. That the letters may be upright, it is best that the next letter on the slip used should also allow the line to appear in it. The required distance of the letters apart must be judged of by the eye, a pencil mark being made, after each letter is completed, to appear in the perforation on the near side of the next letter to be stencilled.

With care, a stencil plate will last in constant use for many years; without care, it is practically spoilt by taking the first impression.

Removing Drawings from the Board.—Make a pencil line round the paper with the tee-square at a sufficient distance to clear the glued edge, and to cut the paper with a penknife, guided by a stout ruler. In no instance should the edge of the tee-square be used to cut by. A piece of hard wood, half an inch thick by two inches wide, and about the length of the paper, forms a useful rule for the purpose, and may be had at small cost. The instrument used for cutting off, in any important draughtsman's office, is what is termed a *stationer's rule*, which is a piece of hard wood of similar dimensions to that just described, but with the edges covered with brass. It is necessary to have the edge thick to prevent the point of the knife slipping over. Either of the above rules will also answer to turn the edge of the paper up against when glueing it to the board.

The Frame for a Drawing is to afford a suitable protection to the finished drawing, and hence should be so subordinate in design and colour as not to distract attention from the drawing.

For geometrical drawings, a gilt frame is, in general, preferable to a dark-coloured wooden one. Occasionally the latter style of frame may be appropriate, as in case of a very darkly-shaded drawing on tinted paper, or of a drawing which very completely fills the paper.

It hardly need be said that a frame of plain mouldings is more appropriate for a geometrical drawing than is a carved or stucco-moulded frame. For ordinary geometrical drawings, nothing is prettier than an Oxford frame of light oak, or a plain gold frame.

Vegetable Parchment is made by dipping ordinary paper, for a few seconds, into a solution, containing one part water to six sulphuric acid; then washing it carefully, to remove every trace of acid.

Indelible Pencil Writing.—Lay the writing in a shallow dish, and pour skimmed milk upon it. Any spots not wet at first may have the milk placed upon them lightly with a feather. When the paper is wet all over, with the milk, take it up and let the milk drain off, and remove with the feather the drops which collect on the lower edge. Dry carefully.

Pencil Drawings, To fix.—Prepare water-starch, in the manner of the laundress, of such a strength as to form a jelly when cold, and then apply with a broad camel-hair brush, as in varnishing. The same may be done with thin, cold isinglass water or size, or rice water.

Mounting Engravings.—Strain thin calico on a frame, then carefully paste on the engraving so as to be free from creases; afterwards, when dry, give two coats of thin size (a piece the size of a small nut in a small cupful of hot water will be strong enough), finally, when dry, varnish with white hard varnish.

To Renew Manuscripts.—Take a hair pencil and wash the part that has been effaced with a solution of prussiate of potash in water, and the writing will again appear if the paper has not been destroyed.

Uniting Parchment to Paper, or Wood.—The surface of the parchment must first be moistened with alcohol or brandy and pressed while still moist upon glue or paste. When two pieces of parchment are to be joined, both must be moistened in this way. It is said that the paper will sooner tear than separate where it has been thus fastened together. Another way is to put a thin piece of paper between the surfaces of parchment and apply the paste. This forms a firm joint, and can with difficulty be separated. Glue and flour paste are best adapted for uniting surfaces of parchment.

Tracing Paper.—1. Wash very thin paper with a mixture of: Spirits of turpentine, 6; Resin, 1; Boiled nut oil, 1, parts by weight, applied with a soft sponge.

2. Brushing over one side of a good, thin, unsized paper with a varnish made of equal parts of Canada balsam and turpentine. If required to take water colour, it must be washed over with ox-gall and dried before being used.

3. Open a quire of double-crown tissue paper, and brush the first sheet with a mixture of mastic varnish and oil of turpentine, equal parts; proceed with each sheet similarly, and dry them on lines by hanging them up singly. As the process goes on, the under sheets absorb a portion of the varnish, and require less than if single sheets were brushed separately.

Transfer Paper is made by rubbing white paper with a composition consisting of 2 oz. of tallow, ½ oz. powdered black-lead, ¼ pint of linseed oil, and sufficient lampblack to make it of the consistency of cream. These should be melted together and rubbed on the paper whilst hot. When dry it will be fit for use.

Babbitt's Attrition Metal.—Preparing and fitting, melt separately 4 lbs. of copper, 12 lbs. best quality Banca tin, 8 lbs. regulus of antimony, and 12 lbs. more of tin while the composition is in a melted state. Pour the antimony into the tin, then mix with the copper away from the fire in a separate pot.

In melting the composition, it is better to keep a small quantity of powdered charcoal on the surface of the metal. The above composition is called "hardening." For lining the boxes, take 1 lb. of hardening and melt it with 2 lbs. of Banca tin, which produces the lining metal for use. Thus the proportions for lining metal are, 4 lbs. of copper, 8 lbs. of regulus of antimony, and 96 lbs. of Banca tin.

The article to be lined, having been cast with a recess for the lining, is to be nicely fitted to a former, which is made of the same shape as the bearing. Drill a hole in the article for the reception of the metal, say a half or three-quarters of an inch, according to the size of it. Coat over the part not to be tinned with a clay wash, wet the part to be tinned with alcohol, and sprinkle on it powdered sal-ammoniac; heat it till a fume arises from the sal-ammoniac, and then immerse in melted Banca tin, taking care not to heat it so that it will oxidize. After the article is tinned, should it have a dark colour, sprinkle a little sal-ammoniac on it, which will make it a bright silver colour. Cool it gradually in water, then take the former, to which the article has been fitted, and coat it over with a thin clay wash, and warm it so that it will be perfectly dry; heat the article until the tin begins to melt, lay it on the former and pour in the metal, which should not be so hot as to oxidize, through the drilled hole, giving it a head, so that as it shrinks it will fill up. After it has sufficiently cooled remove the former.

A shorter method may be adopted when the work is light enough to handle quickly; namely when the article is prepared for tinning, it may be immersed in the lining metal instead of the tin, brushed lightly in order to

remove the sal-ammoniac from the surface, placed immediately on the former and lined at the same heating.

Blanched Copper.—Fuse 8 oz. of copper and ½ oz. of neutral arsenical salt, with a flux made of calcined borax, charcoal dust, and powdered glass.

Yellow Brass.—30 parts of zinc and 70 of copper in small pieces.

YELLOW BRASS, *for Turning.*—(*Common article.*)—Copper, 20 lbs.; zinc, 10 lbs.; lead from 1 to 5 oz. Put in the lead last before pouring off.

Red Brass, *for Turning.*—Copper, 24 lbs.; zinc, 5 lbs.; lead, 8 oz. Put in the lead last before pouring off.

RED BRASS, *free, for Turning.*—Copper, 160 lbs.; zinc, 50 lbs.; lead, 10 lbs.; antimony, 44 oz.

Another Brass, *for Turning.*—Copper, 32 lbs.; zinc, 10 lbs.; lead, 1 lb.

Best Red Brass, *for fine Castings.*—Copper, 24 lbs.; zinc, 5 lbs.; bismuth, 1 oz. Put in the bismuth last before pouring off.

Rolled Brass.—32 copper, 10 zinc, 1·5 tin.

Common Brass, *for Castings.*—20 copper, 1·25 zinc, 2·5 tin.

Hard Brass, *for Casting.*—25 parts copper, 2 zinc, 4·5 tin.

Brass Melting.—The best plan of smelting brass is to melt the copper in a black-lead crucible first, *dry* and *cool* the zinc as much as possible and immerse the whole of the zinc into the copper when the latter is not hotter than barely to continue fluid. Drop a piece of borax the size of a walnut into the pot. When the surface of the hot metal is covered by fine charcoal, or borax, which is prevented by renewal from burning, the smallest loss of zinc is sustained.

The melting together of tin and copper is less difficult than that of zinc and copper, because tin is not so liable to evaporate as zinc, and little metal is lost. The appearance of the alloy may be improved by covering the melted metal with about one per cent. of dried potash; or, better still, a mixture of potash and soda. This flux has a remarkable influence on the colour, and particularly on the tenacity of the alloy. The former becomes more red, and the latter stronger. The scum forming on the surface by this addition ought to be removed before the metal is cast. Tin and copper are liable to separation in cooling; this can be prevented, at least partly, by turning the mould containing the fluid metal, and keeping it in motion until it is chilled.

Copper and lead unite only to a certain extent: 3 lead and 8 copper is ordinary pot metal. All the lead may be retained in this alloy, provided the object to be cast is not too thick. When the cast is heavy, or much lead is used, it is pressed out by the copper in cooling. 1 lead, 2 copper, separates lead in cooling—it oozes out from the pores of the metal: 8 copper and 1 lead is ductile, more lead renders copper brittle. Between 8 to 1 and 2 to 1 is the limit of copper and lead alloys. All of these alloys are brittle when hot or merely warm.

Equal parts of copper and silver and 2 per cent. of arsenic form an alloy similar to silver, a little harder, however, but of almost equal tenacity and malleability. Antimony imparts a peculiar beautiful red colour to copper, varying from rose-red in a little copper and much antimony, to crimson or violet when equal parts of both metals are melted together.

Hardening for Britannia.—(*To be mixed separately from the other ingredients.*)—Copper, 2 lbs.; tin, 1 lb.

Good Britannia Metal.—Tin, 150 lbs.; copper, 3 lbs.; antimony, 10 lbs.

Britannia Metal, *2nd quality.*—Tin, 140 lbs.; copper, 3 lbs.; antimony, 9 lbs.

BRITANNIA METAL, *for Casting.*—Tin, 210 lbs.; copper, 4 lbs.; antimony, 12 lbs.

BRITANNIA METAL, *for Spinning.*—Tin, 100 lbs.; Britannia hardening, 4 lbs.; antimony, 4 lbs.

BRITANNIA METAL, *for Registers.*—Tin, 100 lbs.; hardening, 8 lbs.; antimony, 8 lbs.

BEST BRITANNIA, *for Spouts.*—Tin, 140 lbs.; copper, 8 lbs.; antimony, 6 lbs.

BEST BRITANNIA, *for Spoons.*—Tin, 100 lbs.; hardening, 5 lbs.; antimony, 10 lbs.

BEST BRITANNIA, *for Handles.*—Tin, 140 lbs.; copper, 2 lbs.; antimony, 5 lbs.

BEST BRITANNIA, *for Lamps, Pillars, and Spouts.*—Tin, 300 lbs.; copper, 4 lbs.; antimony, 15 lbs.

BRITANNIA, *for Casting.*—Tin, 100 lbs.; hardening, 5 lbs.; antimony, 5 lbs.

Lining Metal, *for Boxes of Railroad Cars.*—Mix tin, 24 lbs.; copper, 4 lbs.; antimony, 8 lbs. (for a hardening); then add tin, 72 lbs.

Bronze Metal.—(1.) Copper, 7 lbs.; zinc, 3 lbs.; tin, 2 lbs. (2.) Copper, 1 lb.; zinc, 12 lbs.; tin, 8 lbs.

Artificial Gold.—Pure copper, 100 parts; zinc, or preferably tin, 17 parts; magnesia, 6 parts; sal-ammoniac, 3·6 parts; quicklime, 1·8 part; tartar of commerce, 9 parts. The copper is first melted, then the magnesia, sal-ammoniac, lime, and tartar, are then added, separately and by degrees, in the form of powder; the whole is now briskly stirred for about half an hour, so as to mix thoroughly; and then the zinc is added in small grains by throwing it on the surface and stirring till it is entirely fused; the crucible is then covered, and the fusion maintained for about 35 minutes. The surface is then skimmed and the alloy is ready for casting. It has a fine grain, is malleable, and takes a splendid polish. Does not corrode readily, and for many purposes is an excellent substitute for gold. When tarnished, its brilliancy can be restored by a little acidulated water.

German Silver, *First Quality for Casting.*—Copper, 50 lbs.; zinc, 25 lbs.; nickel, 25 lbs.

GERMAN SILVER, *Second Quality for Casting.*—Copper, 50 lbs.; zinc, 20 lbs.; nickel (best pulverized), 10 lbs.

GERMAN SILVER, *for Rolling.*—Copper, 60 lbs.; zinc, 20 lbs.; nickel, 25 lbs. Used for spoons, forks, and table ware.

GERMAN SILVER, *for Bells and other Castings.*—Copper, 60 lbs.; zinc, 20 lbs.; nickel, 20 lbs; lead, 3 lbs.; iron (that of tin plate being best), 2 lbs.

In melting the alloy for German silver it is difficult to combine a definite proportion of zinc with the compound of nickel and copper previously prepared. In fusing the three metals together there is always a loss of zinc by volatilization, which may be lessened by placing it beneath the copper in the crucible. The best method is to mix the copper and nickel, both in grains first, place them, thus mixed, in the crucible, when melted add the zinc and a piece of borax the size of a walnut. The zinc will gradually dissolve in the fluid copper, and the heat may be raised as their fluidity increases. In this instance, as in all others of forming alloys, it is profitable to mix the oxides of the various metals together, and reduce them under the protection of a suitable flux. The metal nickel can be produced only from pure oxide of nickel; and, as purity of the alloy is essential to good quality, the common commercial zinc is *not* sufficiently pure for forming argentan. Copper cannot well be used in the form of oxide, but grain copper or wire-scraps will serve equally as well.

Imitation of Silver.—Tin, 3 oz.; copper, 4 lbs.

Pinchbeck.—Copper, 5 lbs.; zinc, 1 lb.

Tombac.—Copper, 16 lbs.; tin, 1 lb.; zinc, 1 lb.

Red Tombac.—Copper, 10 lbs.; zinc, 1 lb.

Stereotype Metal.—1 tin; 1 antimony; 4 lead. In using stereotype metal, brush the type with plumbago or a small quantity of oil, then place in a frame, and take a cast with plaster of Paris. The cast is dried in a very hot oven, placed face downwards upon a flat plate of iron; this plate is laid in a tray or pan of iron, having a lid securely fastened, and furnished with a hole at each corner. Dip the tray in the fluid metal, which will flow in at the four corners. When the tray is re-

moved, dip the bottom only in water; and as the metal contracts in cooling, pour in melted metal at the corners so as to keep up the fluid pressure, and obtain a good solid cast. When cool open the tray; remove the cake of plaster and metal, and beat the edges with a mallet to remove superfluous metal. Plane the edges square, turn the back flat, in a lathe, to the required thickness, and remove any defects. If any letters are damaged cut them out, and solder in separate types instead. Finally, fix upon hard wood to the required height.

Casting Stereo-Plates by the Paper Process.—Lay a sheet of tissue paper upon a perfectly flat surface, and paste a soft piece of printing paper, which must be pressed evenly on, to the tissue. Lay the paper on the form, previously oiled, and cover with a damp rag; beat with a stiff brush the paper in evenly, then paste a piece of blotting paper, and repeat the beating in; after which about three more pieces of soft tenacious paper must be pasted and used in a similar way; back up with a piece of cartridge paper. The whole must then be dried with moderate heat, under a slight pressure. When thoroughly dry, brush well over with plumbago or French chalk. When this is done it is ready for the matrix. This is a box of a certain size for the work required, the interior of which is type high. In it is what is termed a gauge, which lifts out to insert your paper cast, and is regulated by hand to the size of the plate required. This being placed inside, the lid is shut down and screwed tight, with the end or mouth-piece left open. By this orifice the metal is poured in, and, as it is mounted to swing, the box is moved about so as to well throw down the metal and make a solid cast. Then water is dashed on the box, the screw-bar unshackled, the lid lifted, the plate taken off, and the paper cast is again ready for work.

Fusible Metal.—1. Bismuth, 8 parts; lead, 5 parts; tin, 3 parts: melt together. Melts below 212° Fahr. 2. Bismuth, 2 parts; lead, 5 parts; tin, 3 parts. Melts in boiling water 3. Lead, 3 parts; tin, 2 parts; bismuth, 5 parts: mix. Melts at 197° Fahr. Used for stereotyping; used to make toy-spoons, to surprise children by their melting in hot liquors; and to form pencils for writing on asses' skin, or paper prepared by rubbing burnt hartshorn into it.

Fusible Alloy, *for Silvering Glass.*—Tin, 6 oz.; lead, 10 oz.; bismuth, 21 oz.; mercury, a small quantity.

Muntz Metal.—6 parts copper; 4 zinc. Can be rolled and worked at a red heat.

Alloy for Cymbals and Gongs.—100 parts of copper with about 25 of tin. To give this compound the sonorous property in the highest degree, the piece should be ignited after it is cast, and then plunged immediately into cold water.

Alloy for Tam-Tams, or Gongs.—80 parts of copper and 20 of tin, hammered out with frequent annealing. An alloy of 78 of copper and 22 of tin answers better, and can be rolled out.

Alloy for Bells of Clocks.—The bells of the *pendules*, or ornamental clocks, made in Paris, are composed of copper 72·00, tin 26·56, iron 1·44 in 100 parts.

Bell Metal, *fine.*—71 copper, 26 tin, 2 zinc, 1 iron.

Bell Metal, *for large Bells.*—Copper, 100 lbs.; tin, from 20 to 25 lbs.

Bell Metal, *for small Bells.*—Copper, 3 lbs.; tin, 1 lb.

Cock Metal.—Copper, 20 lbs.; lead, 8 lbs.; litharge, 1 oz.; antimony, 3 oz.

Alloy for Journal Boxes.—Copper, 24 lbs.; tin, 24 lbs.; and antimony, 8 lbs. Melt the copper first, then add the tin, and lastly the antimony. It should be first run into ingots, then melted and cast in the form required for the boxes.

Queen's Metal.—A very fine silver-looking metal is composed of 100 lbs. of tin, 8 of regulus of antimony, 1 of bismuth, and 4 of copper.

Chinese Silver.—65·2 parts copper, 19·5 zinc, 13 nickel, 2·5 silver, and 12 cobalt of iron.

Hard White Metal.—Sheet brass, 32 oz.; lead, 2 oz.; tin, 2 oz.; zinc, 1 oz.

Metal for Taking Impressions.—Lead, 3 lbs.; tin, 2 lbs.; bismuth, 5 lbs.

White Metal.—Tin, 82; lead, 18; antimony, 5; zinc, 1; and copper 4 parts.

Metal for Tinning.—Malleable iron 1 lb., heat to whiteness; add 5 oz. regulus of antimony, and Molucca tin, 24 lbs.

Frick's German Silver.—53·39 parts copper, 17·4 nickel, 13 zinc.

Best Pewter.—5 lbs. tin to 1 lb. of lead.

Common Pewter.—82 parts pure tin, 18 parts lead.

Speculum Metal.—Equal parts of tin and copper form a white metal as hard as steel. Less tin and a small quantity of arsenic added to the alloy forms a white hard metal of high lustre. 2 lbs. copper, 1 lb. tin, 1 oz. arsenic, form a good speculum metal. An alloy of 32 copper, 16·5 tin, 4 brass, 1·25 arsenic is hard, white, and of brilliant lustre.

Type Metal.—9 parts lead to 1 antimony forms common type metal; 7 lead to 1 antimony is used for large and soft type; 6 lead and 1 antimony for large type; 5 lead and 1 antimony for middle type; 4 lead and 1 antimony for small type; and 3 lead to 1 antimony for the smallest kinds of type.

Statuary Metal.—91·4 parts copper, 5·53 zinc, 1·7 tin, 1·37 lead; or copper 80, tin 20.

Metal for Medals.—50 parts copper, 4 zinc.

Or-Molu.—The or-molu of the brass-founder, popularly known as an imitation of red gold, is extensively used by the French workmen in metals. It is generally found in combination with grate and stove work. It is composed of a greater portion of copper and less zinc than ordinary brass, is cleaned readily by means of acid, and is burnished with facility. To give this material the rich appearance, it is not unfrequently brightened up after "dipping" by means of a scratch brush, the action of which helps to produce a very brilliant gold-like surface. It is protected from tarnish by the application of lacquer.

Spanish Tutania.—Iron or steel, 8 oz.; antimony, 16 oz.; nitre, 3 oz. Melt and harden 8 oz. tin with 1 oz. of this compound.

Another Tutania.—Antimony, 4 oz.; arsenic, 1 oz.; tin, 2 lbs.

Gun Metal.—Bristol brass, 112 lbs.; zinc, 14 lbs.; tin, 7 lbs.

Rivet Metal.—Copper, 32 oz.; tin, 2 oz.; zinc, 1 oz.

RIVET METAL, *for Hose.*—Copper, 64 lbs.; tin, 1 lb.

Bullet Metal.—98 lead to 2 arsenic. For round shot the fused metal is dropped from a high elevation in a shot tower into a basin of water; or thrown down a stack of limited height, in which a strong draught of air is produced by a blast machine.

Pipe Metal for Organs.—Melt equal parts of tin and lead. This alloy is cast instead of rolled in the desired form of sheets, in order to obtain a crystallized metal, which produce a finer tone. The sheets are formed by casting the metal on a horizontal table, the thickness being regulated by the height of a rib or bridge at one end, over which the superfluous metal flows off. The sheets thus obtained are planed with a carpenter's plane, bent up, and soldered.

Aluminium Bronze.—100 parts copper and 10 aluminium, measured by weighing, when combined is a durable alloy, which may be forged and worked in the same manner as copper, and is the same colour as pale gold. 80 parts copper, 19 zinc, and 1 aluminium, form a good durable alloy.

Aquafortis.—*Simple or Single.*—Distil 2 lbs. of saltpetre and 1 lb. of copperas.

Double.—Saltpetre, 6 lbs., copperas, 6 lbs. in its usual crystallized state, together with 3 lbs. calcined to redness.

Strong.—Copperas calcined to whiteness, and white saltpetre, of each 30 lbs.

mix, and distil in an iron pot with an earthenware head.

Spirit of Nitre.—White saltpetre, 6 lbs.; oil of vitriol, 1½ lb.: distil into 1½ pint of water.

Dilute.—Strong aquafortis, 1 oz. by measure, and water 9 oz. by measure.

Proof.—The same as Assayer's Acid.

Compound.—Double aquafortis, 16 oz.; common salt, 1 dram: distil to dryness.

Aqua Regia.—Distil together 16 oz. of spirit of nitre, with 4 oz. of common salt; equal parts of nitric acid and muriatic acid mixed, or nitric acid 2 parts, and muriatic 1 part.

Amber, To Work.—Amber in the rough is first split and cut rudely into the shape required by a leaden wheel worked with emery powder, or by a bow saw having a wire for the blade, Tripoli or emery powder being used with it. The roughly-formed pieces are then smoothed with a piece of whetstone and water. The polishing is effected by friction with whiting and water, and finally with a little olive oil laid on and well rubbed with a piece of flannel, until the polish is complete. In this process the amber becomes hot and highly electrical; as soon as this happens it must be laid aside to recover itself before the polishing is continued, otherwise the article will be apt to fly into pieces.

Amber, To Mend.—Smear the parts which are to be united with linseed oil, hold the oiled part carefully over a small charcoal fire, a hot cinder, or a gas-light, being careful to cover up all the rest of the object loosely with paper; when the oiled parts have begun to feel the heat, so as to be sticky, pinch or press them together, and hold them so till nearly cold. Only that part where the edges are to be united must be warmed, and even that with care, lest the form or polish of the other parts should be disturbed; the part joined generally requires a little re-polishing.

Bleaching Silk.—A ley of white soap is made by boiling in water 30 lbs. of soap for every 100 lbs. of silk intended to be bleached, and in this the silk is steeped till the gum in the silk is dissolved and separated. The silk is then put into bags of coarse cloth and boiled in a similar ley for an hour. By these processes it loses 25 per cent. of its original weight. The silk is then thoroughly washed and steeped in a hot ley composed of 1½ lb. of soap, 90 gallons of water, with a small quantity of litmus and indigo diffused. After this, it is carried to the sulphuring room: 2 lbs. of sulphur are sufficient for 100 lbs. of silk. When these processes are not sufficiently successful, it is washed with clear *hard* water and sulphured again.

Bleaching Wool.—The wool is first prepared according to the purposes for which it is intended, by treating it with solutions of soap. By this process it is cleared of a great quantity of loose impurity and grease which is always found in wool, often losing no less than 70 per cent. of its weight. The heat of the ley must be carefully attended to, as a high temperature is found to fix the unctuous matter or yolk of the wool. After washing, it is taken to a sulphur chamber, where it is exposed to the fumes arising from the slow combustion of sulphur, for from five to twenty hours, according to circumstances. It is again washed, and then immersed in a bath composed of pure whiting and blue. It is then exposed a second time to the fumes of the sulphur, and washed with a solution of soap, which renders it of the proper whiteness.

Paper Bleaching.—For bleaching rags, and other materials from which paper is at first fabricated, rags, when grey or coloured, are to be separated and ground in the paper-mill in the usual way, till brought to a sort of uniform consistence, having been previously macerated according to their quantity and tenacity. The mass is then treated with an alkaline ley. It is next treated with a solution of chloride of lime. If this immersion do not produce the desired effect, which does not often happen if the colours are tenacious, such as red and blue, let the treatment with the alkaline ley be repeated, and follow it

with another bath of the chlorine preparation. Then sour the whole in a bath of sulphuric acid, much diluted and cold, for when hot its action will be less effectual. Water is then to be run upon it till it comes off without colour or indication of acidity. Black is the most easily discharged colour, and will seldom require being treated with ley or steep of sulphuric acid, one bath of alkali and another of chloride of lime being sufficient to produce a good white. *Old printed* or *written paper* is first to be sorted according to its quality, and all the yellow edges cut off with a bookbinder's plane. One hundredweight of this paper is to be put sheet by sheet into vats sufficiently capacious, with 500 quarts of hot water. The whole is to be stirred for about an hour, and as much water gradually added as will rise about three inches above the paper, and to be left to macerate for four or five hours. It is then ground coarsely in the mill, and boiled in water for about an hour, taking care to add before it begins to boil, thirteen quarts of caustic alkaline ley. After boiling, it is macerated in the ley for twelve hours, when it is pressed, and, if sufficiently white, made into paper.

To Bleach Prints and Printed Books. — Simple immersion in oxygenated muriatic acid, letting the article remain in it, a longer or shorter space of time, according to the strength of the liquor, will be sufficient to whiten an engraving; if it be required to whiten the paper of a bound book, as it is necessary that all the leaves should be moistened by the acid, care must be taken to open the book well, and to make the boards rest on the edge of the vessel, in such a manner that the paper alone shall be dipped in the liquid; the leaves must be separated from each other, in order that they may be equally moistened on both sides. The liquor assumes a yellow tint, and the paper becomes white in the same proportion; at the end of two or three hours the book may be taken from the acid liquor, and plunged into pure water with the same care and precaution as recommended in regard to the acid liquor, that the water may touch both sides of each leaf. The water must be renewed every hour, to extract the acid remaining in the paper, and to dissipate the disagreeable smell. Printed paper may also be bleached by sulphuric acid, or by alkaline or soap leys.

Bleaching Ivory. — Antique works in ivory that have become discoloured may be brought to a pure whiteness by exposing them to the sun under glasses. It is the particular property of ivory to resist the action of the sun's rays, when it is under glass; but when deprived of this protection, to become covered with a multitude of minute cracks. Many antique pieces of sculpture in ivory may be seen, which, although tolerably white, are, at the same time, defaced by numerous cracks; this defect cannot be remedied; but, in order to conceal it, the dust may be removed by brushing the work with warm water and soap, and afterwards placing it under glass. Antique works in ivory that have become discoloured, may be brushed with pumice-stone, calcined and diluted, and while yet wet placed under glasses. They should be daily exposed to the action of the sun, and be turned from time to time, that they may become equally bleached; if the brown colour be deeper on one side than the other, that side will, of course, be for the longest time exposed to the sun.

Bleaching Powder. or Chloride of Lime, is prepared by passing chlorine gas into boxes of lead in which a quantity of slaked lime is laid on shelves. The stuff to be bleached is first boiled in lime water, wash, and without drying boil again, in a solution of soda or potash; wash, and without drying steep in a weak mixture of chloride of lime and water for six hours; wash, and without drying steep for four hours in a weak solution or mixture of sulphuric acid and water; wash well and dry; upon an emergency chloride of potash mixed with three times its weight of common salt, and diluted in water, may be used as a *bleaching liquid*.

To Bleach Sponge.—Soak it well in dilute muriatic acid for twelve hours. Wash well with water, to remove the lime, then immerse it in a solution of hyposulphate of soda, to which dilute muriatic acid has been added a moment before. After it is bleached sufficiently, remove it, wash again, and dry it. It may thus be bleached almost snow white.

To Whiten Lace.—Lace may be restored to its original whiteness by first ironing it slightly, then folding it and sewing it into a clean linen bag, which is placed for twenty-four hours in pure olive oil. Afterwards the bag is to be boiled in a solution of soap and water for fifteen minutes, then well rinsed in lukewarm water, and finally dipped into water containing a slight proportion of starch. The lace is then to be taken from the bag and stretched on pins to dry.

Alcohol Barrels — Barrels or casks designed to be filled with alcohol, may be made tight by the application of the following solution:—Dissolve in a water bath 1 lb. of leather scraps and 1 oz. of oxalic acid, in 2 lbs. of water, and dilute gradually with 3 lbs. of warm water. Apply this solution to the inside of the barrel, where, by oxidation, it will assume a brown colour, and become insoluble in alcohol. This coat closes all the pores of the wood, and does not crack or scale off.

Paste Blacking.—Mix 1 part of ivory black, ½ treacle, ⅛ sweet oil, then add ¼ oil of vitriol and ⅛ hydrochloric acid. Dilute each ingredient with three times its weight of water before mixing.

Liquid Blacking.—2 lbs. of ivory black in fine powder, treacle 1½ lb., ½ pint of sperm oil. Rub the black and oil well together, add the treacle and mix.

Another Method. — 4 oz. of ivory black, 3 oz. coarse sugar, a table-spoonful of sweet oil, and 1 pint of weak beer; mix them gradually together until cold.

Black Reviver.—Take 2 pints of vinegar, and infuse 1 oz. of iron filings, 1 oz. copperas, 1 oz. ground logwood, and 3 oz. bruised galls.

Blue Black is a paste made of ivory black and indigo, ground together with water.

Blue, *Soluble.*—7 parts oil of vitriol, place in a glass vessel, and set this in cold water, add gradually 1 part indigo in powder, stirring the mixture at each addition with a glass rod. Cover the vessel for twenty-four hours, then dilute with an equal quantity of water.

Boiler Incrustation.—The following remedies have been used with varying success to prevent incrustation:—

1. Potatoes, $\frac{1}{10}$th of weight of water prevents adherence of scale.
2. 12 parts salt, 2½ caustic soda, ½ extract of oak bark, ½ potash.
3. Pieces of oak-wood suspended in boiler and renewed monthly.
4. 2 oz. muriate of ammonia in boiler twice a week.
5. A coating 3 parts of black-lead, 18 tallow, applied hot to the inside of the boiler every few weeks.
6. 12½ lbs. of molasses fed into an 8-horse boiler at intervals, prevented incrustation for six months.
7. Mahogany or oak sawdust in small quantities. Use this with caution, as the tannic acid attracts iron.
8. Carbonate of soda.
9. Slippery elm bark.
10. Chloride of tin.
11. Spent tanners' bark.
12. Frequent blowing off.

Brightening and Colouring Brass.—The work to be brightened and coloured is first annealed in a red-hot muffle, or over an open fire, allowing the cooling to extend over one hour; the object of the heating being to remove the grease or dirt that may have accumulated during the process of fitting. Soft soldered work, however, must be annealed before fitted together, and afterwards boiled in a lye of potash; this is also done with work having ornamental surfaces. Next, it is immersed in a bath of diluted oil of vitriol or aquafortis, which may be made with two or three parts of water, and one of acid; but the old acid that contains a small quantity of copper, in solution, is

frequently preferred. The work is allowed to remain in this liquid for one or two hours, according to the strength of the acid; it is then well rinsed in water, and scoured with sand, which is applied with an ordinary scrubbing brush, and washed. The pickling bath is made by dissolving one part of zinc in three parts of nitric acid of 36° Baume, in a porcelain vessel, and adding a mixture of eight parts of nitric acid, and eight parts of oil of vitriol. Heat is then applied, and when the liquid is boiling the work is plunged into it for half a minute, or until the violent development of nitrous vapour ceases, and the surface is getting uniform. Then it is plunged into clean water, and well rinsed, to remove the acid. The ordinary, dark greyish, yellow tint, which is thus very often produced, is removed on immersing the work again in aquafortis for a very short time. Then it is plunged into clean or slightly alkaline water, well rinsed to remove the acid, and plunged into warm dry beech or boxwood saw-dust, and rubbed until quite dry. To prevent the action of the atmosphere it is lacquered; if a green tint is to be produced, the lacquer is coloured with turmeric. A dark, greyish, but agreeable tint, is obtained by immersing the work previously in a solution of white arsenic in hydrochloric acid, or in a solution of bichloride of platinum, under addition of some vinegar, or rubbing with plumbago.

Bronze for Statuary.—1. Copper, 88 parts; tin, 9 parts; zinc, 2 parts; lead, 1 part. 2. Copper, 88½ parts; tin, 5 parts; zinc, 10½ parts; lead, 2 parts. 3. Copper, 90 parts; tin, 9 parts; lead, 1 part. 4. Copper, 91 parts; tin, 9 parts.

For Medals.—1. Copper, 89 parts; tin, 8 parts; zinc, 3 parts. 2. Copper, 95 parts; tin, 5 parts.

For Cutting Instruments.—Copper, 100 parts; tin, 14 parts.

For Ornaments.—1. Copper, 82 parts; tin, 3 parts; zinc, 18 parts; and lead, 2 parts. 2. Copper, 83 parts; zinc, 17 parts; tin, 1 part; lead, ½ part.

Bronze Liquid.—Take 1 pint of strong vinegar, 1 oz. of sal ammoniac, ½ oz. of alum, ½ oz. of arsenic; dissolve them in the vinegar, and the compound is fit for use. We know brass-founders who have been in the habit of using this for several years, and, where the metal is good, it is seldom found to fail.

Bronze Powders, *Aurum Musivum.*—Melt together, in a crucible over a clear fire, equal parts of sulphur and the white oxide of tin. Keep them continually stirred with the stem of an earthenware pipe or glass rod, till they assume the appearance of a yellow flaky powder.

An iron rod must not be used in stirring up any mixture of sulphur when melted, or the sulphur and iron will unite. *Aurum Musivum*, or *Mosaic Gold*, is used as a cheap bronze powder. It is rubbed on with the finger. Another way to prepare it is to take quicksilver, tin, sulphur, and sal ammoniac, equal parts. First melt the tin, then pour the quicksilver into it, afterwards grind up with the amalgam thus made the sulphur and sal ammoniac. Place the mixture in a crucible, and heat until the powder in the crucible becomes gold-coloured, and also until no fumes of quicksilver arise.

Copper-coloured Bronze may be obtained by dissolving copper in aquafortis until it is saturated, and then putting into the solution some small pieces of iron, when the copper will be precipitated in the metallic state; the fluid must then be poured off, and the powder carefully washed, dried, and levigated, when it may be put by for use.

Bronze powder is sometimes made from Dutch gold, which is sold in books at a very low price. All these inferior bronzes require to be covered with a coat of clear varnish, or they will very soon lose their metallic appearance, nor will the varnish entirely prevent, although it will greatly retard, this change.

Cheap Bronze.—Verdigris, 8 oz.; flowers of zinc or tutti powder, 4 oz.; borax and nitre, of each 2 oz.; corrosive sublimate, 3 drachms, made into a paste

with oil, and melted together. Used in the commoner kinds of tea-boards, &c.

Silver Bronze.—Bismuth and tin, of each 2 lbs.; melt together and add 1 lb. of quicksilver. Pound all together into a powder.

This soft fusible amalgam is used as an imitation of silver bronze for plaster figures and other common purposes, in the same way as the aurum musivum is for gold-coloured articles. It may be used as spangles in sealing-wax; it must then be mixed when the resinous part of the wax is getting cold.

Gold Powder for Bronzing.—Leaf gold is ground with virgin honey on a stone, until the leaves are broken up and minutely divided. The mixture is removed from the stone by a spatula, and stirred up in a basin of water, whereby the honey is melted and the gold set free; the basin is then left undisturbed until the gold subsides; the water is poured off, and fresh quantities added until the honey is entirely washed away; after which the gold is collected on filtering paper, and dried for use.

Gold Size is prepared from ½ lb. of linseed oil with 2 oz. of gum animi; the latter is reduced to powder and gradually added to the oil while being heated in a flask, stirring it after every addition until the whole is dissolved; the mixture is boiled until a small quantity, when taken out, is somewhat thicker than tar, and the whole is strained through a coarse cloth. When used, it must be ground with as much vermilion as will render it opaque, and at the same time be diluted with oil of turpentine, so as to make it work freely with the pencil.

Bronzing Plaster. — Lay the figure over with isinglass size, until it holds out, or without any part of its surface becoming dry; then, with a brush, such as is termed by painters a sash tool, go over the whole, taking care to remove, while it is yet soft, any of the size that may lodge on the delicate parts of the figure. When it is dry take a little very thin oil *gold size*, and with as much as just damps the brush, go over the figure with it, allowing no more to remain than causes it to shine. Set it aside in a dry place free from smoke, and in forty-eight hours the figure is prepared to receive the bronze.

After having touched over the whole figure with the bronze powder, let it stand another day, and then with a soft dry brush rub off all the loose powder, particularly from the points, or more prominent parts of the figure.

Bronzing Wood.—The wood is first covered with a uniform coating of glue, or of drying oil, and when nearly dry the bronze powder, contained in a small bag, is dusted over it. The surface of the objects is afterwards rubbed with a piece of moist rag. Or the bronze powder may be previously mixed with the drying oil, and applied with a brush.

Bronzing Paper.—Gum is substituted for drying oil in bronzing paper When dry, the paper is submitted to the action of the burnisher, which imparts great brilliancy to it.

Bronzing small Brass Articles.—1 part oxide of iron, 1 part white arsenic, 12 parts hydrochloric acid. Clean the brass well to get rid of lacquer or grease, and apply with a brush until the desired colour is obtained. Stop the process by oiling well, when it may be varnished or clear lacquered.

Bronzing Gas Fittings.—Boil the work in strong ley, and scour it free from all grease or old lacquer; pickle it in diluted nitric acid till it is quite clean (not bright), then dip in strong acid, and rinse through four or five waters; repeat the dip, if necessary, till it is bright; next bind it very loose with some thin iron wire, and lay it in the strongest of the waters you have used for rinsing. This will deposit a coat of copper all over it if the water or pickle be not too strong; if such is the case the copper will only be deposited just round where the wire touches. When the copper is of sufficient thickness wash it again through the waters, and dry it with a brush in some hot saw-dust; box-dust is best, but if this is

not at hand, oak, ash, or beech will do. It is now ready for bronzing. The bronze is a mixture of black-lead and red bronze, varied according to shade required, mixed with boiling water. The work is to be painted over with this and dried, then brushed until it polishes. If there are any black spots or rings on the work, another coat of the bronze will remove them. Lacquer the work with pale lacquer, or but very slightly coloured, for if it is too deep it will soon chip off.

Another method is to mix vinegar or dilute sulphuric acid (1 acid 12 water) with powdered black-lead in a saucer or open vessel; apply this to the brass with a soft plate brush by gentle brushing. This will soon assume a polish, and is fit for lacquering. The brass must be made slightly warmer than for lacquering only. A little practice will enable the operator to bronze and lacquer with once heating. The colour, black or green, varies with the thickness of black-lead.

Green Bronze.—Dissolve 2 oz. of nitrate of iron, and 2 oz. of hyposulphite of soda in 1 pint of water. Immerse the articles in the bronze till of the required tint, as almost any shade from brown to red can be obtained; then well wash with water, dry, and brush. One part of perchloride of iron and two parts of water mixed together, and the brass immersed in the liquid, gives a pale or deep olive green, according to the time of immersion. If nitric acid is saturated with copper, and the brass dipped in the liquid, and then heated, it assumes a dark green. If well brushed, it may be lacquered with pale gold lacquer, or else polished with oil.

Black Brasswork for Instruments.—Take lampblack, about a thimbleful, and put it on a flat stone or smooth slate; add four or five spots of gold size, and well mix with a palette knife, make the whole about as thick as putty; well mix. The less gold size there is the better, so that the lampblack just sticks together; if too much gold size be added, the effect will be a bright black and not a dead black. Now add turpentine, about twice its own volume, to the whole, mix with a camel-hair brush, and apply to the brasswork.

Black Bronze for Brass.—Dip the article bright in aquafortis; rinse the acid off with clean water, and place it in the following mixture until it turns black:—Hydrochloric acid, 12 lbs.; sulphate of iron, 1 lb.; and pure white arsenic, 1 lb. It is then taken out, rinsed in clean water, dried in saw-dust, polished with black-lead, and then lacquered with green lacquer.

Bronzing Iron.—To one pint of methylated finish add 4 oz. of gum shellac and ½ oz. gum benzoin; put the bottle in a warm place, shaking it occasionally. When the gum is dissolved let it stand in a cool place two or three days to settle, then gently pour off the clear into another bottle, cork it well, and keep it for finest work. The sediment left in the first bottle, by adding a sufficient quantity of spirit to make it workable, will do for the first coat or coarser work when strained through a fine cloth. Next get ½ lb. of finely-ground bronze green, the shade may be varied by using a little lampblack, red ochre, or yellow ochre; let the iron be clean and smooth, then take as much varnish as may be required, and add to the green colour in sufficient quantity; slightly warm the article to be bronzed, and with a soft brush lay a thin coat on it. When that is dry, if necessary lay another coat on, and repeat until well covered. Take a small quantity of the varnish and touch the prominent parts with it; before it is dry, with a dry pencil lay on a small quantity of gold powder. Varnish over all.

Bronzing Copper Utensils.—If the article is not new take it to pieces, wiping off all the solder with a wisp of tow, and taking care not to let any of the metal in the fire; then twist a little tow on the end of a stick, and pickle with spirits of salts all those parts that are tinned, pickling the outside as well as the in, rinse in water, and scour outside with wisp of tow and sand, fine coke-dust is best for the

tinned parts, which must be brought quite clean, rinse clean, smear the outside with wet whiting, and then tin with bar tin, sal ammoniac being the best agent; then pickle only the outside with diluted spirits of salts, rinse, and scour with clean sand till the surface is perfectly clean and bright, taking care to rub as much as possible in one direction. The cast parts and those not tinned are pickled in dilute oil of vitriol, and scoured with sand, same as the body; beat with a brush, then dried in saw-dust, and the article is now ready for bronzing. Procure some crocus, some knowledge is wanted to select a good one, as it may be too light, or too dark, or too fine, or too coarse; then make into a thick cream with water. Having used a forge fire to tin with, to be on the safe side it is best to rake out all the old coke and light afresh, and the coke should be a nice, clear, firm, grey ore, in pieces the size of a walnut; also have some clear bright coal, then blow up a clear bright fire, and heap up plenty of coke that the sulphur may burn off; now take a little of the mixed crocus and brush up the body, using a hard brush; get all the crocus off clean, and wipe with a clean piece of rag, and it is best to hold with this, as the perspiration of the hand will prevent the colour taking; now blow up fire, making a hole in centre, so that a good blast comes up, and having painted the body evenly with the red cream so that the colour does not run (a flat camel-hair brush, 2½ inches wide, is the best thing to do it with), hold it with the tongs and turn it steadily so that all parts are exposed fairly to the blast. As soon as it is dry, throw into the fire a bit of coal about the size of a Spanish nut, more or less to size of work, and let the work have an even coat of smoke till it is quite black, but no more (if the coal is not burnt out hold the work on one side), then turning it steadily, keep up a sharp blast till the smoke is burnt off, and stand it to cool. Treat cast parts the same, but as soon as the smoke is burnt off, dip them into clean cold water, else, on account of their thickness the colour will burn; when cold, wipe the crocus off the body with wisp of clean tow, then brush hard till quite clean, wipe with rag and repeat the above once or twice, according to the shade required. To finish properly the body is hammered all over with bright hammers shaped to parts, and on suitable tools which are covered with two or three folds of lasting; the inside is scoured bright, and the parts soldered together, using resin. Medals only want brushing up with wet crocus, taking care not to touch with hand, and then colouring as above. Only copper coins can be bronzed.

Copper Articles may also be bronzed by the following process:—Dissolve in vinegar two parts verdigris and one part sal ammoniac. Boil, skim, and dilute with water, until white precipitate ceases to fall. Set in a pan meanwhile the articles to be bronzed, made perfectly clean and free from grease. Boil solution briskly and pour over the articles in the pan and boil them briskly. A bright reddish-brown colour is thus acquired; but the articles should be frequently inspected, and removed as quickly as the desired shade is obtained. Then they are to be repeatedly washed and dried. The solution must not be too strong, for then the bronze will come off by friction, or turn green on exposure to the air.

To Bronze Electrotypes, *Green.*—Steep the medal or figure in a strong solution of common salt or sugar, or sal ammoniac, for a few days, wash in water and allow to dry slowly, or suspend over a vessel containing a small quantity of bleaching powder, and cover over—the length of time it is allowed to remain will determine the depth of the colour.

Brown.—Four or five drops of nitric acid to a wine-glassful of water, and allowed to dry, and when dry impart to the object a gradual and equal heat; the surface will be darkened in proportion to the heat applied.

Black.—Wash the surface of the object over with a little sulphurate of ammonia (dilute), and dry at a gentle

heat, polish with a hard brush afterwards.

Browning Gun Barrels.—Chloride of antimony has been much used for bronzing gun barrels, is excellent in its operation, and has been called, in consequence, bronzing salt. It is used for bronzing, mixed to a thin creamy consistence with olive oil; the iron is slightly heated, dressed evenly upon its surface with this mixture, and left until the requisite degree of browning is produced. The sharpening of the chloride of antimony can be effected by adding a little nitric acid to the paste of olive oil and chloride of antimony, so as to hasten the operation. Another formula is—Aquafortis, ½ oz.; sweet spirit of nitre, ½ oz.; spirit of wine, 1 oz.; blue vitriol, 2 oz.; tincture of chloride of iron, 1 oz.; water, 40 oz. Dissolve the blue vitriol in the water, then add the other materials, and the water is warmed to dissolve the blue vitriol; let it get cold before adding the other materials. The burnishing and marking can be effected with the burnisher and scratch brush. The polishing is best effected by rubbing with a piece of smooth, hard wood, called polishing wood. It is lastly varnished with shellac varnish, and again polished with the hard wood polisher. Some prefer the tone of brown produced by blue vitriol, 1 oz.; sweet spirit of nitre, 1 oz.; water, 20 oz. In any case, the surface of the iron must be well cleaned, and rendered quite bright; it is then freed from grease by rubbing with whiting and water, or better, with powdered quicklime and water. The browning composition is then placed on, and allowed to remain twenty-four hours. It is then rubbed off with a stiff brush. If not sufficiently browned, repeat the last process after browning. Clean the surface well with hot water containing a little soda or potash, and, lastly, with boiling water, and dry it. The surface can be burnished and polished. Varnish with tinsmith's lacquer, or with gum shellac, 2 oz.; dragon's blood, 3 drs.; methylated spirits of wine, 4 pints. The metal should be made hot before applying this varnish, and will present an excellent appearance. If the varnish is not required to colour, but only to preserve the actual tint produced on the metal surface by the browning fluid, leave out the dragon's blood.

Catgut, To Make.—Take the entrails of sheep, or any other animal, procured from the newly-killed carcass. Thoroughly clean them from all impurities and from attached fat, and wash them well in clean water; soak in soft water for two days, or in winter three days, then lay them on a table and scrape them with a small plate of copper, having a semicircular hole cut in it, the edges of which must be quite smooth and not capable of cutting. Now, after washing, put them into fresh water, and there let them remain till the next day, when they are again to be scraped. Let them soak again in water for a night, and two or three hours before they are taken out add to each gallon of water 2 oz. of pearlash. They ought now to scrape quite clean from their inner mucous coat, and will consequently be much smaller in dimensions than at first. They may now be wiped dry, slightly twisted, and passed through a hole in a piece of brass, to equalize their size; as they dry, they are passed every two or three hours through other holes, each smaller than the last. When dry they will be round and well polished, and being oiled are fit for use.

Cameos, To Carve.—Take the common helmet, or the red helmet shell (those shells whose inner surface is pink or dark coloured are most suitable), cut them into squares with a lapidary's mill, round off the corners, and shape them into an oval on a wet grindstone. Fix the enamel side on a short stick with jeweller's cement, grind off the brittle surface, sketch the subject with a black-lead pencil, cut the subject with engraver's tools, namely, a chisel tool to clear the bare places; a lozenge-shape for forming the subject, and a scraper, made of a three-angled file, ground off taper to the point, for cleaning the enamel surface round the subject, and also for forming the lineaments and other delicate parts The colour on the cheeks and hair is

produced by leaving the layer of coloured shell on those places. The stick must be grasped in the left hand, and held firmly against a steady bench, and with the tool resting in the hollow of the right hand, dig away the shell. A convenient length for the tools is three inches and a half; they must be kept in good condition to work with accuracy. The cameos are polished with a cedar stick, or a piece of cork dipped in oil of vitriol and putty powder, and cleaned with soap and water. Mother-of-pearl is carved in the same way.

Coments, How to Use.—Take as small a quantity of the cement as possible, and bring the cement itself into intimate contact with the surfaces to be united. If glue is employed, the surface should be made so warm that the melted glue is not chilled before it has time to effect a thorough adhesion. Cements that are used in a fused state, as resin or shellac, will not adhere unless the parts to be joined are heated to the fusing point of the cement. Sealing-wax, or ordinary electrical cement, is a good agent for uniting metal to glass or stone, provided the masses to be united are made so hot as to fuse the cement, but if the cement is applied to them while they are cold it will not stick at all. This fact is well known to the itinerant vendors of cement for uniting earthenware. By heating two pieces of china or earthenware so that they will fuse shellac, they are able to smear them with a little of this gum, and join the pieces so that they will rather break at any other part than along the line of union. But although people constantly see the operation performed, and buy liberally of the cement, it will be found in nine cases out of ten that the cement proves worthless in the hands of the purchasers, simply because they do not know how to use it. They are afraid to heat a delicate glass or porcelain vessel to a sufficient degree, or they are apt to use too much of the material, and the result is a failure.

Cement for Aquariums.—1. Take 1 gill of plaster of Paris, 1 gill of litharge, 1 gill of fine white sand, ½ of a gill of finely-powdered resin. Mix well, and bottle and cork it until wanted for use, then mix it with boiled oil and dryers until as thick as putty. Mix the cement only in small quantities, as it dries quickly. 2. Mix boiled linseed oil, litharge, red and white lead together, using white-lead in the largest proportion, spread on flannel, and place on the joints. 3. A solution of glue, 8 oz. to 1 oz. of Venice turpentine; boil together, agitating all the time, until the mixture becomes as complete as possible, the joints to be cemented to be kept together for forty-eight hours if required. 4. Take ½ a gill of gold size, 2 gills of red-lead, 1½ gill of litharge, and sufficient silver-sand to make it into a thick paste for use. This mixture sets in about two days.

Armenian, or Jeweller's Cement.—Dissolve 5 or 6 bits of gum mastic the size of a large pea, in as much spirits of wine as will suffice to render it liquid; in a separate vessel dissolve as much isinglass (previously softened in water, though none of the water must be used) in rum, or other spirit, as will make a 2-oz. phial of very strong glue, adding two small pieces of gum ammoniacum, which must be rubbed or ground till they are dissolved; then mix the whole with a sufficient heat. Keep it in a phial closely stopped, and when it is to be used, set the phial in boiling water. The preceding is also effectual in uniting almost all substances, even glass, to polished steel.

Acid Proof Cement.—Make a concentrated solution of silicate of soda, and form a paste with powdered glass. This simple mixture will sometimes be found invaluable in the operations of the laboratory where a luting is required to resist the action of acid fumes.

Cutler's Cement.—1. Resin, 4 parts, to 1 part beeswax and 1 part of brick-dust, or plaster of Paris. 2. Sixteen parts resin, 16 hot whiting, and 1 wax. 3. Pitch, 4 parts; resin, 4; tallow, 2; and brick-dust, 2. The opening for the blade is filled with one of these compositions. The lower end of the iron heated and pressed in.

Cement for Bottle-Corks.—The bituminous or black cement for

bottle-corks consists of pitch hardened by the addition of resin and brick-dust.

Cement for Ivory, or Mother-of-Pearl.—Dissolve 1 part of isinglass and 2 of white glue in 30 of water, strain and evaporate to 6 parts. Add $\frac{1}{10}$th part of gum mastic, dissolved in $\frac{1}{2}$ a part of alcohol, add 1 part of zinc white. When required for use, warm and shake up.

Cement for Jet.—Shellac is the only cement used by jewellers for jet articles. The broken edges should be made warm before applying the cement. Should the join be in sight, by smoking the shellac before applying it, it will be rendered the same colour as the jet itself.

Cement for Meerschaum.—Take some garlic and crush it, in order to form a kind of dough, rub over the broken pieces of Meerschaum with it and reunite them by drawing very closely, bind them with iron wire according to the strength of the pieces, and finally make them boil during half an hour in a sufficient quantity of milk. Or use quicklime mixed to a thick cream with the white of an egg. These cements will also unite glass or china.

Plumber's Cement.—Black resin, 1 part; brick-dust, 2 parts; well incorporated by a melting heat.

Turner's Cement.—1. Take of Burgundy pitch, 2 lbs.; of resin, 2 lbs.; of yellow wax, 2 oz.; and of dried whiting, 2 lbs.: melt and mix. 2. Black resin, $\frac{1}{4}$ lb.; yellow wax, 1 oz.; melt together, and pour into a tin canister. When wanted for use, chip out as much as will cover the chuck to the $\frac{1}{16}$th of an inch, spread it over the surface in small pieces, mixing it with an eighth of its bulk of gutta-percha in thin slices; then heat an iron to a dull red heat, and hold it over the chuck till the mixture and gutta are melted and liquid; coil the iron a little, and with it stir the cement until it is homogeneous; chuck the work, lay on a weight to enforce contact, leave it at rest for half an hour, when it will be ready for the lathe. 3. Four parts resin melted with 1 part pitch; while these are boiling add brick-dust until by dropping a little upon a cold stone you think it hard enough.

Indianite Cement.—1. 100 parts finely-chopped rubber, 15 resin, 10 shellac, dissolved in a sufficient quantity of bisulphide of carbon. Used for uniting pieces of india-rubber. 2. India-rubber, 15 grs.; chloroform, 2 oz.; mastic, $\frac{1}{2}$ oz. The two first-named to be mixed, and after the rubber is dissolved add the mastic in powder; allow to macerate for a week.

Cheap India-rubber Cement.—Cut virgin or native india-rubber with a wet knife into the thinnest possible slices, and with shears divide these into threads as fine as fine yarn. Put a small quantity of the shreds (say $\frac{1}{10}$th or less of the capacity of the bottle) into a wide-mouthed bottle, and fill it three-quarters full with benzine of good quality, perfectly free from oil. The rubber will swell up almost immediately, and in a few days, especially if often shaken, assume the consistence of honey. If it incline to remain in undissolved masses, more benzine must be added; but if too thin and watery it needs more rubber. A piece of solid rubber the size of a walnut will make a pint of the cement.

This cement dries in a few minutes, and by using three coats in the usual manner, will unite leather straps, patches, rubber soles, backs of books, &c., with exceeding firmness.

Cement, Elastic.—Bisulphide of carbon, 4 oz.; fine india-rubber in shreds, 1 oz.; isinglass, 2 drachms; gutta-percha, $\frac{1}{2}$ oz.; dissolve. Used for cementing leather or india-rubber. The parts to be joined must be coated thinly with the solution, and allowed a few minutes to dry, then heat to melting; place the parts together and well hammer the air bubbles out.

Cement for Mounting Photographic Prints.—Fine wheat starch, 4 drachms; beat into a paste with cold water 1 oz. of best Russian glue; dissolve in a pint of boiling water; while boiling pour on the starch; put the whole into a saucepan, and boil till as thick as treacle. When required for

use a small quantity is to be melted in a little warm water.

Cement for Wood Vessels required to be Water-tight.—A mixture of lime-clay and oxide of iron separately calcined and reduced to fine powder, then intimately mixed, kept in a close vessel, and mixed with the requisite quantity of water when used.

Cement for Leather.—A good cement for splicing leather for straps is gutta-percha dissolved in bisulphide of carbon, until it is of the thickness of treacle; the parts to be cemented must first be well thinned down, then pour a small quantity of the cement on both ends, spreading it well so as to fill the pores of the leather, warm the parts over a fire for about half a minute, apply them quickly together, and hammer well. The bottle containing the cement should be tightly corked and kept in a cool place.

Marble Cement.—Take plaster of Paris, and soak it in a saturated solution of alum, then bake in an oven, the same as gypsum is baked to make it plaster of Paris; after which grind the mixture to powder. It is then used as wanted, being mixed up with water like plaster and applied. It sets into a very hard composition capable of taking a very high polish, and may be mixed with various colouring minerals to produce a cement of any colour capable of imitating marble. This cement is also used for attaching glass to metal.

Impervious Cement for Apparatus, Corks, &c.—Zinc white, rubbed up with copal varnish to fill up the indentures; when dry, to be covered with the same mass, somewhat thinner; and lastly, with copal varnish alone.

Chinese Cement.—Finest pale orange shellac, broken small, 4 oz.; rectified spirit (the strongest 58 o.p.) 3 oz.; digest together in a corked bottle in a warm place until dissolved; it should have the consistence of treacle. For wood, glass, ivory, jewellery, and all fancy works, used.

Cements for Cracks in Wood.—Make a paste of slacked lime, 1 part; rye meal, 2 parts; with a sufficient quantity of linseed oil. Or, dissolve 1 part of glue in 16 parts of water, and when almost cool stir in saw-dust and prepared chalk a sufficient quantity. Or, oil-varnish thickened with a mixture of equal parts of white-lead, red-lead, litharge, and chalk.

Cements for Joining Metals, or Glass and Wood.—Melt resin and stir in calcined plaster until reduced to a paste, to which add boiled oil a sufficient quantity to bring it to the consistence of honey; apply warm. Or, melt resin 180 parts, and stir in burnt umber, 30; calcined plaster, 15; and boiled oil, 8 parts. Or, dissolve glue in boiling water to the consistence of cabinet-maker's glue, then stir in sufficient wood ashes to produce a varnish-like mixture. While hot, the surfaces to be united must be covered with this compound and pressed together.

Stonemason's Cement.—Clean river sand, 20 lbs.; litharge, 2 lbs.; quicklime, 1 lb.; linseed oil, sufficient to form a thin paste. This cement is applied to mend broken pieces of stone, and after a time it becomes exceedingly hard and strong. A similar composition has been used to coat brick walls, under the name of mastic.

Fireproof and Waterproof Cement.—To 4 or 5 parts of clay, thoroughly dried and pulverized, add 2 parts of fine iron filings free from oxide, 1 part of peroxide of manganese, ½ part of sea salt, and ½ part of borax. Mingle these thoroughly and render them as fine as possible, then reduce them to a thick paste with the necessary quantity of water, mixing thoroughly well. It must be used immediately. After application it should be exposed to heat gradually increasing almost to a white heat. This cement is very hard, and presents complete resistance alike to a red heat and boiling water. Another method:—To equal parts of sifted peroxide of manganese and well-pulverized zinc white, add a sufficient quantity of commercial soluble glass to form a thin paste. This mixture, when used immediately, forms a cement quite equal in hardness and resistance to that obtained by the first method.

Electrical or Chemical Cement.—A good cement for chemical and electrical apparatus may be prepared by mixing 5 lbs. of resin, 1 lb. of wax, 1 lb. of red ochre, and 2 oz. of plaster of Paris, and melting the whole with moderate heat.

Engineers' Cements for Making Joints.—1. Mix ground white-lead with as much finely-powdered red-lead as will make it the consistence of soft putty. 2. Mix equal parts of white-lead and red-lead, and add as much boiled linseed oil as is required to give it the proper consistence; or boiled linseed oil and red-lead mixed into a putty. These cements are used for making metallic joints sound.

Iron Cements, or Rust Joints.—1. 1 lb. clean iron borings, pounded fine in a mortar, 2 oz. sal ammoniac in powder, 1 oz. flour of sulphur. The whole mixed by pounding, and to be kept dry. For use, mix 1 part of the above with 20 of iron borings pounded, adding water to the consistence of mortar. 2. 2 lbs. clean iron borings, 1 oz. flour of sulphur, 1 oz. sal ammoniac. 3. 98 parts of fine iron borings through a sieve, 1 flour of sulphur, 1 sal ammoniac. Mix and dissolve in boiling water when required for use. 4. Mix 1 lb. fine borings, ½ oz. sal ammoniac, pounded small, ½ oz. spirits of salts, and a little water. Prepare the joint by bringing the inner joint rings of the flanges together—screwing up the bolts firmly; in this condition there should be an annular space between the flanges of from ¼ in. to ⅜ in. in width; a strand of rope-yarn or any soft fibre should now be stuffed to the bottom of the joint, so as to prevent the jointing material from being driven through in the process of calking. A good hammer, a calking iron rather thinner than the joint, and a flat piece of wood or sheet iron should be in readiness. Take a suitable quantity of fine cast-iron borings, free from dust, and which may be passed through a sieve to remove large pieces; next dissolve a very small piece of sal ammoniac in water, say a drachm to a quart. In the absence of sal ammoniac to mix up the borings with, the urine of any animal does quite as well. Now mix the borings with sufficient of the fluid to cause them to adhere together in lumps when compressed in the hand. It is now ready for use. By means of the calking iron, and the piece of board or plate, stuff the moist material into the joint to a depth of 1 in. or so from the bottom, all round; now calk it down with the iron and hammer until it sounds perfectly solid, as though it struck against solid iron. Repeat the process of filling, then the calking, and so on, until the joint is filled to the surface. The joint should rest for at least ten hours before being put under pressure.

Cement to Mend Iron Pots and Pans.—Take 2 parts of sulphur, and 1 part, by weight, of fine black-lead; put the sulphur in an old iron pan, holding it over the fire until it begins to melt, then add the lead; stir well until all is mixed and melted; then pour out on an iron plate, or smooth stone. When cool, break into small pieces. A sufficient quantity of this compound being placed upon the crack of the iron pot to be mended, can be soldered by a hot iron in the same way a tinsmith solders his sheets. If there is a small hole in the pot, drive a copper rivet in it and then solder over it with this cement.

London Cement.—Boil a piece of Gloucester cheese three times in water, each time allowing the water to evaporate. Take the paste thus left and thoroughly incorporate with dry quicklime. It will mend glass, wood, china, &c., very effectually.

Architectural Cement.—Strong rice-water size and paper pulped in boiling water are mixed together; enough whiting is then added to make it of a proper consistence.

Renovating Files.—The file to be first cleansed from all foreign matter, and then dipped in a solution of 1 part nitric acid, 3 parts sulphuric acid, and 7 parts water; the time of immersion will be according to the extent the file has been worn and the fineness of the teeth, varying from 5 seconds to 5 minutes. On taking it out of the mixture, wash in

water, then dip in milk of lime, wash off the lime, dry by a gentle heat, rub over equal parts of olive oil and turpentine, and finally brush over with powdered coke.

Galvanic Method. — Well-worn files are first carefully cleaned by means of hot water and soda; then placed in connection with the positive pole of a battery, in a bath composed of 40 parts of sulphuric acid, 80 parts of nitric acid, and 1000 parts of water. The negative pole is formed of a copper spiral surrounding the files, but not touching them; the coil terminates in a wire which rises towards the surface. When the files have been ten minutes in the bath they are taken out, washed, and dried.

Softening Files. — Cover them with oil and hold them over the fire until the oil blazes, as soon as the flame runs all over the file, plunge it in the water; or put them in a moderate hot oven for half an hour if large files, but if small the first plan is the best.

Softening Cast Iron.—Heat the metal to a bright red, cool quickly in water, reheat, and then anneal by cooling slowly in ashes. Or, heat the metal to a red heat, let it lie a few minutes until nearly black, and then throw it into soapsuds.

Softening Castings.—Place the castings, surrounded by saw-dust, in an iron box, close it up with clay to exclude the air, and subject it to a red heat for several hours. The castings must be cold before they are withdrawn.

Hardening and Tempering Tools and Metals.—The following is the colour and temperature required:— Pale straw, 430° Fah., for lancets, &c.; dark yellow, 470° Fah., for razors, &c.; dark straw, 470° Fah., for penknives; clay yellow, 490° Fah., for chisels and shears; brown yellow, 500° Fah., for adzes and plane irons; very pale purple, 520° Fah., for table-knives; light purple, 530° Fah., for swords and watch-springs; dark purple, 550° Fah., for softer swords and watch-springs; dark blue, 570° Fah., for small fine saws; blue, 590° Fah., for large saws; pale blue, 610 Fah., for saws, the teeth of which are set with pliers; greenish blue, 630 Fah., for very soft temper. To obtain the proper temper lay the metal on a lump of iron heated to a sufficiently strong heat in the forge or other fire. The desired temper may be thus secured with the greatest facility and exactitude, as the clean bright metal shows the degrees of oxidation from the blue upwards most distinctly, which oxidation can be arrested at will. Cleanliness, or rather brightness of surface, is essential.

Tempering Mill Picks and Chisels.—Heat the bill to a blood-red heat, and then hammer it till nearly cold; again heat it to a blood red, and quench as quick as possible in three gallons of water, in which is dissolved 2 oz. of oil of vitriol, 2 oz. of soda, and ½ oz. of saltpetre; or, 2 oz. of sal ammoniac, 2 oz. spirit of nitre, 1 oz. oil of vitriol. The bill to remain in the liquor until it is cold. 2. 1 oz. white arsenic, 1 oz. spirits of salts, 1 oz. sal ammoniac, dissolved in four gallons of spring water, and kept in a tube or iron phial for use. Heat the tool to a blood-red heat, then quench it in this mixture, draw it gently over the clean fire till the spittle flashes off it, then let it cool. 3. To 3 gallons of water add 3 oz. of spirit of nitre, 3 oz. of spirits of hartshorn, 3 oz. of white vitriol, 3 oz. of sal ammoniac, 3 oz. of alum, 6 oz. of salt, with a double handful of hoof parings; the steel to be heated a dark cherry red. Used to temper chisels for cutting French burr stones.

Tempering Cast Steel.—Dissolve a small quantity of sal ammoniac in water, make the metal red, drop it into the mixture for a second or two, and take it out, leaving enough heat in the metal to draw it back a bit. If left till cold, the steel will be a great deal too hard.

Tempering Springs. — Get a piece of spring steel about the size of spring wanted; when forged and filed to tilt, make it warm-red, immerse in spring water (a little cow-dung improves it, mixed well with the water

before using it). Dry the spring, then tie a piece of wire fast to the spring in any form, so as to hold it. Dip in clean tallow or oil, put it on the fire till all the grease is burnt off, and swing round and round as swift as you can till cold.

Malleable Iron.—2 oz. fluoric acid, 1 oz. nitric acid, 1 oz. saltpetre, to 10 lbs. of metal. When the metal is melted, add the solution. It can be made in a crucible in a brass furnace. When you have cast off patterns, the castings want keeping at red heat for three or four days in iron boxes in a furnace.

Casehardening Iron.—Procure a quantity of old boots, burn these until they become charred, beat off the black and charred portion with a hammer, until sufficient powdered carbon is obtained; then place this powder with the articles to be operated upon into a sheet-iron box or a piece of wrought-iron gas-pipe sufficiently large, taking care that the articles are well covered and in the centre of the mass; lute the ends or top of the box with clay, and place the whole into a fire made of coke, keeping them there for an hour or more, taking care that the heat shall be equal (between dark red and red); now plunge the contents into water. Should the articles require to be blue, such as the barrels or chambers of pistols, repolish them on an emery wheel, and put them into a sand bath or powdered charcoal, until the blue colour is attained, taking them out immediately this change takes place. The following are mixtures that will do instead of the burnt leather:—3 parts of prussiate of potash to 1 sal ammoniac; or 2 parts sal ammoniac, 2 bone-dust, 1 prussiate of potash. Bones, urine, and night-soil, are also used for this purpose. A simple method of case-hardening iron is to sprinkle powdered prussiate of potash over it at a red heat and plunge into water; bicromate of potash, with the pith of rams' horns, may be used with good results, instead of the prussiate.

To Clean Pearls.—Soak them in hot water in which bran has been boiled, with a little salts of tartar and alum, rubbing gently between the hands when the heat will admit of it. When the water is cold renew the application till any discoloration is removed, rinse in lukewarm water; lay them on white paper in a dark place to cool.

To Clean Marble, Jasper, Porphyry, &c.—Mix up a quantity of the strongest soap-lees with quick-lime, to the consistence of milk, and lay it on the stone for twenty-four hours; clean it afterwards, and it will appear as new.

This may be improved by rubbing afterwards with fine putty powder and olive oil.

Cleaning Alabaster.—Strong soap and water is good for cleaning alabaster; if too much discoloured make a paste with quicklime and water, cover the article well with it, and let it remain all day; wash off with soap and water, rubbing hard the stains. Or supply dilute muriatic acid, having previously washed off dirt and grease.

To Clean Pictures.—Wash with a sponge or a soft leather and water, and dry by rubbing with a silk handkerchief. When the picture is very dirty, take it out of its frame, procure a clean towel, and making it quite wet, lay it on the face of the picture, sprinkling it from time to time with clear soft water; let it remain wet for two or three days; take the cloth off and renew it with a fresh one; after wiping the picture with a clean wet sponge, repeat the process till all the dirt is soaked out; then wash it well with a soft sponge, and let it quite dry: rub it with some clear nut or linseed oil. Spirits of wine and turpentine may be used to dissolve the hard old varnish, but they will attack the paint as well as the varnish if the further action of the spirits is not stopped at the proper time by using water freely.

Cleaning the Hands.—For cleaning the hands when stained with chemicals:—Put ¼ lb. glauber salts, ¼ lb. chloride of lime, and 4 oz. of water into a small wide-mouth bottle, and when required for use pour some of the thick sediment into a saucer, and rub it well over the hands with pumice-stone or a

nail brush. Stains of nitrate of silver may be removed from the hands by means of a solution of chloride of iron.

To Clean Plate.—Take an ounce each of cream of tartar, muriate of soda, and alum, and boil in a gallon or more of water. After the plate is taken out and rubbed dry, it puts on a beautiful silvery whiteness. Powdered magnesia may be used dry for articles slightly tarnished, but if very dirty it must be used first wet and then dry.

To Clean Brass or Copper.—Take 1 oz. of oxalic acid, 6 oz. rotten-stone, ½ oz. gum arabic, all in powder, 1 oz. sweet oil, and sufficient of water to make a paste. Apply a small portion, and rub dry with a flannel or leather.

Cleaning Brass Inlaid Work.—Mix tripoli and linseed oil, and dip felt into the preparation. With this polish. If the wood be rosewood or ebony, polish it with finely-powdered elder ashes, or make a polishing paste of rotten-stone, a pinch of starch, sweet oil, and oxalic acid, mixed with water.

Silver Cleaning Liquid.—Prepared chalk, 8 oz.; turpentine, 2 oz.; alcohol, 1 oz.; spirits of camphor, 4 drachms; liquor of ammonia, 2 drachms. Apply with a sponge and allow to dry before polishing. Or use a solution of cyanide of potassium, 12 oz. cyanide to 1 quart water; immerse the silver, brush it with a stiff brush until clean, wash and dry.

Cleaning Steel Articles.—Unslacked lime is a capital thing to clean steel articles with. If steel ear-rings, brooches, &c., are kept in powdered quicklime they suffer very little from rust. They should be carefully cleaned when put away, to remove any moisture that may have collected on them by handling.

To clean swords, &c., rub them with powdered brick-dust and oil, rub dry with brick-dust, polish with crocus and leather.

Cleaning Hats.—The stains of grease and paint may be removed from hats by means of turpentine, and if the turpentine leaves a mark finish with a little spirits of wine.

Cleaning Metals.—Mix half a pint of neat's-foot oil, and half a gallon of spirit of turpentine; wet a woollen rag with some of this and put on it a little powder, made thus:—Take 2 oz. green copperas and ½ oz. sub-carbonate of potash, burn these together in a clay vessel for a quarter of an hour in the fire, when it should be reduced to an impalpable powder for use. Having put the powder in the oiled part of the rag, well rub the metal; wipe off with a soft cloth, and polish with a dry leather and some more powder.

Cleaning Jewellery.—Common jewellery may be effectually cleaned by washing with soap and warm water, rinsing in cold water, dipping in spirits of any kind, and drying in warm *box-wood* saw-dust. Good jewellery only needs washing with soap and water, and polishing with rouge and a chamois leather.

Cleaning Engravings.—Put the engraving on a smooth board, cover it thinly with common salt finely pounded; squeeze lemon-juice upon the salt so as to dissolve a considerable portion of it; elevate one end of the board, so that it may form an angle of about 45 or 50 degrees with the horizon. Pour on the engraving boiling water from a tea-kettle, until the salt and lemon-juice be all washed off; the engraving will then be perfectly clean, and free from stains. It must be dried on the board, or on some smooth surface, gradually. If dried by the fire or the sun, it will be tinged with a yellow colour.

Crayons, Method of Making.—White paste, used for white crayons or for a body for other colours:—1. Washed pipe-clay, and washed chalk equal parts, mix them into a paste with sweet ale made hot, and with a chip or two of isinglass dissolved in it.

2. Take the finest powder of calcined oyster-shells, sifted through muslin, mix it up with water in which a little rice and a little white sugar-candy has been boiled; according to the quantity of rice, so will be the hardness of the crayon. The quantity of sugar-candy should not be more than the size of a filbert-nut to a pint of water.

3. Take common pipe-clay in powder, mix it up into a paste with very strong soapsuds, made thus:—Cut up an ounce of white soap into small shavings, dissolve it over the fire in ½ pint of water, stir into the mixture while hot the powdered pipe-clay as long as you can stir it. Spirits of wine added before the powders to render the soap-water transparent, is an improvement.

4. Take 3 oz. of spermaceti, dissolve it in 1 pint of water, stir into it a quantity of fine-sifted or washed white colour till of a proper consistence. If to be mixed with dark powders, a very little ox-gall is an improvement.

5. Melt 3 oz. of shellac in 2 oz. of spirits of wine, this will form a thick liquid; to this add 6 parts of pipe-clay and 1 part of oil of turpentine; grind all well together. The lighter the colour of the shellac the better; also if colours are to be added they should be ground up with the turpentine, before this is added to the rest.

The great object of attention is to procure the white chalk or pipe-clay without grit. To accomplish this, take a large vessel of water, put the whiting into it and mix well, pour off the top into another vessel, and throw the gritty sediment away; repeat several times. When this is done, let the whiting settle, and then pour the water from it and dry it for use.

The compositions for white crayons and the requisite colours being prepared, and that chosen made up into a stiff paste, it is to be placed upon a smooth slab of marble slightly oiled. The paste is rolled out with a rolling pin, then cut into slips and these rolled into cylinders by the aid of a little flat piece of wood, then cut to the length of 3 inches each, and placed in a slow oven or drying stove to become hard.

Instead of rolling the composition, it may be forced through the nozzle of a tin funnel, this is better for the delicate colours than rolling them; when dry they may be pointed.

It will always happen that except in black or white crayons, the colour alters very much in drying, so that in mixing an allowance must be made for this effect.

Crayons, Colours for.—*White.*—The best whites to employ are whiting or prepared chalk, pipe-clay, alum white or alumina, oyster-shell white, calcined bones, &c.

Carmine and Lake.—Crayons of these colours are generally hard; when made with powdered colours, the proper way of mixing is to dissolve the colour first in water or spirits of wine, and add it to nearly-dry white colour, grinding the whole well together. There should be four or five shades—madder is not used.

Vermilion and Red Lead, Red Ochre, Indian Red.—Each of these may be well ground in water, and when wet, mixed well with the white in different shades. These will make various reds, as well as salmon colour, flesh colour, orange Hamatite or crocus, of itself, ground and mixed with a little size, forms an excellent crayon.

The square chalks, or crayons, are made of the mineral red chalk, or ochre cut into slips with a saw. The same material is used in pencils for carpenters and others.

Yellows.—Dissolve the colours, which are Naples yellow, King's yellow, and yellow lake, in spirits of wine, and mix as for carmine. The chrome yellows are not so useful, because less durable. Gamboge, Indian yellow, and gall stone are not employed, but the various yellow ochres make good crayons.

Blue.—A good soluble colour is Prussian blue, but it is hard to grind. Dissolve it in water, then put the solution in a hole cut in a piece of chalk, this will absorb the water, and leave a great portion of the colour ready for mixing. Blue verditer is a good bright colour, but is so gritty as to require washing, as recommended for whiting. The same may be said of smalts or cobalt.

Browns.—These are Cologne earth, umber, raw and burnt; sienna, raw and burnt; treated as the blue.

Greens.—These may be either simple colours, as emerald green, Prussian green, green carbonate of copper; or better formed by adding the compositions of

the yellow and blue crayons together. Raw and burnt sienna may also be used in combination with Prussian blue or indigo. Good green crayons are more difficult to make than those of any other colour.

Black.—Chalk or charcoal is first to be sawed in 3-inch lengths, free from knots; then saw them longitudinally in narrow strips. Procure a tin trough about 4 inches by 3, and partly fill it with white wax; and after properly melted, the pieces of charcoal are to be saturated for forty-eight hours, and after draining they are fit for use. When white paste is employed the only powdered colour to be used is lampblack, all the others are apt to get mouldy.

Mixed Colours.—Mixed or half colours are produced by an admixture of the colours required in the paste. Thus a combination of blue and carmine produces a purple; the yellows and red united form orange; black and carmine is a beautiful tint for shading; vermilion and black form a fine rich brown; green and brown form an olive colour; and red and brown a chocolate.

CRAYONS FOR DRAWING ON GLASS.—Melt together equal quantities of asphaltum and yellow wax; add lampblack, and pour the mixture into moulds for crayons. The glass should be well wiped with leather, and in drawing be careful not to soil the glass with the fingers. In trimming these crayons, if the edge be bevelled, like scissors, the point may easily be rendered very fine.

Dyeing Silk.—For dyeing purposes we may consider that a pound of silk woven into common sarsenet, measures about 13 yards: this multiplied by 16, gives 208; or for a more convenient standard, we may calculate 200 yards at 16 lbs., 100 at 8 lbs., and so on.

JET BLACK *from Nitro-Sulphate of Iron.*—For 200 yards or 16 lbs. Prepare in a hot solution of nitro-sulphate of iron. 5° Twaddle, 150° Fahrenheit; work 30 minutes in this; lift, and wash well in 3 warm waters; then boil 18 lbs. of fustic; put off the boil; enter, and winch for 30 minutes; lift; boil 16 lbs. logwood, put off the boil, and decant the clear liquor into a large tub; add 1 lb. of white soap; enter, and winch for 30 or 40 minutes in this; lift; wash in 2 waters, and you will have a brilliant jet black.

JET BLACK *from Nitrate of Iron.*—For 200 yards. After being cleaned, prepare in a cold solution of nitrate of iron, 5° Twaddle (this is strong enough for light silks, 4° or 4½° will do for dark and dipping silks); 30 minutes in this; lift; boil 14 lbs. fustic; put off the boil; enter, and winch 30 minutes; lift; wash in 3 waters, blood-warm; then boil 16 lbs. logwood; decant as before; give the same quantity of soap, and finish in the same way.

BLACK *from Sulphate of Iron.*—For 200 yards. After being cleaned or scalded, discharge in a hot vitriol sour; a cold and then a warm water out of the sour; run through another scald, and 2 warm waters; then boil 14 lbs. fustic; put off the boil; winch 30 minutes, and lift for saddening; make up a solution with some of the fustic left in the last process, and 1 lb. copperas; winch in this for half an hour; wash in 3 waters; dye with 16 lbs. logwood and 1 lb. of soap.

HAT BLACK.—Work 5 lbs. silk in a mixture of 2 lbs. fustic chips; 1 lb. quercitron bark; lift; then add 6 oz. verdigris, 6 oz. copperas; work for quarter of an hour, and hang up all night; wash and dye with a decoction of 5 lbs. logwood with as much white as will make a lather.

DYEING SHOTS.—When satins, satinets, sarsenets, or silks of any kind are found to contain shots, that is, *warp and weft of different qualities*, they must be prepared as follows:—For 100 yards. Dissolve 1½ lb. salt of tartar in a copper containing 150 gallons boiling water; winch in this one hour; lift, and wash in 2 waters; and then prepare for any colour. If, after dyeing black, brown, or any colour, the silk is found to contain a shot of different silk, it must be discharged to the bottom, and put through the stuff as directed above; then prepare a new, for whatever colour required.

CINNAMON BROWN.—For 100 yards

Boil 12 lbs. fustic; 3 lbs. ground madder, 2 lbs. barwood. Cool to 200° Fahrenheit, then enter, and winch 20 minutes; air out, and repeat; with a little of the liquor in another dish, sadden to pattern with 4 or 5 oz. copperas, 1 or 2 shots; wash in 2 waters, and dry.

OLIVE BROWN.—For 10 yards. Boil fustic, 1 lb.; logwood, 3¼ oz.; cudbear, 2½ oz. Cool to 200° Fahrenheit; enter, and winch for 20 minutes; air out; repeat: sadden to pattern with 4 oz. copperas; wash and dry.

FRENCH BROWN.—Prepare it in a hot solution of alum, for 10 or 12 hours; lift, and wash in 2 waters; boil or scald. For 10 yards. Limawood, 1 lb.; ground fustic, 4¾ oz. Decant the clear of both liquors into another dish; enter, and winch for 30 minutes; air out, and repeat; if dark enough, wash in 2 waters, and dry. Common brown is done in this way by adding a little logwood.

In preparing this and the following colour, a little copperas is sometimes used along with the alum; when done in this manner, raise slightly with muriate of tin.

CLARET.—Prepare with alum like the last; boil or scald. For 10 yards. Limawood, 1¼ lb.; logwood, 3¾ oz. Decant the clear of both liquors into a tub of sufficient size; enter, and winch for 30 minutes; air out, and repeat; when dark enough, wash and dry.

In dyeing the two last, they ought to get two liquors, or the liquor at twice, as one will hardly make the colour as full as it ought to be.

PALE BLUE.—For 100 yards. 3 oz. paste or extract of indigo; 6 oz. tartaric acid. Sour first in a hot solution of sulphuric acid (about 1½ gill), lift, and wash in 1 water. Prepare the paste and dissolve the acid in a little hot water; then take a copper or stoneware vessel of sufficient size, fill it nearly full of water, 110° Fahrenheit; put in the paste, and 5 parts of the tartaric acid; winch in this 15 minutes; lift; wash in cold water; harden with the part of tartaric not used; lift, and dry.

In dyeing printed silks, containing black or any colour you wish to retain, they must not be soured in dyeing, and use as little raising as possible.

TO PREPARE EXTRACT OF INDIGO.—Every particle must be well broken with a palette knife, or the back of a tablespoon, after which pour on a little boiling water; stir it up, and let it settle for a little before using.

ROYAL BLUE.—Prepare in a solution of nitrate of iron, 3° Twaddle, 100° Fahrenheit; and for every pound of prussiate used in dyeing, add as much of the crystals of tin (dissolved in hot water) to the preparation; work in this till the silk turns a light buff colour; lift, and wash in 1 water; after which, for 100 yards, dissolve 4 lbs. prussiate of potash in a little boiling water; put this into a copper containing 80 gallons water, 120° Fahrenheit; add 1½ gill sulphuric or muriatic acid; enter in this; winch 15 minutes; lift; 1 water; run again through the preparation; add 2 gills sulphuric acid to the prussiate; repeat in it, and if not dark enough, lift, and add a little nitrate of iron; after getting it to the required shade, give 2 waters; then harden in a solution of alum; and dry in a hot stove.

PEA GREEN.—For 100 yards. 10 oz. extract of indigo, 2½ lbs. ebony, 1 lb. alum. Sour first; wash in 1 water; boil or scald the ebony; decant the clear into another dish, and add the extract of indigo and alum; enter in this, and winch for 10 or 15 minutes; wash in 1 water.

COMMON PALE GREEN.—For 11 yards. Extract of indigo, 2 oz.; ebony, 1¾ oz.; alum, 1¾ oz.; sulphuric acid, 1¼ oz. Work as for Pea Green.

GRASS GREEN.—For 10 yards. Fustic, 12 oz.; extract of indigo, 3 oz. 3 drachms; alum, 3 oz. 3 drachms; sulphuric acid, 1½ oz. Boil the fustic first; then add the extract of indigo, alum, and acid; put off the boil; enter and winch till you get the shade required; if not blue enough, give more extract of indigo; if not yellow enough, more fustic.

MYRTLE GREEN.—For 10 yards. Fustic, 1 lb.; logwood, 3 oz. 3 drachms; extract of indigo, 3 oz. 3 drachms; bluestone, ½ oz. Boil the logwood and fustic

together; put off the boil; enter; winch 20 minutes; air out and repeat; raise with 3 oz. bluestone dissolved in the boiler; then give the extract of indigo; 1 water; rince in the remaining 2 oz. bluestone; harden in a solution of alum, and dry.

OLIVE GREEN.—For 100 yards. 10 lbs. fustic, 2 lbs. logwood, 10 oz. camwood. Boil altogether for 30 minutes; put off the boil; enter and winch for 20 minutes; air out and repeat; sadden with 3 or 4 oz. copperas in the same liquor, or with a little of the liquor in another dish; when the required shade is got, wash and dry.

DRAB.—For 100 yards. Boil 4 lbs. fustic and 6 oz. logwood; 2½ oz. cudbear; 1¼ oz copperas. Cool to 200° Fahrenheit; enter; winch 20 minutes; air out; repeat; then take a little of the liquor out of the boiler, dissolve the copperas, reduce it to handling heat with water, and give 1 or 2 shots through it as the pattern requires; 1 water out of the saddening; then give a warm, but weak sour, to clear the colour; wash in 2 waters, and dry.

Before using cudbear, it must always be drenched with a little hot water, to the consistency of paste; then scald or boil it as occasion may require.

FAWN.—For 10 yards. Fustic, 6½ oz.; cudbear, ½ oz.; copperas, 1½ drachm. Use as for Drab.

STONE.—For 100 yards. 3 lbs. fustic, 7½ oz. logwood, 2½ oz. cudbear, 2 oz. copperas. Use as for Drab.

SLATE.—For 100 yards. 8 oz. cudbear, 2 lbs. logwood, 1 lb. tartar. Bottom with the cudbear; lift; boil the logwood; decant into a tub of sufficient size; enter and winch in this for 15 minutes; lift and raise with the tartar at twice, then wash and dry.

STRAW.—For 10 yards. Annatto, 6½ drachms; barks, 1½ oz.; muriate of tin, 1½ oz. Give the annatto on the bottom 212° Fahrenheit; 1 water out, and then give the barks and muriate of tin, same heat.

Before using annatto, it must be boiled with half its weight of American ashes, in the least possible quantity of soft water. This applies to every process where annatto is used.

BUFF.—For 10 yards. Annatto, 1½ oz.; vitriol, 1½ oz. Give the annatto at 212° Fahrenheit; when full enough, lift; wash in 2 waters; then raise with the vitriol.

CREAM COLOUR.—For 10 yards. Boil annatto, 9½ drachms; vitriol, 1 oz. Work in the same manner as Buff.

CHAMOIS.—For 10 yards. Annatto, 9½ drachms; fustic, 6½ oz.; madder, 6½ drachms; cudbear, 3½ drachms. Bottom with the annatto, 212° Fahrenheit; wash in 1 water; boil the fustic, madder, and cudbear together; put off the boil, and enter; winch 15 minutes; if not full enough, air out and repeat; then wash and dry.

SALMON COLOUR.—For 10 yards. Annatto, 1½ oz.; cudbear, 4 drachms. Boil the annatto; then add the cutbear; put off the boil; enter and winch 30 minutes; wash in 2 waters; then dry.

ORANGE.—For 10 yards. Annatto, 1¾ oz.; bark, 1½ oz.; muriate of tin, 1½ oz. Give a good body of annatto, 212° Fahrenheit; wash in 1 water; then top with the bark and muriate of tin.

AMBER. — For 10 yards. Annatto, 1½ oz.; bark, 1½ oz.; muriate of tin, 2½ oz. Bottom with the annatto, and top with the bark and muriate of tin. Use as for Orange.

PINK.—For 10 yards. Bottoming, blue archil, ½ oz.; dyeing, safflower, 2 oz.; raising, tartaric acid, ½ oz. Put the archil into 100 gallons boiling water; winch in this 15 minutes; lift; bleed; then refine the safflower with cotton; make up a safflower liquor of 100 gallons; enter and winch 15 minutes; lift; put in half the raising; return and winch 10 minutes; lift again and add the other half of the raising; return for 10 minutes more; then wash in 1 water; harden with a little tartaric in another, and dry.

Rose colour may be made in this way, by giving more stuff.

TO PREPARE SAFFLOWER. — Steep 2½ lbs. safflower all night in water; in the morning rub the cakes between the hands, so that it may be all broken; then put it into a bag or close sieve; stand with it under a good run of water

until the particles are all disengaged from each other, and purged of impurities; then put 20 or 30 gallons of water into a large tub, add ½ lb. soda dissolved, and put in the safflower; stir it up, and let it bleed 30 or 40 minutes; then strain it through the bag into a second tub; if not well enough bled, repeat in the first tub with a little more soda. To refine safflower after being bled, —immerse 3 or 4 lbs. cotton yarn or cloth in it; in 10 minutes lift, and add a little tartaric; return for 10 minutes; add a little tartaric again; return for 10 minutes more; lift, and add the tartaric a third time, at which time it must do no more than taste slightly sour; then wash in 2 or 3 waters, after which it must be bled in a tub of clean water with a little soda; then make up this liquor with water for dyeing.

ROSE COLOUR WITH COCHINEAL.—For 10 yards. Bottoming, blue archil, ¾ oz.; preparation, tartar, ¾ oz.; scarlet spirits, 2½ oz.; dyeing, cochineal, fully 1½ oz. Bottom with archil; lift; dissolve the tartar, and put it and the spirits into 100 gallons water; winch in this for some time; then let it lie 12 hours (if this preparation is made hot, 3 or 4 hours will do); pound, and then boil the cochineal; put off the boil; lift out of the preparation, and enter; winch till the liquor cools, and the colour will be full enough.

SCARLET WITH COCHINEAL.—For 10 yards. Bottoming, annatto, fully 1½ oz.; preparation, tartar, 1½ oz.; scarlet spirits, 3½ oz.; dyeing, cochineal, 2½ oz. Bottom with the annatto, 212° Fahrenheit; winch 15 or 20 minutes, and it should be a full orange; then give the preparation and cochineal as for rose colour.

FAST CRIMSON.—For 10 yards. Bottoming, cudbear, 1½ oz.; preparation, tartar, 1½ oz.; scarlet spirits, 3½ oz.; dyeing, cochineal, 2 oz. Boil or scald the cudbear; winch in this 30 minutes; then prepare and dye as before.

PURPLE.—The best purples are made upon the purple vat. For a red shade, wash in 2 cold waters; for a blue shade, wash in 2 hot waters. Another but inferior method is, to prepare with alum, dye with logwood, and raise with double muriate of tin.

ROYAL BLUE PURPLE.—For whatever depth of colour required, winch upon the purple vat, wash in 2 warm waters; then put a little extract of indigo into a tub of cold water; add a little sulphuric acid; enter and work in this till you get the required shade, then wash in cold water, and dry

LILAC.—The best lilac is dyed upon nitro sulphate of iron spirits, when without these, the following is the simplest method: 10 gallons water, 1 pint purple vat. Add raw muriatic acid till the glass stands at 6° Twaddle; enter in this, and work till you get the required shade; if too light, add more purple liquor, wash in 2 warm waters, and dry.

LAVENDER.—Same as lilac, by adding a little neutralized extract of indigo. Break 4 oz. of extract of indigo; dilute it with 2 quarts of hot water, and add half an ounce of soda, to destroy or neutralize whatever acid the extract contains; after stirring it well up, let it stand for two days, then strain it for use. Silver grey gets less stuff than lavender.

Aniline Colours.—No mordant is necessary for these colours when used on silk or woollen; the proper quantity of clear liquid is mixed with slightly warm water, the scum formed skimmed off, and the goods entered and worked until the required shade is obtained. Paste mauve is dissolved in spirit before being used, and care must be taken to prevent irregularities from the tarry scum. For dyeing on cotton, the cloth is steeped in sumac or tannic acid dyed in the colour, and can then be fixed by tin; or the cloth may be sumaced and mordanted as usual with tin, and then dyed.

Woollen Dyeing.—A pound of wool woven into common merino measures about 3 yards, common moreen about 2 yards.

JET BLACK.—For 50 lbs. Prepare with 2½ lbs. chrome; boil half an hour, and wash in 2 waters. Dye with 20 lbs. logwood and 2 lbs. fustic. Boil half an

hour; 1 water, then a slight sour, moderately warm; 1 cold water, and finish out of a warm one, softened with a little urine.

GENEVA BLACK.—3 lbs. green copperas, 3 lbs. tartar, ½ lb. sulphate of copper, 1 lb. fustic, 1 lb. logwood. Boil for half an hour; enter, and boil the cloth 3 hours; wash; then enter into a vat with 11 lbs. logwood; boil 1 hour; raise; enter into logwood vat for half an hour, and finish.

FAST BLACK.—For 50 lbs. Prepare with 2 lbs. chrome, 1 lb. tartar, and 1 quart muriate of tin; boil 1 hour, and wash in 2 waters. Dye with 25 lbs. logwood and 3 lbs. fustic. Boil 30 minutes, lift, add 1 pint vitriol. Return for 10 minutes, then wash and dry. To render this *blue-black*, omit the fustic.

CINNAMON BROWN.—For 50 lbs. 8 lbs. fustic, 2 lbs. madder, 10 oz. cudbear, 1 lb. tartar, 2 lbs. alum. Give 2 runs, and sadden with 3 or 4 oz. of copperas.

FRENCH BROWN.—For 50 lbs. Preparation, 1½ lb. chrome. Dyeing, 6 lbs. fustic, 1 lb. ground madder, ½ lb. cudbear, 1 lb. tartar; and if not dark enough, add 8 oz. logwood. Boil half an hour.

CLARET.—For 50 lbs. Preparation, 1½ lb. chrome. Dyeing, 9 lbs. limawood, 2 lbs. logwood, ½ lb. tartar. Boil half an hour.

OLIVE BROWN.—For 50 lbs. Preparation, 1½ lb. chrome. Dyeing, 7 lbs. fustic, 3 lbs. madder, 1 lb. logwood, 2 lbs. tartar, 8 oz. cudbear. Run; raise in the second with 5 or 6 oz. bluestone; wash well and dry.

COMMON DARK BROWN.—For 40 lbs. 6 lbs. logwood, 12 lbs. redwood, 4 lbs. madder. Boil half an hour, air out and repeat, then sadden with 1 lb. copperas; if too dark, raise to pattern with muriate of tin.

RUBY.—For 50 lbs. Preparation, 3 lbs. tartar and 2 lbs. alum. Boil half an hour, and wash in 3 warm waters. Dyeing, 8 lbs. limawood, ½ lb. cudbear, and ¾ lb. tartar. Boil half an hour, and blue to pattern with hot water.

PURPLE.—For 50 lbs. Preparation, 1½ lb. tartar and 1 lb. alum; wash in 3 waters. Dye with 10 lbs. logwood; boil half an hour; raise with 1 quart muriate of tin.

ROYAL PURPLE.—For 50 lbs. Blue on the woad vat, either warm or cold, for whatever depth of colour required; wash in 2 waters; then give 2½ lbs. cudbear; boil half an hour, or until you get the shade wanted; if not blue enough, give another run upon the vat.

PALE BLUE.—For 50 lbs. 1 gill sulphuric acid, 3 oz. extract of indigo, 1 lb. alum. Enter cold with one half of the extract; give the other half when the boiler warms; bring to the spring.

ROYAL BLUE.—For 50 lbs. 3½ lbs. super-sulphate of tartar, 3½ lbs. prussiate of potash, 2 lbs. 10 oz. logwood, 3½ quarts royal blue spirits, 3½ pints muriate of tin. Into a boiler containing 100 gallons of water, put the prussiate and super-sulphate of tartar, after being dissolved in a little boiling water; have the logwood boiled beforehand, put it in, and one-half of the blue spirits; enter cool, heat up to 180° Fahrenheit, and lift; give the rest of the blue spirits; return and boil for a quarter of an hour; lift again, cool well and give the muriate of tin; return and boil 15 minutes; lift, wash, and dry.

ROYAL BLUE PURPLE.—For 50 lbs. 10½ lbs. logwood, 1½ lb. prussiate of potash, 3½ lbs. super-sulphate of tartar, 3½ quarts royal blue spirits, 3½ pints muriate of tin. Give the logwood at twice lest the colour get unlevel.

PEA GREEN.—For 54 lbs. 2 lbs. extract of indigo, 7 lbs. fustic, 1 lb. alum. Bring on from the cold; when the boiler heats to 180° Fahrenheit, put in the fustic; boil 15 minutes.

COMMON PALE GREEN.—For 50 lbs. 3½ lbs. extract of indigo, 2½ lbs. fustic, 10 oz. tartar, 1 gill sulphuric acid. Give the extract and acid first; when at 180° Fahrenheit, put in the fustic and tartar; boil 15 minutes.

GRASS GREEN.—For 50 lbs. Boil 20 lbs. fustic, 7 lbs. extract of indigo, 1½ lb. tartar, 3 gills sulphuric acid.

OLIVE GREEN.—For 50 lbs. Prepare with 1½ lb. chrome; boil half an hour, and wash in 2 waters; then boil 12 lbs. fustic and 2½ lbs. logwood for 1

hour; add 2 lbs. madder and 2 lbs. redwood. Enter; boil half an hour. Raise in the same liquor with 4 oz. bluestone; wash well and dry.

PEACH.—For 50 lbs. Drench 8½ lbs. cudbear with a little hot water; boil or scald it in 3 or 4 gallons; decant the clear liquor into a boiler containing 100 gallons water; enter cold; bring to the boil; lift and put in 1 lb. soda, or 2 gallons urine; return and boil 10 minutes.

DRAB.—For 50 lbs. 7 lbs. fustic, 8 oz. madder, 4 oz. cudbear, 2 lbs. alum, 8 oz. tartar. Enter between the cold and 160° Fahrenheit; after heating up, boil from 10 to 30 minutes; wash in 2 waters. All dark shades of this and the four following colours may be slightly prepared with chrome; wash in 2 waters.

LIGHT DRAB.—For 50 lbs. 4 lbs. fustic, 1½ lb. alum, 4 oz. madder, 4 oz. tartar, 3½ oz. cudbear. Work as for drab.

FAWN.—For 50 lbs. 5 lbs. fustic, 1 lb. madder, ½ lb. camwood, ½ lb. cudbear, 2 lbs. alum. Work as for drab.

STONE.—For 50 lbs. 1 lb. logwood, 4 oz. fustic, 8 oz. extract of indigo, 3 lbs. alum, 1½ lb. tartar. Work as for drab.

SLATE.—For 50 lbs. 1 lb. logwood, 8 oz. extract of indigo, 4 oz. fustic, 2 lbs. tartar, 2 lbs. alum. Work as for drab.

STRAW.—For 50 lbs. Boil 3½ lbs. quercitron bark and 3 oz. cochineal. Add 2½ lbs. tartar, 3 quarts muriate of tin. Enter at 150° Fahrenheit; boil 30 minutes.

PRIMROSE.—For 50 lbs. Boil 2½ lbs. bark. Add 2 lbs. tartar, 2 quarts muriate of tin. Enter at 150° Fahrenheit; boil 30 minutes.

YELLOW.—For 40 lbs. 2½ lbs. bark, 2 lbs. tartar, 2 quarts muriate of tin. Enter at 150° Fahrenheit; boil 30 minutes.

BUFF.—For 45 lbs. Boil 4½ lbs. fustic and 1½ lb. madder. Add 7 lbs. alum. Enter at 200° Fahrenheit; boil 30 minutes.

AMBER.—For 40 lbs. Boil 4 lbs. bark and 8 oz. madder. Add 3 quarts muriate of tin, 1 lb. tartar. Enter at 200° Fahrenheit; boil 30 minutes.

ORANGE.—For 50 lbs. Boil 10 lbs. bark and 1½ lb. cochineal. Add 2 lbs. tartar, 2½ quarts yellow spirits. Enter at 200° Fahrenheit; boil 30 minutes.

LILAC.—For 50 lbs. Boil 5½ lbs. logwood and 2 lbs. alum. Add 2 quarts muriate of tin, 8 oz. extract of indigo. Brought on from 100° Fahrenheit.

LAVENDER.—For 45 lbs. Boil 2 lbs. logwood and 2 lbs. alum. Add 10 oz. extract of indigo. Enter cold, and bring up to the boil.

FRENCH GREY.—For 50 lbs. Boil 7 lbs. fustic and 12 oz. cudbear. Add 6 oz. extract of indigo, 1 pint sulphuric acid. Cool to 180° Fahrenheit; ente., and boil 20 minutes.

SILVER GREY.—For 50 lbs. Boil 1 lb. logwood and 2½ lbs. alum. Add 5 oz. extract of indigo. Brought on from 100° Fahrenheit; boil 10 minutes.

FRENCH PINK.—For 50 lbs. 3 gills ammonia paste; 1¼ lb. tartaric acid, to redden; 10 oz. oxalic acid, to blue. Enter at 140° Fahrenheit; heat no higher than 200°.

ROSE COLOUR.—For 40 lbs. 1 lb. cochineal, 3 gills double muriate of tin, 1 lb. tartaric acid. Enter at 100° Fahrenheit; heat up; boil 15 minutes; lift, and cool to 120°, by throwing out part of the liquor, and filling up with water, —add 1 gill ammonia paste, 12 oz. tartaric acid, 6 oz. oxalic acid. Bring up to the boil; when the desired shade is got, wash well, and dry.

SCARLET WITH COCHINEAL.—For 50 lbs. Boil 4 lbs. cochineal and 1½ lb. bark. Add 3 lbs. tartar, 2 quarts scarlet spirits. Enter at 200° Fahrenheit; boil one hour; wash well. Sour before dyeing, either cold or warm; 1 water, out.

SCARLET WITH LAC.—For 50 lbs. Boil 5½ lbs. lac and 1½ lb. bark. Add 3 lbs. tartar, 2 quarts lac scarlet spirits. Enter at 200° Fahrenheit; boil 1 hour; wash well. Sour as before.

SCARLET WITH LAC AND COCHINEAL.—For 50 lbs. Boil 4½ lbs. lac and 1½ lb. bark. Add 2 lbs. tartar, 2 quarts lac scarlet spirits. Enter at 200° Fahrenheit; boil in this 30 minutes; lift, and wash well; then, in a boiler of clean

water, boil 14 oz. cochineal and 14 oz. tartar. Add 1½ pint scarlet spirits. Enter at 200° Fahrenheit; boil 20 minutes, and wash well out. Sour before dyeing.

LIMAWOOD CRIMSON. — For 50 lbs. Prepare with 2 lbs. alum and ½ lb. tartar. Boil half an hour; wash in 3 warm waters. Boil in 11 lbs. limawood, and add ½ lb. cudbear. Boil in this for half an hour, and blue with warm water.

FAST CRIMSON.—For 50 lbs. 6½ lbs. cochineal, ½ lb. cudbear. Boil in this three-quarters of an hour; raise with 2 quarts crimson spirits; boil a quarter of an hour; lift, wash well, and dry.

COCHINEAL CRIMSON. — For 50 lbs. 3½ lbs. cochineal, 2½ lbs. tartar, 2 quarts crimson spirits. Boil half an hour; wash well; blue with urine or a little ammonia, in a clean tub of warm water, 150° F.

Cotton Dyeing. BLACK.—For 40 lbs. Boil or scald 10 lbs. sumac; lay the cloth or yarn in this for 18 hours; wring out; run through acetate of iron, 40° Twaddle; 4 turns, or for half an hour; wring out; repeat and wash well in 3 waters; then boil 8 lbs. logwood and 1 lb. fustic; put off the boil and enter; or the clear of the liquor may be decanted into another dish; 1 run, continue half an hour; wring out; repeat; sadden with 1 lb. copperas; 2 runs; wash and dry. In Job Dyeing, for a piece of cloth 20 yards, prepare in strong hot sumach like the above; then put 3 quarts slacked lime into 20 gallons water; when the lime precipitates, decant the clear into another tub, lift the cloth out of the sumach, give 1 run through acetate of iron, 1 through lime, repeat in the iron, and again through the lime. Should the cloth have got unlevel, give an extra run through the lime to make it level; then wash in 2 waters, and give logwood and a little fustic, like the above.

FAST BLACK. — For 50 lbs. Dark blue on blue vat *cotton;* lay then in 18 lbs. hot sumach for 24 hours; lift, and sadden with black iron liquor; wash and dry.

BROWN.—For 50 lbs., or 200 yards. Prepare with 2½ lbs. sumach, acetate of iron, 2° Twaddle, and lime, 1° Twad. Dye with 18 lbs. redwood and 4 lbs. fustic. Twenty-four hours in the sumach; lift, and run through the iron tub, then through the lime; repeat in each tub, and wash in 3 waters; then scald or boil the wood; decant into another tub; enter and winch for 20 minutes; air out, and repeat; if not dark enough, add a little logwood; then sadden with 6 or 8 oz. copperas.

MADDER BROWN.—For 40 lbs. Boil or scald 10 lbs. sumach; lay the goods in it for 24 hours; lift, and decant into a tub, containing 60 gallons water, 1 quart acetate of iron, and 1 quart mordant. Enter; turn for half an hour; lift, and wash in 2 waters; then dye with 10 lbs. best crop madder; enter cold, and bring to the spring.

DARK BROWN WITH CATECHU.—For 200 yards. Boil 30 lbs. catechu; enter the cloth as it leaves the singeing-work; winch it in the catechu for some time, and let it down into the boiler all night; in the morning light a fire under the boiler; lift the cloth, and give 2 runs through acetate of iron wash well out of the iron; have the boiler up, and give another run through it at the boil, 1 hour; lift, and give other 2 runs of iron, when it will be quite black; stripe with lime to the shade required.

LIGHT CATECHU BROWN.—For 50 lbs. Boil 20 lbs. catechu in one boiler, 5 lbs. chrome in another. Enter in the catechu first; work 20 minutes, and wring out; then through the chrome, 10 minutes, and wring out; through catechu again; giving shot about till dark enough; finishing with catechu.

CLARET.—For 50 lbs. Preparation, 12½ lbs. sumach; spirit tub, 3° Twad. Dyeing, 15½ lbs. limawood; 2 lbs. logwood, to blue. Raising, 1 quart red spirits for cotton. 8 to 10 hours in the sumach; work 1 or 2 hours in the spirit tub; wash out of it in 3 waters; boil the limawood and logwood decant into a large tub; winch 30 minutes; lift, and give the raising; enter again for 15 minutes; lift, wash, and dry.

RUDY. — For 50 lbs. Preparation,

12½ lbs. sumach; spirit tub, 3° Twad. Dyeing, 12½ lbs. limawood; 1 lb. logwood to blue. Raising, 1 quart red spirits, for cotton; wrought like *claret*.

PURPLE.—For 50 lbs. Preparation, 12½ lbs. sumach; spirit tub, 2½° Twad. Dyeing, 15 lbs. logwood. Raising, 1 quart purple spirits, cotton; wrought like claret.

SCARLET.—For 40 lbs. Preparation, 16 lbs. sumach; spirit tub, 3° Twad. Dyeing, 24 lbs. limawood, 3½ lbs. turmeric. Raising, 6 lbs. alum. After lying in sumach 24 hours, lift, and winch it in the spirit tub; wash well out; boil the wood; decant the clear liquor into a large tub; enter, and winch for 30 minutes; then raise with alum.

CRIMSON WITH COCHINEAL.—For 50 lbs. Prepare with 15 lbs. sumach and 10 lbs. alum. Dye with 6½ lbs. cochineal. Twenty-four hours in the sumach; lift; make up a hot solution of alum; winch in that 2 or 3 hours; lift; wash in 2 waters; then boil the cochineal; put off the boil; enter, and winch till full enough; then wash and dry.

LIMAWOOD RED.—For 40 lbs. 10 lbs. sumach; spirit vat, 2½° Twaddle; 12 lbs. limawood; 1 quart red spirits. After being prepared with sumach, winch it in the spirit vat for 2 hours; lift, and wash well in 3 waters; boil or scald the limawood; decant the clear liquor into another vessel; enter, and winch in this for 30 minutes; lift, and raise in the same liquor, with 1 quart of red spirits.

BARWOOD RED.—For 40 lbs. 10 lbs. sumach; spirit vat, 2½° Twaddle; 40 lbs. barwood; 1 quart red spirits; done in the same manner as limawood red.

DRAB.—For 40 lbs. Boil 6 lbs. fustic; scald 2½ lbs. limawood; 2 lbs. sumach. Decant into a wooden vessel, capable of containing 100 gallons; reduce with cold water to handling heat; enter; 6 turns; wring out; sadden with 8 oz. copperas; 4 turns; wring out again, and give 4 oz. bluestone.

FAWN.—For 50 lbs. Boil 5 lbs. fustic and 3 lbs. limawood. Add 2 lbs. alum. Decant the fustic and limawood into a large tub; reduce to handling heat; enter and work 15 minutes; if not dark enough, add 8 oz. logwood; then wash and dry.

STONE.—For 50 lbs. Boil 4 lbs. fustic, 2 lbs. limawood, 2 lbs. madder. Decant and work in this 15 minutes; air out and repeat; lift, and add 4 or 6 oz. copperas; enter again, and work till you get the required shade; then wash and dry.

LAVENDER.—100 yards. Scald 1 lb. logwood and 2 lbs. sumach. Decant both into a tub of sufficient size; cool to 150° Fahrenheit; add 2 gills vitriol; winch in this 20 minutes; lift and run slightly through acetate of iron; wash in 2 waters, then give 1 lb. logwood as before; raise with a pint of muriate of tin; wash in 2 waters; then, in a tub of cold water, put 4 oz. extract of indigo; enter, and winch in this 15 minutes; lift, give 1 water, and dry.

LILAC.—100 yards. Scald 1½ lb. logwood, 2 lbs. sumach. Decant, and work like the last; sadden, and top with logwood; raise with muriate of tin.

PINK.—For 30 lbs. yarn, or 250 yards cloth. Bleed 7 lbs. safflower in 50 gallons soft water; dissolve 2 lbs. tartar in 3 gallons hot water; enter the yarn in the safflower, and give 4 turns; lift, and put in one-half of the tartar; enter; 4 turns more; lift again, and put in all the tartar, and work in it all you get the required shade.

DEEP BLUE.—Put 10 lbs. cotton through the *blue vat*; soak in a decoction of 2 lbs. sumach for 3 hours; work for 15 minutes through water containing 1 pint red mordant and 1 pint black liquor; wash twice in hot water, then work 20 minutes in a decoction of 2 lbs logwood; lift, and raise with ½ pint of red mordant, work 10 minutes; wash and dry.

PALE BLUE.—For 50 lbs. 2½ lbs prussiate of potash; nitrate of iron, 3° Twaddle; add 2½ lbs. crystals of tin, 1 pint vitriol. Turn in the iron tub 20 minutes; lift; run through cold water (not rinced), wring up; shake well out dissolve the prussiate into 100 gallons water; enter, and winch 15 minutes;

lift, and give 2 gills vitriol; return for 10 minutes; lift, and run through water; again through the iron tub; repeat in the prussiate; raise again with vitriol, and when the required shade is got, lift; 1 water, and finish out of a weak solution of alum.

ROYAL BLUE.—Run upon the cold blue vat, *cotton;* air out; wash in 2 waters, and sour; then give a run through the iron (nitrate) tub; 1 water, and top with prussiate of potash, ½ an ounce to the pound of yarn. If the vat is not in good order, or without that convenience, better do this colour with prussiate altogether.

ORANGE.—For 40 lbs. 2½ lbs. annatto, 24 lbs. bark, 3 quarts muriate of tin. Boil the annatto; put off the boil; enter, and winch till it has a good body; wring out, wash well, wring again, and shake out; then, in a clean boiler, boil the bark in a bag for 15 minutes; add the muriate of tin, and enter; winch at the spring till the required shade is got.

ORANGE YELLOW. — For 50 lbs. Bottoming, 1½ lb. annatto. Dyeing, 5 lbs. bark, 3 quarts muriate of tin. Give the annatto boiling hot; wash in 2 waters; boil the bark, and add the muriate of tin; enter; winch 20 minutes, then wash and dry.

CHROME YELLOW. — For 50 lbs. 10 lbs. acetate of lead, 5 lbs. chrome. Dissolve separately, and put each into a tub containing 100 gallons water; enter in the lead first, 4 or 5 turns; wring out; then through chrome; continue from the one to the other till dark enough.

OLIVE.—For 50 lbs. 10 lbs. bark, 2 lbs. logwood, 8 oz. bluestone. Boil the bark in a bag; put off the boil, and enter; winch 20 minutes; lift, and put in the bluestone; return for 10 minutes; lift and wash in 2 waters, and top; give the logwood in another dish; when dark enough, wash and dry.

BUFF.—Give nitrate of iron, 6° Twaddle, 150° Fahrenheit; winch in this till full enough, then lift; give 2 waters; raise in a solution of lime, 1° Twaddle; if not dark enough, repeat in the iron tub, then in the lime.

GREEN.—For 40 lbs. Preparation, nitrate of iron, 4° Twaddle. Dyeing, 1½ lb. prussiate of potash, 45 lbs. fustic, 8 oz. extract of indigo. Raising, 1 pint vitriol, 5 lbs. alum. Turn in an iron tub for 20 minutes; wring out; run through cold water lightly, wring and shake well out; dissolve the prussiate; put it into a tub of cold water, 4 or 5 turns; lift, and give 2 gills sulphuric acid; 4 or 5 turns more; run through cold water, and wring out; repeat in the iron and prussiate tubs as before dyeing; give the fustic moderately warm in a clean liquor; turn 30 minutes; lift, and raise in the same liquor with 5 lbs. alum and 6 oz. extract of indigo; winch in this till you get the required shade.

FAST CHROME GREEN.—For 56 lbs. 10½ lbs. chrome, 5 lbs. acetate of lead. Blue on the blue vat, *cotton;* wash in 2 waters, and give a warm sour then dissolve, and put the lead and chrome into separate tubs; enter in the lead tub first; wring out; then through the chrome; continue from the one to the other till dark enough.

Vats for Various Colours.—WOAD VAT.—250 gallons water, 170° Fahrenheit, put in 150 lbs. best English woad, well chopped; 9 lbs. best indigo, well ground; 2½ lbs. madder; 2½ lbs. bran. Rake altogether well up, and the vat ought to assume a green appearance; in 12 or 14 hours, dip a piece of cloth, or a little wool, into the vat; if it dye green, it will turn blue by exposure to the air; rake up, and if it holds the head well up, put in 1 quart of quicklime, and rake again; in 3 hours after, rake again, and if it looks of a greenish yellow, put in 1½ quart more of lime; in 3 or 4 hours after, rake again; if the vat looks yellower, use another quart of lime; in an hour after this, if it smells slightly of lime, it has enough; if it smells strongly of lime, it has too much, which may be counteracted by using 1½ or 2 lbs. of madder, or by heating the vat; when the liquor is hard, it is of an orange colour, which may be seen by blowing; when it is soft, it appears faint yellow, and throws up a scum. In serving or heating the vat, it should

be raked occasionally, taking care not to disturb the sediment, but merely to bring the liquor to an equal degree of heat; then put in 3 lbs. indigo, and 1½ lb. madder; allow it to settle for 12 hours; then, if it looks of a greenish colour, and does not smell of lime, use 1 quart of lime. In all cases, if the vat smells slightly of lime, it is a proof that it has enough; if it smells very strongly of lime, give 1½ lb. of potash, and 2 lbs. madder; then, if it smells of lime instead of woad, cool by taking off the covering, and a considerable quantity of the lime will evaporate; heat up again, and put in 30 or 35 lbs. of woad; when hot, rake well up; look at the vat in 6 or 8 hours, if the upper part of the liquor looks yellow, rake up, and if it does not darken, use 2 quarts of lime: when you rake up, stir the bottom at all times, except when heating up; 3 hours is long enough for a woad vat to settle. In dyeing silk or cotton on this vat, it is safest to work it cold, or at most lukewarm.

Ash Vat, *Woollen.* — 400 gallons water, heat to 170° Fahrenheit, 5 lbs. ground indigo, 10 lbs. American potash, 3 lbs. madder, 4 lbs. bran. Apply a slow fire, and it will come to fermentation in 14 or 16 hours; then add 1 or 2 lbs. madder. In renovating this vat, use more potash in proportion to your indigo, than in setting a new vat.

Blue Vat, *Cotton.* — 140 gallons water, 16 lbs. copperas, 8 lbs. ground indigo, 16 lbs. quicklime. Rake up occasionally for 5 or 6 hours, till all the copperas be dissolved; if the vat be of a greenish yellow colour, consider it in good order; if it assumes a dark green colour, it shows a deficiency of lime; if yellowish, it is short of copperas; after raking, allow 12 hours to settle before working; renovate with copperas and lime, according to the state of the vat.

Purple Vat.—Boil 1 cwt. of the best logwood in 30 gallons of water for 3 or 4 hours, when it will be reduced to 26 gallons; decant the clear liquor into a wood or stone vessel; let it stand till quite cold, and add 56 lbs. purple vat spirits, 7° Twaddle. In renovating this vat, it is made up with raw muriatic acid till the glass stands as high as when set.

Crimson Vat.—Boil 1 cwt. limawood; decant it in the same manner as the last, and add 56 lbs. crimson vat spirits; renovate with killed spirits, 7° Twaddle.

Lavender Vat.—50 lbs. Boil 14 lbs. logwood in 10 or 12 gallons water; decant the clear into a 60-gallon tub containing 40 gallons of water; when it is quite cold, add 45 lbs. lavender spirits; rake up occasionally for 3 or 4 hours; next day it will be fit for working, and the glass will stand at 6° Twaddle. This will dye lilac; add neutralized paste for lavender. Renovate with raw muriatic acid till the glass stands at 6°.

Rose Pink Vat.—Boil 1½ lb. of limawood in 3 gallons water; decant the clear into a tub containing 20 gallons water, and add 5 quarts double muriate of tin; the hydrometer will stand at 7°; renovate with double muriate of tin.

Silk Spirits. Nitro-sulphate of Iron.—2 galls. of 30 lbs. double aquafortis, 24 lbs. copperas. Put the aquafortis into a leaden or stoneware pot place it near a fire, and add the copperas at 3 or 4 times; if without the convenience of a fire, put in a quart of hot water with the first of the copperas.

Nitrate of Iron.—2 galls. aquafortis, 5½ lbs. old iron. Put this into a 6-gallon pot; add the iron by degrees; and keep it warm, like the last.

Scarlet.—3 lbs. muriatic acid, 3 lbs. pure double nitric acid; add 2 oz. sal ammoniac, and feed with 1½ lb. granulated tin.

Purple Vat Spirits. — 4 galls (54 lbs.) marine acid, 1¼ gall. (20 lbs. nitric acid. Kill with 3½ lbs. granulated tin; ¾ oz. to the pound.

Crimson Vat Spirits. — 3 galls. muriatic acid, 2 galls. nitric acid, 2 oz. sal ammoniac, fed with 3½ lbs. tin.

Lavender.—30 lbs. muriatic acid, 15 lbs. double nitric acid. Kill with 3 lbs. granulated tin; nearly 1 oz. to the pound.

MURIATE OF TIN.—Give any quantity of muriatic acid as much tin as it can consume; you will know when it has enough, by seeing tin lying undissolved at the bottom of the pot.

Double Muriate of Tin.—It requires twice as much tin as the last; it may be made by heating common muriate of tin in a stoneware pot, placed in a hot sand-bath, and giving as much tin as it can consume.

INDIGO, EXTRACT OF. — 1 lb. best ground indigo, 6 lbs. double vitriol. Mix together; let stand 48 hours in a stone pot; then put the vessel into a warm bath till properly dissolved; take 6 gallons water, 170° Fahrenheit; add the indigo slowly, filter through woollen cloth, covered with brown paper, into a wooden vessel; what remains on the paper put away, as it is only earth; then add your liquor, 4 lbs. common salts, 1 lb. pearl-ash. Let it stand till it ceases fermenting, then filter again through brown paper, and what remains on the paper is pure extract of indigo; there should be 12 lbs. of it.

AMMONIA PASTE. — 1 quart strong ammonia, 1 ditto water, 2 lbs. ground cochineal. Stir them all well together in a stone pot; tie up the mouth of it tightly, and set it in some warm place, such as the flue of a stove, for two days, and it will be fit for use.

Woollen Spirits. ROYAL BLUE. —2 quarts of muriatic acid, 1 ditto nitric acid, no tin. Before using, let it stand until the gas goes off.

SCARLET SPIRIT.—Put any quantity of nitre, and the same of clear water, into a stoneware pot; the water first; then add 1 lb. muriatic acid to every 5 lbs. of the above, and give 2 oz. of tin to the pound of spirits, adding it very slowly for one or two days, because in giving the tin too fast the spirits get fired, which precipitates the nitre, and they are lost.

CRIMSON SPIRITS are the same as scarlet spirits, but have more tin dissolved in them; give as much as they will take, till they turn of a bluish colour.

LAC SCARLET SPIRIT —3 galls. muriatic acid, 2 galls. water, feed with 6 lbs. tin, 1 gall. nitric acid.

PURPLE SPIRITS.—1 gall. muriatic acid, feed with 2 lbs. granulated tin, or an ounce to every gill.

Cotton Spirits, RED.—For 50 lbs. 40 lbs. muriatic acid, 10 lbs. nitric acid, carefully and slowly killed with 9½ lbs of tin, or 3 oz. of tin to the pound.

PURPLE.—2 quarts muriatic acid, feed with 1½ lb. tin, or 1½ oz. to the gill.

Black Liquor.—300 lbs. copperas dissolved with 175 galls. hot water, then add 57 galls. acetate of lime liquor at at 16° Tw., or 32 lbs. copperas, 5 quarts pyroligneous at 7° Tw., 10 galls. acetate of lime liquor at 24° Tw. Used as a mordant; gives black with madder at 6° Tw.; very diluted gives various shades of violet, and with red liquor gives chocolates.

Red Mordant.—20 lbs. powdered alum is dissolved in 9 galls. water heated to 140°; mix with this 20 lbs sugar of lead, and add 2 lbs. soda crystals; should be frequently stirred for days. Used in the above proportions for calico.

RED MORDANT, *for Madder Pink.* —8 lbs. alum, 9 quarts water, 6 lbs. sugar of lead. For lighter pink, use 10 galls. water, 37 lbs. alum, 15 lbs. sugar of lead, 2½ lbs. pulverized chalk, 5 lbs. chloride of sodium or common chalk.

Ageing Liquor.—20 lbs. caustic soda at 60° Tw., 20 lbs. white arsenic in powder. Boil until all the arsenic is dissolved. Make a solution of 3 lbs. of chlorate of potash in 4 galls. of water; add the first liquor until it stands at 28° Tw.

Pink Mordant, *Alkaline.* — 10 galls. caustic potash add slowly 35 lbs. sulphate of alumina; thicken with British gum, and fix with chloride of zinc or sal ammoniac.

VERDIGRIS.—2 quarts water at 160° Fahr., 2 lbs. white sugar of lead, 2 lbs. sulphate of copper. Used in calico printing, and in the black dye for silk.

Cheap Filter.—Take a common flower-pot as large as possible, plug the

hole with a piece of sponge, then put a layer of powdered charcoal about an inch thick, the same of silver sand, and a layer of small stones and coarse gravel about 2 in. thick. A good filter may be made by placing in a tank of impure water a vessel so arranged that a sponge which it contains shall lap over its edge and dip into the water of the tank. The sponge gradually sucks up and purifies the water in the reservoir, and allows it to drop into the smaller vessel or receiver, from which it may be drawn off by a tube. By placing a few lumps of charcoal in the bottom of the receiver, filtration of the most perfect kind is effected.

Gluo Melting.—Break the glue into small pieces and soak from twelve to twenty-four hours in cold water, put the glue in the glue-pot, fill the outer vessel with water, and apply heat. For ordinary purposes it should run freely, and be of the consistency of thin treacle. The hotter glue is, the more force it will exert in keeping the two parts glued together; in all large and long joints, the glue should be applied immediately after boiling. Glue loses much of its strength by being often melted; that glue, therefore, which is newly made, is much preferable to that which has been used. When done with add some of the boiling water from the outer vessel to the glue, so as to make it too thin for use. Put it away till wanted again, and by the time the water in the outer vessel is boiled, the glue in the inner is ready melted and the proper thickness for use. Powdered chalk, brick-dust, or saw-dust added to glue, will make it hold with more than ordinary firmness.

LIQUID GLUE. — 1. Soft water, 1 quart; best pale glue, 2 lbs.; dissolve in a covered vessel by the heat of a water bath; after cooling, add with caution 7 oz. of nitric acid; when cold, bottle off. 2. White glue, 16 oz.; dry white-lead, 4 oz.; soft water, 2 pints; alcohol, 4 oz.; stir together, and bottle while hot. 3. 3 parts glue broken into small pieces should be covered with 8 parts of water, and left to stand for some hours; one-half of hydrochloric acid and three-fourths of sulphate of zinc must then be added, and the whole exposed to a temperature of from 81° to 89° C. during ten or twelve hours. Allow the compound to settle.

ELASTIC GLUE.—Dissolve glue by the aid of a water bath, evaporate till thick fluid is obtained, add an equal weight of glycerine, continue the evaporation with stirring until the remaining water is driven off; run it out on a marble slab to cool. This composition might be advantageously applied to the manufacture of printers' rollers, and similar articles.

GLUE FOR GUTTA-PERCHA.—2 parts common black pitch, and 1 part gutta-percha, melted in a ladle and well stirred together, then run into moulds.

PORTABLE, OR MOUTH GLUE.—Fine pale glue, 1 lb.; dissolve over a water bath in sufficient water, add brown sugar, ¼ lb.; continue the heat till amalgamation is effected; pour on a slab of slate or marble, and when cold cut into squares. Used by moistening with the tongue.

GLUE TO RESIST HEAT OR MOISTURE. —Mix a handful of quicklime in 4 oz. of linseed oil; boil them to a good thickness, then spread it on tin plates in the shade, and it will become very hard, but may be easily dissolved over the fire as glue. A glue which will resist the action of water is made by boiling 1 lb. of common glue in 2 quarts of skimmed milk.

MARINE GLUE.—1. Dissolve by heat 1 part of pure india-rubber in naphtha; when melted add 2 parts shellac; melt until mixed. Pour while hot on metal plates to cool; when required to use, melt and apply with a brush. 2. Caoutchouc, 20 grains; chloroform, 2 fluid oz.; dissolve and add 4 drachms of powdered mastic; let it macerate for a week; must be kept cool and well corked.

RICE GLUE.—Mix rice flour intimately with cold water, and gently simmer it over the fire, when it readily forms a delicate and durable glue.

Bookbinders' Paste.—Place half a quartern of flour in a saucepan, put as much cold water on it as will cover it,

and stir it well up, so as to break all the lumps while in a state of dough. Then pour on about 2 quarts of cold water and 1 oz. of powdered alum. Stir well and boil till it becomes thick.

Putty.—Mix a quantity of whiting into a very stiff paste with linseed oil, rubbing and beating it well before using. For particular purposes, as for fanlights, iron-framed greenhouses, and other places where the lap or hold is very narrow, a little white-lead may be added to advantage. Coloured putty has a mixture of red ochre, lampblack, or other colour with the whiting.

SOFT PUTTY.—10 lbs. of whiting and 1 lb. of white-lead, mix with the necessary quantity of boiled linseed oil, adding to it ¼ a gall of the best salad oil. The last prevents the white-lead from hardening and preserves the putty in a state sufficiently soft to adhere at all times, and not by getting hard and cracking off, suffering the wet to enter, as is often the case with ordinary hard putty.

TO SOFTEN PUTTY.—1 lb. of American pearlash, 3 lbs. of quick stone lime; slack the lime in water, then add the pearlash, and make the whole about the consistence of paint. Apply it to both sides of the glass and let it remain for twelve hours, when the putty will be so softened that the glass may be taken out of the frame with the greatest facility.

Sealing-wax, *Red.*—Take 1 lb. of yellow resin, 5½ oz. of gum lac, 5½ oz. of Venice turpentine, and 1 oz. of vermilion. Melt the lac in a copper pan suspended over a clear fire, add the resin, pour the turpentine slowly in, and soon afterwards add the vermilion, stirring the mixture all the time. Form either into round sticks by rolling it out on a smooth stone slab by means of a wooden board, or into oval sticks by casting it into stone moulds made in two pieces.

Black sealing-wax is made by substituting either lampblack or ivory-black in the above receipt.

Gold Sealing-wax. — To common colourless sealing-wax, made of shellac 5 parts, add turpentine 1 part, and when melted and beginning to cool, gold-coloured spangles of mica, Dutch leaf, or gold.

Potting, BODIES.—English porcelain and earthenware are made from the following bodies, which are prepared by soaking the clays in a large vessel of water, and when of the consistence of slip passing them through the finest silk lawn into another vessel in which proper gauges are fixed, so that the other materials may be afterwards added in a slop state. Clay slip should weigh 13½ lbs.; Cornish clay, 13½ lbs.; Cornish stone, 16½ lbs.; and flint, 16½ lbs. a gallon. The passing through the lawn is repeated as often as is needful, so that the mixture may be deprived of impurities. Care must be taken that the bones used for china bodies are not decayed, and for the other materials used in making porcelain, great care is necessary to see that they are of the purest kinds. These bodies fire at a higher temperature than that usually observed, and are placed and fixed in the furnace with ground flint. For the coloured bodies the marls used should be selected of the finest quality, argillaceous marl being the best; and very fine lawn will be required if it is intended that the body should be clean and free from metallic spots. Clay in which the silicious ingredients are in proportion of three to one are the best for the use of porcelain; those in which argil is in excess are the best for coarser earthenware, because less acted upon by alkalies. The colours in clays produced by vegetables or bituminous particles are destroyed by heat in an open fire, and are by no means prejudicial; but those which arise from metallic particles are obstinate, and should be avoided as much as possible. Clays which contain argil and silex only are very refractory, but calcareous earths in the proportion of 10 to 12 per cent. will render any clay fusible. The clays for porcelain should be those which contain the most sand, and are of the greatest fineness; also such as do not retain water with too much tenacity, which is the case when argil is not com-

bined with fixed air therefore all clays ought to be exposed to the action of the atmosphere for a long time previous to using. Calcareous earth in its common form is limestone or spar, magnesia, &c., which in their pure state are not so easily dissolved as when combined with fixed air. Argillaceous clay or alumina clay forms the basis of common alum; is called argil, and is never found pure; the finest part is extracted from alum, and is not fusible in the strongest heat required for china or earthenware. Argil in its usual state of dryness is capable of absorbing two and a half times its weight of water. Silicious earths found in a stony state abound in flint; the purest are found in crystals and quartz of a pure white; fixed alkalies, vegetables, or minerals are their true solvents. It should be understood that flint and bones, in all instances, are to undergo the process of calcination previous to using.

FIRING.—Articles formed of one of the bodies are first moderately burnt in earthen pots, to receive a certain degree of compactness, and to be ready for glazing. The *glaze* consists of an easily melted mixture of some species of earths, which, when fused together, produce a crystalline or vitreous mass, and which after cooling is very finely ground and suspended in a sufficient quantity of water. Into this fluid the rough ware is dipped, by which the glazing matter is deposited uniformly on every part of its surface. After drying, each article is thoroughly baked or fired in the violent heat of the porcelain furnace. It is usual to decorate porcelain by paintings, for which purpose *enamels* or pastes, coloured by metallic oxides, are used, so easy of fusion as to run in a heat less intense than that in which the glazing of the ware melts.

PORCELAIN BODY.—1. 360 parts of bones; 230, Cornish clay; 50, Cornish stone; 20, flint; 20, blue or brown clay; 10, *body frit* (p. 45); ½, blue calx. 2. 400 parts, bones; 360, Cornish clay; 250, Cornish stone; 20, flint; ½, blue calx.

IRONSTONE BODY.—1. 300 parts Cornish stone; 250, Cornish clay; 200, blue or brown clay; 100, flint; 1, blue calx. 2. 175 parts, Cornish stone; 150, Cornish clay; 90, blue or brown clay; 35, flint; 5, body frit; ½, blue calx. These bodies are very ductile, and fire at the temperature of the common biscuit oven; each piece of ware should be perfectly dry when placed in the seggars, because they are made a great deal thicker than any other kind. Setters also should be used at the bottom of each piece, and ground flint applied, but not sand, for the placing or seating; the body, when burnt, is quite vitrified, and the pieces of ware strong and heavy, ringing remarkably shrill.

PRINTED EARTHENWARE BODY, *Superior.*—3 parts, blue clay; 1, black or brown clay; 2, Cornish clay; 1¼, flint; ¼, Cornish stone.

—— *Common.*—2 parts, blue clay; 2, brown or black clay; 1, Cornish clay; 1¼, flint.

CREAM-COLOURED BODY, *Superior.*—1½ part, blue clay; 1½, brown clay; 1, black clay; 1, Cornish clay; 1, flint; ¼, Cornish stone.

—— *Common.*—1½ part, blue clay; 1½, brown clay; 1½, black clay; 1, flint.

LILAC PORCELAIN BODY.—200 parts, bones; 115, Cornish clay; 25, blue clay; 20, flint; 15, chalk; 10, Cornish stone; 1¼, blue calx.

DRAB BODY.—24 parts, argillaceous marl; 48, Cornish stone; 24, blue clay; 10, bones; 1, calcined nickel.

COMMON BROWN, or COTTAGE BODY.—20 parts, red or brown clay; 8, Cornish clay; 4, blue clay; 2, flint.

FAWN, or DRAB BODY.—40 parts, marl; 4, Cornish clay; 1, flint.

CALCIDONY BODY.—32 parts, yellow clay; 10, Cornish clay; 4, flint.

BROWN BODY.—50 parts, red clay; 7½, common clay; 1, manganese; 1, flint.

JASPER BODY.—10 parts, chalk; 10, blue clay; 5, bones; 2, flint; 1¼ blue calx. All the materials should be ground together, as much depends on the different articles being well united, which adds greatly to its fineness in

colour and lustre. It fires at the temperature of earthenware ovens.

SUPERIOR WHITE BODY.—50 parts, chalk; 50, blue clay; 25, bones; 10 flint. This body is of the same consistency, and requires the same temperature as the jasper body. It is perfectly adapted also for the purpose of figures in bas-relief, and other ornamental work.

STONE BODY.—480 parts, Cornish stone; 250, blue and brown clay; 240 Cornish clay; 10, glass; 1, blue calx. This body will be sufficiently vitrified at the temperature of the earthenware biscuit oven, and is adapted for the purpose of manufacturing jugs, mugs, and so on; it is requisite to place rings on each piece of ware, in order to keep them from being crooked when burnt in the oven; in all other respects to be treated as earthenware bodies.

STONE MORTAR BODY.—480 parts, Cornish stone; 250, blue and brown clay; 240, Cornish clay; 10, glass; principally used for making stone mortars, and when burnt is of a yellowish white, absolutely vitrified, exceedingly strong, very durable, and produces a clear bell sound.

BLACK EGYPTIAN BODY.—235 parts, blue clay; 225, calcined ochre; 45, manganese; 15, Cornish clay; the materials must be accurately examined on account of the manganese, which ought to be free from lime or other calcareous earth; the pieces of ware when manufactured are very apt to crack, because of the sudden transition from heat to cold, provided above a certain proportion of lime is contained in the manganese. This kind of earthenware requires only once burning, after which it is scoured with fine sand, and then a small quantity of oil rubbed over it.

RING BODY.—150 parts, blue clay; 100, Cornish stone; 100, bones; 52, plaster. Used for making rings and setters, for placing porcelain and ironstone; the porcelain clay which gets dirty or injured by working may be used for the same purpose, in the proportion of two of the former to one of the latter.

SAUCER MOULD BODY.—10 parts, flint; 4, blue clay; 2, Cornish clay; 1, black clay. Prepared for the sole purpose of making moulds, principally those of saucers; moulds made in this way are preferable, and considerably more durable than those which are made of plaster; the contraction of this clay in burning is inconsiderable.

FAWN POROUS BODY.—40 parts, argillaceous clays; 4, blue clay; 2, flint. This body makes porous wine and butter coolers, and water bottles, on the principle of absorption and evaporation. The articles are generally ornamented with various coloured clays, according to the five following recipes; they should be kept in the wet clay state, at the time of being painted, otherwise the different colours laid upon them will not sufficiently adhere, but are liable to chip and peel off when burnt. A moderate degree of heat must be applied, as too great a temperature will cause the body to be too dense, and prevent absorption; it will therefore be necessary to fire such articles in the easy parts of an earthenware biscuit oven.

Silicious and Argillaceous Clays.—These clays are for the purpose of painting porous coolers and bottles in the Mosaic style, and are equally applicable to the ornamenting of china and earthenware; the mixtures must be well ground, for their fineness has a great tendency to equalize the contraction and expansion of bodies in firing.

WHITE CLAY.—4 parts, blue clay; 2, Cornish clay; 2, flint; 1, Cornish stone.

BLUE CLAY.—30 parts, *white clay*; 1, blue calx.

BLACK CLAY.—4 parts, black Egyptian clay; 1, *white clay*; 1, *blue clay*.

ORANGE CLAY.—4 parts, yellow clay; 2, Cornish clay; 1, flint; ¼, Cornish stone.

GREEN CLAY.—12 parts, *white clay*; 1, nickel; ½, *blue clay*.

Glazes.—PORCELAIN GLAZE.—40 parts, Cornish stone; 45, red-lead; 38, borax; 32½, flint; 22½, flint glass; 13, crystal of soda; 5, oxide of tin; 1, enamel blue. The particles are made small and well mixed together, then calcined

in the coolest part of the glazing oven, in seggars thickly lined with flint; care must be observed that the frit is not too highly calcined, or brought into a nigh state of vitrification; if so, it will render it difficult to grind, and injure its good qualities in dipping. The frit likewise if too finely ground will cause the glaze to be uneven on the surface of the ware; if any inconvenience of this nature arises, by adding a solution of potash in hot water, that defect will be instantly obviated.

IRONSTONE GLAZE.—36 parts, Cornish stone; 30, borax; 20, flint; 15, red-lead; 6, crystallized soda; 5, oxide of tin; ½, blue calx. With the above frit is to be added 15 parts, white-lead; 10, Cornish stone; 10, flint; when ground together, the composition is ready for use; should the glaze prove too thin for dipping, add a small quantity of muriatic acid.

BODY FRIT.—60 parts, Cornish stone; 40, flint; 30, crystallized soda; 8, oxide of tin; 10, borax. This frit is used in small quantities, in china and ironstone bodies.

FRIT FOR GLAZES.—1. 40 parts, Cornish stone; 36, flint glass; 20, red-lead; 20, flint; 15, potash; 10, white-lead; 3, oxide of tin. This frit is intended to be used in glazes, in lieu of those which contain a large proportion of borax; therefore, by substituting it when the price of that article is high, will, of course, be advantageous, and the texture of the glaze will still be good and admissible.

2. 36 parts, Cornish stone; 30, red-lead; 20, flint; 20, borax; 15, crystal of soda; 5, oxide of tin. These two frits may be calcined in the easy part of the glazing oven, in seggars lined with flint; particular care should be observed that they are clean chipped, and free from pieces of seggars, or any dirty substance.

EARTHENWARE PRINTED GLAZE, *Superior.*—90 parts, white-lead; 35, Cornish stone; 20, flint glass; 20, flint; 60, frit (for glazes, 2); ½, blue calx.

Common.—85 parts, white-lead; 35, Cornish stone; 22, flint; 15, flint glass; 24 frit (for glazes, 2); ½, blue calx. These glazes, when ground, to be sifted through a fine lawn; the former glaze is of the finest texture, and will require rather a thinner coating when dipped than those of common glazes. Fire in seggars, either washed with common glaze, or a mixture of lime and slip without flint.

COMMON PRINTED GLAZE.—90 parts, white-lead; 45, Cornish stone; 22, flint; 20, flint glass; ½, blue calx. To this, after being properly ground and sifted, add 1 lb. of common salt and ½ lb. of borax, which forms a smear or flow, as it is generally termed, but must not be put into the glaze until the blue stain is perfectly incorporated with it; the ware dipped therein must be placed in seggars washed with glaze.

WHITE EARTHENWARE GLAZE.—35 parts, Cornish stone; 20, borax; 10, crystal of soda; 20, red-lead; ½, blue calx. Calcine and then pulverize coarsely, and grind with 20 lbs. white-lead, 10 lbs. Cornish stone, and 5 lbs. flint.

BLUE AND GREEN EDGE GLAZE.—72 parts, litharge; 36, Cornish stone; 20, flint glass; 17, flint; 12, frit (for glazes, 2); ½, blue calx. The blue and green edged ware when dipped in this glaze should be perfectly dry previous to being placed in the seggars, and the green edge should be seated in the coolest part of the glazing oven.

CREAM-COLOUR GLAZE, *Superior.*—85 parts, white-lead; 40, Cornish stone; 22, flint; 16, flint glass; 8, frit (for glazes, 2).

Common.—75 parts, litharge; 40, Cornish stone; 23, flint; 10, flint glass.

CRYSTAL GLAZE.—105 parts, Cornish stone; 90, borax; 60, flint; 50, red-lead 12, crystal of soda; 10, oxide of tin; ½, blue calx. This glaze produces very superior white earthenware, and, for the purpose of enamelling, the colours, lustres, and burnished gold appear to considerable advantage; it is also adapted for ironstone, and makes superior blue printed earthenware; it has a singularly striking effect on printed brown and mulberry. When used for dipping it must be considerably diluted, and requires but

little shaking from the hand of the operator. It requires the heat of a china glazing oven, but to answer the earthenware oven a small addition of white-lead must be made, according to the temperature of firing. The materials must be mixed and calcined, and the ware fired in lime and slip seggars, well washed.

BROWN COTTAGE GLAZE.—60 parts, litharge; 32, flint; 8, brown slip. This and the two following glazes require using about the same consistency as the cream-colour glaze, and will stand the highest temperature of heat in a common glazing oven.

CALCEDONY GLAZE.—65 parts, litharge; 40, Cornish stone; 20, flint; 6, frit (for glazes, 2).

DRAB GLAZE.—70 parts, litharge; 30, flint; 25, Cornish stone; 10, drab slip.

BLUE GLAZE.—50 parts, flint; 30, borax; 22, red-lead; 10, Cornish stone; 6, crystallized soda; 6, oxide of tin; 3, blue calx. In preparing this glaze follow the same directions as for porcelain glaze.

GREEN GLAZE.—3 parts, blue vitriol, calcined; 1, flint glass; 1, flint. When ground, take 4 quarts of this mixture to 30 quarts of the following mixture, ground:—35 parts, litharge, 20, flint; 10, Cornish stone; 10, frit, for glazes. This glaze is sufficiently fired in the coolest part of the glazing oven. Particular attention should be observed as to the proper wash used for the seggars, for much depends on that simple process. The brightness and lustre of the glaze will be secured by adopting the following wash:—5 parts of the solution of quicklime; 1, of clay slip, free from the least particle of flint, and applied about the thickness of common glaze.

YELLOW GLAZE.—95 parts, white-lead; 35, flint glass; 20, flint; 14, oxide of yellow; 10, Cornish stone; 16, frit, for glazes. The oxide of yellow must be very finely ground, and the other materials ground and sifted before the oxide of yellow is added. It would be as well first to mix the yellow and the frit together, then let them be passed through a lawn into a vessel containing the other ingredients; by this means the materials will be better incorporated; use it about the same thickness as cream-coloured glaze, and treat it the same. It will fire almost in any part of the oven, in seggars either washed with glaze or mixture of lime and slip.

ALKALINE GLAZE.—30 parts, borax; 30, flint; 18, Cornish stone; 2, oxide of tin. The materials must be calcined, and particular caution observed in the course of chipping from the seggars, that not the least particle of any colouring matter be mixed with it, for it is very susceptible of being materially injured in its colour; when ground, a small quantity of muriatic or nitrous acid should be added, and at the same time quickly stirred about, and the motion continued for some time, in order to prevent it setting at the bottom of the vessel; in all other respects treated the same as common glazes, except with regard to dipping, in which case it must be used very thin.

Colours under Glaze, with the exception of the green, should be mixed together and calcined in a reverberatory furnace or glazing oven in seggar hillers, or dishes lined with flint; then spread on the mixture about an inch in thickness, observing that the hiller or dish have a sufficient access of air allowed, to prevent the metals from reviving again in their metallic state: the green ingredients only require grinding.

NAPLES YELLOW UNDER GLAZE.—12 parts, white-lead; 2, diaphoretic antimony; 1, crude sal ammoniac; ½, alum. Mix intimately, calcine in a crucible, over a slow fire, for the space of three hours, stirring it nearly the whole of the time, when the mass will be found of a beautiful yellow or gold colour.

LINING BROWN UNDER GLAZE.—7 parts, glass of antimony; 3, raw litharge; 2½, manganese; 1, nitre; 1, blue calx.

PAINTING BROWN UNDER GLAZE.—5 parts, glass of antimony; 5, raw litharge; 2, manganese; ½, blue calx.

ORANGE UNDER GLAZE.—6 parts, raw litharge; 4, crude antimony; 2, crocus-martis; 1, oxide of tin.

YELLOW UNDER GLAZE.—4 parts, raw

litharge; 3, crude antimony; 1½, oxide of tin.

GREEN UNDER GLAZE. — 12 parts, oxide of yellow; 4, white enamel; 2, frit (for glazes prepared without the oxide of tin); 1½, blue calx.

PRINTED BROWN UNDER GLAZE.—5 parts, raw litharge; 5, crude antimony; 2½, manganese; 1, blue calx.

PRINTED BLACK UNDER GLAZE.—3 parts, red-lead; 1½, antimony; ¾, manganese. After these ingredients have been calcined, add the following, and calcine again: 2 parts, blue calx; ½, oxide of tin. This black under glaze, in the last stage of preparation, must be calcined in the highest heat of a biscuit oven, and *crystal glaze* is the most suitable to it. The ware must be fired in an easy part of the glazing oven; the brown calcined in the usual way, and dipped in the common printed glaze.

PRINTED MULBERRY UNDER GLAZE. —4 parts, manganese; 2, blue calx; 1, nitre; ½, borax. Calcine this colour in the usual way, either in a dish or seggar hiller, and after the mixture is spread on the dish or hiller, a small quantity of pounded nitre should be scattered thinly over, and when calcined, add 2 parts of flint glass; 1, flint; then grind all the ingredients up together for use.

GREEN FOR EDGING UNDER GLAZE.— 3 parts, oxide of copper; 3, flint glass; 2, flint, 2, oxide of tin; 1, enamel blue. Grind these ingredients together, after which add 8 quarts of *earthenware printed glaze*, and 4 quarts of *cream-colour glaze*, mix well together, and sift them through a fine lawn. Lay this green on the ware after it is dipped, and fire it in the coolest part of the glazing oven.

BLUE PRINTED FLUX. — 1. 2 parts, flint; 1 frit, for glazes; ½, flint glass. 2. 5 parts, flint; 1½, borax; ½, nitre. 3. 3 parts, flint glass; 2½, flint; 1, nitre; 1, borax.

PAINTING AND EDGING BLUE. — 2 parts, blue calx; 3, frit, for glazes; 1½, flint glass; 1, flint; ½, white-lead. The frit should be prepared without the oxide of tin, when mixed with the blue calx, for that metal and arsenic are both prejudicial to its colour.

STRONG PRINTING BLUE. — 2 parts, blue calx; 3, *blue printed flux*.

WEAK PRINTING BLUE.—1 part, blue calx; 4, *blue printed flux* (2).

Printing Oil for Pottery.—1. 1 quart linseed oil, 1 pint rape oil, 2 oz. balsam capivi, 1 oz. pitch, ½ oz. amber oil, ½ oz. white-lead. 2. 1 quart linseed oil, ½ pint rape oil, ½ pint common tar, 1 oz. balsam sulphur, 1 oz. balsam capivi. The linseed oil should be boiled for some time alone, then add the rape oil and the balsam capivi, allow the boiling to be continued until it begins to approach the proper consistency, and add the remaining ingredients. The mixture should be allowed to cool a short time, after which the whole mass may be boiled slowly until it has assumed the proper thickness; the vessel must be generally covered during the process, and the sulphur previously to being mixed with the oil should be perfectly pulverized, as by that means it is less liable to curdle the oil.

Stains for Pottery. — In preparing these stains the ingredients must be ground remarkably fine, and then so perfectly dried as not to leave the least humidity, after which they must be ground again with oil prepared for the purpose, composed of 2 parts of balsam of sulphur, 1 part of amber oil, and as much turpentine as will render them of a proper consistency; they may then be used with ease for painting various devices on biscuit ware.

BLUE STAIN.—5 parts, blue calx; 2, *frit, for glazes*, without oxide of tin; 1, flint glass; 1, enamel blue.

YELLOW STAIN.—3 parts, *yellow under glaze;* 1, frit, for glazes; ½, chromate of iron.

GREEN STAIN.—3 parts, blue stain; 1, yellow stain; ½, enamel blue green.

Gold Flux.—11 parts, borax; 5½, litharge; 1, oxide of silver. In these enamel fluxes the materials are to be made very fine, particularly the flint, and mixed well together, so that the particles may more easily concrete when in a state of fusion; then calcined in an

air furnace or an earthenware glazing oven, when the whole mass, by means of the proper temperature of fire, will be changed into a brittle resplendent and transparent glass.

Enamel Flux.—1. 8 parts, red-lead; 6, flint glass; 3, borax; 3, flint. 2. 7 parts, red-lead; 4, borax; 2½, flint. 3. 4 parts, borax; 3, red-lead; 3, flint glass; 2, flint. 4. 3 parts, red-lead; 1, flint glass; 1, flint.

Smalts.—32 parts, sand; 32, potash; 10, borax; 1, blue calx. These smalts, the materials of which are calcined in the usual manner, when finely pulverized will produce a fine rich-looking blue powder.

Enamels for Porcelain Painting.—The enamels, after being finely ground, should be thoroughly dried; then mixed up with turpentine, and used like other colours with a pencil; after which fused again, and vitrified by fire. Spirits of tar may be substituted instead of turpentine in all enamels, with the exception of blue and colours prepared from chrome. With regard to the burning, the lustres will bear the highest temperature of an enamelling heat; the rose colour, cornelian red, and pomona green require a less degree of heat, and are generally placed in the middle of the kiln or muffle, as well as burnish gold; other colours are not so susceptible of being destroyed by heat, and will fire in any part of the kiln or muffle. The even surface of the various coloured grounds on china is produced by first laying the space wanted with linseed oil, previously boiled with a little red-lead and a small portion of turpentine; the enamel colour is then ground fine, and dusted on the oiled part with cotton wool, or laid on with a large camel-hair pencil. The component parts of the different colours are as accurately stated as possible, but the preparation principally depends on observation, therefore experiments will be necessary that a proper judgment may be formed.

White Enamels.—These require the materials to be made very fine and calcined in air furnace, the heat at first to be generated very gradually; and when the whole mass is in a state of fusion increase the fire quickly, and there will soon be produced a fine white enamel; in the time of fusion it will be requisite to keep stirring the whole together with an iron spatula or rod.

Venetian White Enamel.—3½ parts, flint; 3, borax calcined; 1, Cornish stone; ½, oxide of tin.

Common White Enamel.—8 parts, flint glass; 2, red-lead; ½, nitre; ½, arsenic.

Blue Enamels.—For these the materials must be calcined in an air furnace or glazing oven, and caution should be observed that they are not too finely ground at the mill, in order to prevent them from crazing or chipping after being burnt on the pieces of ware. 1. 16 parts, flint glass; 5, red-lead; 2, white enamel; 2, blue calx; 1, common salt; 1, potash. 2. 16 parts, flint glass; 5, red-lead; 2, nitre; 2, potash; 2½, blue calx.

Black Enamels.—Copper black is a very fine colour, the obtaining of which altogether depends upon a proper temperature of heat being applied, for nothing is more fickle and uncertain; if in the least degree overfired the colour is destroyed, and becomes of a dirty green. The other blacks are called umber blacks, and will stand any degree of heat which is required in an enamelling kiln or muffle. The umber to be highly calcined in a biscuit oven, but particular caution should be observed that it is the real Turkey umber, and not the English, which is of an inferior quality. The two first enamel blacks to be calcined in the usual way; the materials of the two latter only want grinding.

Enamel Painting Black.—4 parts, borax; 2, umber calcined; 2½, red-lead; 2, enamel blue; 1, flint; 1, blue calx. A superior black enamel is composed by uniting with 8 parts of this composition, 1 enamel; 1 enamel purple.

Enamel Printed Black.—1 part umber calcined; 1¼, borax calcined; ½, blue calx.

Copper Black Enamel.—1 part, copper calcined; 3, *enamel flux* (1).

RED ENAMEL.—1 part, green copperas calcined 3, *enamel flux* (3). The greatest difficulty in preparing red is the calcination of the copperas; calcine the copperas in a vessel exposed to the heat of an open fire, by which means it will dissipate all its volatile contents, and leave a residue of oxide of iron in powder; when it attains an orange or light red, the calcination is sufficiently accomplished; the residue is then washed repeatedly with boiling water, until the water becomes insipid and free from vitriolic acid.

BROWN ENAMEL, *Dark.*—1 part, copperas calcined brown; 2, *enamel flux* (4); ½, *enamel flux* (1). Brown enamel only requires grinding before it is fit for use; the copperas for the purpose of making dark brown will require calcining in the most intense heat of a biscuit oven; the colour of it varies according to the temperature it undergoes, first white, then orange, red, and lastly brown.

Light.—1 part, umber calcined; 1, yellow under glaze; ½, copperas calcined red; ¼, white enamel; 5½, *enamel flux* (2); 3, *enamel flux* (3).

BLUE GREEN ENAMEL.—42 parts, red-lead; 15, flint; 12, borax; 2¾, blue vitriol calcined. To these materials, after being calcined in an air furnace or glazing oven, must be added 12 parts of *white enamel*, then grind them all together.

GRASS GREEN ENAMEL.—3½ parts, blue green frit; 1, enamel yellow.

YELLOW GREEN ENAMEL.—2½ parts, blue green; 1, enamel yellow.

YELLOW ENAMEL.—1 part, Naples yellow; 2, *enamel flux* (1); 1, *enamel flux* (3).

ORANGE ENAMEL.—1 part, orange under glaze; 2, *enamel flux* (1); 1, *enamel flux* (4).

PURPLE DISTANCE ENAMEL.—2 parts, enamel purple; 3, oxide of manganese; 12, *enamel flux* (3).

CORNELIAN RED ENAMEL.—1 part, chromate of iron; 3½, *enamel flux* (4). This fine colour is produced from the chromate of iron, or the yellow oxide of chroma, which has a greater affinity for lead than an alkali, consequently the flux prescribed is the only one which is susceptible of yielding its proper colour, as those fluxes which contain a large proportion of borax are very prejudicial, destroying the colour, and with the greatest difficulty forming any affinity at all, therefore should be avoided. The flux used should be highly calcined until it assumes a dark orange-coloured glass. Mix up with spirits of turpentine when dry.

POMONA GREEN ENAMEL.—1 part, oxide of green chrome; 2½, *enamel flux* (1); 1½, *enamel flux* (4). This green is prepared by simply grinding the ingredients, and produces that dark colour equal to the French green, provided the oxide is genuine; and by adding a proportion more of flux and white enamel, there still will be a rich tint, though weaker and lighter in colour.

Burnish Gold from Brown Gold.—12 parts, brown oxide of gold; 8, quicksilver; 2, oxide of silver; 1, white-lead. Put the whole of these ingredients into an earthenware mortar, and triturate them until the whole is amalgamated; the mercury being the solvent fluid, very readily combines with the rest, to which it communicates more or less of its fusibility, after which grind them very fine with spirits of turpentine.

BURNISH GOLD FROM GREEN GOLD.—12 parts, green gold; 7½, quicksilver; 1½, oxide of silver; 1½, gold flux. Place the gold in an earthenware vessel on an open fire, and when heated red hot, take four times its weight of mercury, and pour it in; the mixture to be stirred with a little iron rod; the gold will be dissolved; it is then thrown into a vessel full of water until it coagulates and becomes manageable; much of the mercury is then pressed through a piece of leather, and the rest dissolved by a quantity of nitrous acid; the acid is afterwards poured off, the gold remaining is repeatedly washed with boiling water as often as needful; it is then dried and mixed up with the other ingredients, and ground with spirits of turpentine for use.

PURPLE ENAMEL.—4 parts, gold in

solution; 1, tin in solution. Procure a vessel to contain 50 parts of water about the temperature of blood-heat, to be well mixed with the solution of gold, and then add the solution of tin by dropping it into the menstruum, at the same time constantly stirring it with a strong feather, which will produce a fine purple-colour liquor; but it will be necessary to add a few drops of the solution of silver, which will much assist to raise the colour and beauty of the purple; to help the precipitation of the gold from its solvent (provided the precipitation does not immediately take place) add a large proportion of boiling water or a small quantity of sal ammoniac, and a precipitate will instantly be procured; the clear liquor must then be decanted off, and the boiling water repeated until it is completely insipid. The residue consists of the oxides of gold, tin, and silver in combination, and is the only substance which has the property of communicating the purple colour to enamel glass; after the precipitate is prepared the flux must be added; the proper quantity will solely depend on the fusibility or softness of the flux, and as the operation in a great measure depends on observation, a few experiments by the operator will be found useful, independent of the accuracy of the receipt. To the purple precipitate may be added from 30 to 45, flux, *enamel flux* (3), according to the strength of colour intended to be made.

ROSE-COLOUR ENAMEL.—3 dwts., gold in solution; 60 leaves, book silver; 2½ lbs., *enamel flux* (1). Procure a vessel to contain 10 parts the quantity of hot water, then mix the water and gold together while the water is at the temperature of 190° F.; add pulverized sal ammoniac rather copiously, at the same time briskly stirring the mixture with a strong feather, until the appearance of a decomposition takes place, which will soon be observable by the gold being precipitated from the menstruum in the form of a fine yellow powder; when that is accomplished, let the vessel stand undisturbed a short time to allow the precipitate to subside, then decant the liquor off, and still add boiling water repeatedly to the precipitate until the water is perfectly insipid; in the next place put it on a plaster bat to dry, after which it must be mixed up with book silver and flux, according to the proportions given above, and well triturated in a mortar; then send it to the mill to be ground, when it will be in a proper state for use. This colour is supposed to be best when of a purple tinge, which may be produced by merely calcining the preparation to the heat of ignition previous to being ground; if the colour be too dark, the mixture does not possess a sufficient quantity of silver, if it is too light, the silver must have been very plentifully added, therefore the operator must add or diminish accordingly. Great caution must be observed with this receipt, as the gold precipitated by the sal ammoniac will unite with it, and then has the property of fulminating; and when gently heated or smartly struck with any hard instrument will immediately detonate; this can only be obviated by a plentiful use of boiling water; a caution which ought to be strictly attended to, as it removes the dangerous quality by depriving the gold of its salt.

GOLD LUSTRE.—Take grain gold and dissolve it in aqua regia, as in the receipt for *solution of gold*; add 5 grains of tin; an effervescence takes place when the solution is completed and in a proper condition to be mixed; take balsam of sulphur 3 parts, spirits of turpentine 2 parts, mix them well together over a slow fire, then gradually drop the solution of gold into the menstruum, and keep stirring until the whole solution be added; provided the mixture should appear too thick, add more turpentine till of a proper consistency. 1 oz. of gold dissolved in the manner described will make upwards of 2 lbs. weight of prepared lustre, and must be used with turpentine, for all other spirits are injurious.

PERSIAN GOLD LUSTRE.—Take any quantity of the precipitate of gold, first mixed with a small portion of fat oil on a flat piece of earthenware, then