XLV. Receipts for enamel colours, and for staining and gilding glass

Mr. R. Wynn

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whole of those clumps on Hounslow heath, where the trees are not destroyed, but grow so as to shelter each other, and in that other clump on the high ground south of the same road, between Egham and Virginia Water; although the trees are all young, there are several feet difference in the height between those on the north and those on the south side of the same clumps.

Hence it is inferred, that no species of the fir tree will arrive at such perfection in our country, on account of its high and rapid change of temperature, as in the higher latitudes.

Yet nature is bountiful in providing for all; as the reverse of this is the case with the oak tree.

*XLV. Receipts for Enamel Colours, and for staining and gilding Glass. By Mr. R. WYNN.**

SIR,—THE liberality of the Society in encouraging and rewarding communications in every useful art, induces me to offer to their notice a concise and complete method of composing enamel colours. Painting in enamel colours has always been considered very interesting, and one of the most costly productions of art in every country where practised: but the real preparation of the colours has always been confined to the knowledge of a few persons who have made a mystery of it, and whatever has been yet published on the subject, appears to be chiefly the compilation of writers unskilled in the profession. Many artists of superior talents, in different parts of this country, could practise the art but for the difficulty of procuring a complete set of good colours: indeed it is extraordinary with what suspicious secrecy the art of making the proper enamel colours has hitherto been conducted. I have been acquainted with several of the best manufacturers, whose colours were used by the most eminent painters on the finest and most elaborate works of the time, who have died without ever benefiting their country by publishing their acquirements, or leaving any documents behind them. By a continued perseverance in such secrecy, it is not impossible that the present improved state of knowledge in the art might, under unfavourable circumstances, be entirely lost, if some experienced professional person did not seek for an opportunity of making it public, and more generally useful. With these motives I take the liberty to offer the accompanying treatise, which

* From the *Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce*, for 1817. Twenty guineas were voted to Mr. Wynn, by the Society, for this communication.

consists of the most valuable selections from the experience and labours of above twenty years.

I am, sir,

Your most obedient servant,

Wellington Place, Vauxhall, March 11, 1817.

ROBERT WYNN.

To A. Aikin, Esq. Sec.

Introductory Remarks.

The different qualities or degree of purity in the ingredients as usually met with, will, with the same prescriptions, produce some slight variations in effect; but the best enamel colours may always be obtained with certainty by careful attention to the following receipts.

When metals are dissolved, the solutions should always be perfectly saturated. In making the fluxes, they should be sufficiently melted in the crucibles, so as to flow liquid and pour out easily.

The various qualities of the material, or surface, on which painting in enamel is performed, require the colours to be adapted to the degree of heat it will bear or require when burnt; and it is generally the practice of the best painters in enamel, to use for the first painting and burning, colours considerably harder than those used in the second painting and burning, the latter being fine soft enamels, in order to finish the work, and give a beautiful smoothness. It cannot but be obvious to every person who uses enamel colours, that the hardening them if necessary, will be effected by adding more of the colouring matter; or lessening the quantity of flux, and, if required to be more soft, or to shine more when burnt, to add a little more flux; and this is best done by a very soft flux generally used for this purpose, such as No. 8; but when particular directions are necessary, they will be found mentioned in the receipt for making the colour. It will be better to make a few ounces at least of each colour at a time, and they are all to be ground as soon as made in water, with a glass muller, or a piece of plate glass, and dried before the fire, then scraped off in powder, and kept in bottles for use.

When used in painting they are ground in spirits of turpentine, and thickened with thick oil of turpentine, which quality the fluid oil of turpentine acquires in three or four years.

PREPARATION OF INGREDIENTS.

Flint Powder.

Take pieces of flint, which have been burnt white at the chalk lime burners (they may be had at the lime burners at Vauxhall), make them clean with hot water and a brush; then throw them
red

red hot into cold water ; after having thus treated them two or three times, pulverize them in a biscuit-ware mortar with a pestle of the same, (which will be easily effected,) and then grind them in water on plate glass.

Where no opportunity occurs of procuring burnt flints from the lime burners, the common black flints broken into pieces, made hot in boiling water (to prevent their flying in the crucible,) and treated in the same way, will produce a fine white powder.

Red Sulphate of Iron.

Sulphate of iron, otherwise called green vitriol, is to be pounded and placed in an earthen ware muffle, (which may be had at the ironmongers, in Foster-lane ; or at Mr. Accum's, in Compton-street) till the moisture is evaporated and a gray powder left : which place in a crucible in a charcoal fire, and stir it with a piece of steel bar, till it is of a fine red colour ; then let it fall out of the crucible into a pan of cold water, under a chimney, to avoid the disagreeable fumes that arise ; when settled at the bottom wash it in several hot waters, and then dry it for use. The more it is burnt, the darker the red.

Brown Sulphate of Iron.

Take sulphate of iron in lumps, and calcine it in a red charcoal heat till it becomes of a dark brown ; and let it cool in the crucible, afterwards wash it repeatedly in hot water.

Black Oxide of Copper.

Take copper and dissolve it in aquafortis, till the acid refuses to take up any more metal ; then dilute the solution with water, and add to it some subcarbonate of potash, dissolved in water ; a green precipitate will fall to the bottom, which must be washed in several hot waters ; when settled, pour off the superfluous water, and place the green matter at the bottom on a piece of coarse open canvass, tied over a large earthen pan, on which a piece of blotting paper is laid ; after the precipitate has been thus drained, it should be taken off and made perfectly dry, by placing the paper on a drawer of powdered chalk to absorb more of the moisture, and then placed before the fire. When dry, calcine it in a crucible in a charcoal fire, and throw it red hot into cold water ; then rinse it in boiling water, and dry at the bottom of the bason before a fire ; what remains is a beautiful black oxide of copper.

Green Oxide of Copper.

Take a saturated solution of copper in aquafortis, and precipitate it with subcarbonate of potash ; then wash it several times in boiling water, filter and dry it.

White

White Oxide of Tin.

Into a small wooden box with a sliding cover, chalked over on the inside, pour melted tin from a ladle, and shake the box till the tin becomes finely granulated; then wash it and dry it, and put it into a Florence oil flask, and pour over it strong nitrous acid, which rapidly converts it to a white powder. When a sufficient quantity of this is obtained, it should be well washed in several boiling waters, poured out into a bason, and dried before the fire;—it then produces a very white oxide of tin.

Black Oxide of Cobalt.

Take good metallic cobalt*, and dissolve it to saturation in nitric acid diluted with a little water, in a flask placed in sand over the fire; then pour it in a large bason, and having added a quantity of water, pour in a solution of subcarbonate of soda, as long as any precipitate falls down: when settled pour off the water, and wash the powder in several hot waters, filter it and dry it. When dry, mix it in a biscuit-ware mortar with a pestle of the same, with three times its weight of dry nitre; place it in a warm crucible, and drop in an ignited piece of charcoal: some slight explosions will then take place, and when these have ceased, make the calx red hot; this, after being washed and dried, produces the best oxide of cobalt for enamel, and capable of making and compounding various colours.

Fluxes.

Take great care to mix all the ingredients accurately together in a biscuit-ware mortar, with a pestle of the same, and to have them all pounded as fine as possible. Let the crucibles be made warm before the fluxes are put into them, (by placing them on the fire with the open end downwards,) which will prevent most of the accidents which happen by their breaking in the fire.

The best furnace for making fluxes, or for any other process that requires great or continual heat, is a common German stove about 18 or 20 inches inside, lined all round from the grating to the top, (except the aperture at the door in the front for the occasional introduction of a muffle,) with one row of fire-bricks set with loam; the iron-pipe chimney projects from the back part near the top. The top or cover of the furnace, to be loose like a lid, and removable by handles; in the centre of it a circular hole is cut out, which is also fitted with a cover through which the top of the crucible may be lifted off, and its contents be stirred up with a bar of steel. A small piece of fire-brick is placed on the grate, for the crucibles to stand on, and the fuel should be charcoal and coke mixed, or charcoal alone.

* In the choice of cobalt, that which when dissolved in nitric acid gives the purest and deepest red solution generally makes the finest colours.

placed

Flux, No. 1. Red lead 8 parts by weight	Flux, No. 5. Flint glass 6
*Calcined borax $1\frac{1}{2}$	Flux, No. 2, 4
Flint powder 2	Red lead 8
Flint glass 6	No. 6. Flux, No. 2, 10
No. 2. Flint glass 10	Red lead 4
White arsenic 1	Flint powder $1\frac{1}{4}$
Nitre 1	No. 7. Flux, No. 4 6
No. 3. Red lead 1	Colcothar 1
Flint glass 3	No. 8. Red lead 6
No. 4. Red lead $9\frac{1}{2}$	Borax not calcined } 4
Borax not calc. $5\frac{1}{2}$	Flint powder 2
Flint glass 8	

After the fluxes have been melted, they should be poured on a flag-stone wet with a sponge; or into a large pan of clean water, then dried, and finely pounded in a biscuit-ware mortar for use.

Yellow Enamels.

Red lead	8
Oxide of antimony	1
White oxide of tin	1

Mix the ingredients well in a biscuit-ware mortar, and having put them on a piece of Dutch tile in the muffle, make it gradually red hot, and suffer it to cool.

Take of this mixture	1
Of flux, No. 4	$1\frac{1}{2}$

Grind them in water for use.

By varying the proportions of red lead and of antimony, different shades of colour may be obtained.

Another Yellow.

Take three parts by weight of sheet lead and one part of block-tin, melt them together in a ladle or a flat shovel, and skim off the top in proportion as it oxidates; when a sufficient quantity is obtained, place it in the muffle in a gentle heat, to reverberate and entirely calcine any remaining particles:

Of which take	$7\frac{1}{2}$
Oxide of antimony	1
Litharge	1

Mix these well together, and give them a red heat in a muffle to bind them together, but not to melt. Use the same flux as for the other yellow.

Orange.

Take red lead	12	Oxide of antimony	4
Red sulphate of iron 1		Flint powder	3

* Borax calcined to a dry white calx in a crucible, only a third part of which should be filled at once, on account of the borax swelling so much as it gets hot.

well

well mixed in the mortar, and calcined so as to stick together, but avoid melting.

Take of the above	1
Flux, No. 7	2½

Grind for use.

Dark Red.

Take sulphate of iron calcined dark	1
Flux, No. 7	3

Grind for use.

Light Red.

Take red sulphate of iron	1
Flux, No. 1.	3
White lead	1½

Grind for use.

Red Brown.

Take brown sulphate of iron calcined dark	1
Flux, No. 1	3

Grind for use.

Vandyke Brown.

Take Flux, No. 4	3
Iron filings	1

melted together in a crucible, and drawn out with curling tongs *; with so much metal it will not pour out freely.

Take of the above	5
Black oxide of cobalt	1

Grind for use.

Another Brown.

Take manganese	2½
Red lead	8½
Flint powder	4

calcined to stick together.

Of this mixture take	1½
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Of Flux, No. 4, and iron filings melted as above	1½
--	----

Flux, No. 4	1
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Grind for use.

Black for painting and mixing with other Colours.

Take of umber, broken into small bits and calcined to a yellow heat in a crucible, till quite black, then washed in boiling water and dried,

Black oxide of cobalt	10
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* In this and in other cases where a muffle is not in readiness, an earthen crucible washed with flint powder inside, or with dry flint powder rubbed inside 1-8th of an inch thick, may be used, and the materials when partially melted, so as to stick together, are completely taken out without loss.

Blue

Blue flint glass	..	..	..	10 $\frac{1}{2}$
Raw borax	..	..	..	7 $\frac{1}{2}$
Red lead	..	..	..	12
Calcine these well together, and take of it				2
Flux, No. 4,	..	..	..	1

Grind in water for use.

Blacks are compounded in other proportions of these ingredients, and manganese is sometimes substituted in the place of umber.

Another Black.

Take umber calcined black	..	..	1
Black oxide of cobalt	..	..	1½
Black oxide of copper	..	..	½
Flux, No. 4	..	..	3

Grind these in water, and when dried place them on a piece of Dutch tile, (washed over with flint-powder ground in water,) in a muffle in a charcoal fire, and calcine them so as to stick together; then add to it one-half of Flux, No. 4. Both these blacks, if too soft, are hardened by adding a little black oxide of cobalt.

Black for shading and drawing under the Greens.

Take manganese	..	..	5
Royal smalt	..	..	1

ground fine in water, and calcined to a high degree of heat in a muffle.

A beautiful Black, for solid grounds or inlaying, but does not mix generally.

Take black oxide of copper	..	..	1
Flux, No. 4	..	..	2

Grind in water for use.

A Frit for transparent Greens.

Take flint powder	..	3	Red lead	..	..	7½	
Flux, No. 2	..	..	3	Raw borax	..	..	2½
Green pot-metal glass	1½		Green oxide of copper	1½			

Melt them in a crucible, pour out the mass, and pound it in an earthenware mortar.

Green.

Take of the green frit	..	..	..	3
Of yellow enamel colour made up as before directed	1½			
If too soft add Naples yellow.				
Grind in water for use.				

Another Green.

Take of green frit	..	..	..	5	Flux,
--------------------	----	----	----	---	-------

Flux, No. 2	..	..	..	$\frac{1}{2}$
Flux, No. 6	..	..	..	$2\frac{1}{2}$

Grind in water for use.

Greens in painting on enamel, are formed of various shades by mixing blue and yellow, or blue and orange, &c. in different proportions.

Blue.

Take of black oxide of cobalt	..	4
Flint powder	..	9
Nitre	..	13

Mix them well in an earthenware mortar, and heat them in the crucible, in a strong fire of coke and charcoal, till perfectly melted*; then pound the mass, wash it in cold water, and dry it.

Of this take	..	1
Flux, No. 5	..	1

Grind in water for use.

Another Blue.

Take black oxide of cobalt	..	1
Raw borax	..	1

Melt them together.

Of this mixture take	..	2
Blue pot-metal glass	..	10
Red lead	..	$\frac{1}{2}$

Melt them in a very strong fire. If either blue is too soft, add a little royal smalt; if too hard, a little flux made of blue glass 2, borax 1.

Purple.

Take fine-grained gold from the refiners, and dissolve it to saturation in an aqua regia made of strongest

Nitric acid	..	1
Muriatic acid	..	3
Distilled water	..	3

} by measure.

Make the solution in a clean Florence oil flask, placed on sand near the fire. Pour melted tin into cold water, and take of the clean parts of this tin

..	..	..	..	1
Aqua regia, diluted with water in the same proportion as above	..	..	..	4

Place the acid and the tin in a large bason covered with a plate, in a temperate heat; when the tin is all dissolved, add

Strong red fuming nitrous acid	..	1
Tin	..	1

And instantly cover the bason with the plate, to prevent the

* If these preparations are not sufficiently fluid in the melted state to pour out of the crucible, the colour will stick to a piece of steel bar when it is warm, and may be drawn out; and sometimes the blues are made in crucibles lined with flint powder as before mentioned.

fumes

fumes from escaping. After standing twenty-four hours, a little distilled water should be poured into the bason. The solution of tin may then be put into a clean phial for use, adding to it a few grains of tin; examine it after four or five days, when the solution, if carefully made, will be of a fine and clear dark colour, and fit to make the purple with. Then of the solution of gold take sufficient to colour distilled water of a faint straw yellow, and drop gradually into it the solution of tin, and a most beautiful purple precipitate will immediately be formed, which must be thrown as it is made into a large vessel, and two or three pieces of the melted tin should be put at the bottom.

Mix the solution of tin with that of the gold in this manner till the last added drops occasion no turbidness in the liquor; the precipitate is then to be washed in several hot waters, filtered on the blotting paper and canvass, and while in a moist and soft state, mixed with flux, No. 4, finely powdered.

The proportion of flux to the purple precipitate is always various, and is judged of by the mass being of a good rich and dark colour, as the ingredients are ground together on the plate glass. Care must be taken to grind this colour before it gets dry.

Twenty-four grains of gold made into a precipitate in this manner will take two ounces of flux, and this may be a rule to the inexperienced practitioner.

Rose Colour.

To a saturated solution of gold in aqua regia (containing twenty-four grains of gold), diluted with 100 times its bulk of warm distilled water, having 20 grains of alum* dissolved in it, add caustic ammonia drop by drop as long as any precipitate is thrown down, which wash in several hot waters.

To 24 grains of gold, precipitated in this manner, put

Flux, No. 4 2 oz.

Flux, No. 3 2 oz.

Mix them together wet, and grind them on a plate glass, adding, by a leaf at a time, sixteen leaves of leaf silver; when the whole is ground fine, let it be dried on the glass, scraped off, and put in a bottle for use.

This rose colour grinds of a gray or slate colour, but after being ground, if placed in a muffle and exposed to a gentle heat, it will turn to a red; but it is fit for use in either state.

If too yellow, add a little purple; and if too purple, add more leaf silver.

Another Rose Colour.

Take purple made as before directed .. 1 oz.

Flux, No. 3 4

Muriate of silver 10 gr.

* The rose colour is sometimes made without any alum.

The

The latter ingredient is prepared by dissolving silver in aqua-fortis, and precipitating it with common salt.

Grind in water for use; if too purple, add more muriate of silver.

Opake White.

Hartshorn shavings burnt in a crucible, in a charcoal fire, till perfectly white, 1

Flux, No. 1 1

Grind in water for use.

Venetian white cake enamel .. 1

Flux, No. 8 $\frac{1}{2}$

Grind in water, then calcine them together in a muffle.

Flux, No. 2, pounded and washed, then dried and calcined in a muffle.

It would not be difficult to exhibit a multitude of specimens of different tints, and fill a volume with descriptions of them, by combining these original enamel colours in various proportions: this, however, may safely be left to the taste and experience of the artist. My object has been to avoid every thing superfluous, and at the same time to explain the processes adapted to immediate practice in terms not liable to be mistaken.

Sir,—When I had the honour of explaining my Treatise on Enamel Colours to the gentlemen forming the Committee of Chemistry, I was requested by them to produce the method of *staining glass*, with a view of adding it as a second part to the Treatise on Enamel Colours.

I have inserted the most valuable information which I possess on this subject in the paper that accompanies this letter, and request that you will present it in my name to the Society of Arts. I am, sir,

Your most obedient humble servant,

No. 3, Taylors-Buildings, May 6, 1817.

ROBERT WYNN.

To A. Aikin, Esq. Sec.

The Art of staining Glass.

In *coloured glass*, the whole body of the material is tinged throughout by means of some colouring ingredient uniformly diffused through, or dissolved in, the substance of the glass.

In *enameling*, the colours, being ground up with an easily vitrifiable flux, are laid on the surface of metal, or porcelain, or glass, and are then exposed to such a degree of heat as shall just melt the enamel, and then fix it on the surface of the substance on which it has been applied.

In *staining glass*, the colouring ingredients are mixed with
water,

water, or some other fluid vehicle, by means of which they are spread over the surface of a plate of glass, and when dry, are exposed to such a degree of heat as by experience has been found to be sufficient. The colour is then rubbed off from the surface of the glass, to which it does not adhere, and those parts of the plate which have been thus covered are found to have acquired a permanent and transparent tinge or stain, doubtless from some particles of the colour having been absorbed, and fixed in the pores of the glass.

In all the compositions for staining glass, silver, in some form or other, enters as an essential ingredient; I shall therefore begin by describing the different preparations of silver that I make use of.

Take two or three ounces of pure nitric acid, dilute it with three times its bulk of distilled water, put it into a Florence flask, or any other convenient glass vessel, and add to it refined silver, by small pieces at a time, till the acid, though kept at a warm temperature, refuses to dissolve any more. After standing quiet for some hours, pour off the clear liquor into a clean ground stoppered phial, and label it Nitrate of silver.

Preparations of Silver.

No. 1. Dissolve common salt in water, and add nitrate of silver, drop by drop, till it ceases to occasion any precipitate; there will thus be obtained a heavy white curd-like substance, which must be well washed in hot water and dried; by exposure to light, it becomes of a dull purple colour. It is known by the name of muriate of silver, or *luna cornea*.

No. 2. Dissolve subcarbonate of soda in water, and add nitrate of silver, as above described. The white precipitate thus obtained, when washed and dried, is ready for use. It is called carbonate of silver.

No. 3. Dissolve subcarbonate of potash in water, and proceed precisely as directed for No. 2. The white powder thus obtained is also carbonate of silver.

No. 4. Dissolve phosphate of soda in water, and proceed as already mentioned. The precipitate thus obtained is of a yellow colour, and is called phosphate of silver.

No. 5. Take any quantity of pure silver rolled out into thin plates, and put it into a crucible, together with some sulphur. When the crucible has been a short time on the fire, the sulphur will first melt, and then will gradually burn away with a blue flame. When the flame has ceased, add some more sulphur, and proceed as before; then take the silver out, and heat it red in a muffle; it will now be white, and very brittle, and, after having been reduced to powder in a mortar, is fit for use.

No. 6. Take any quantity of a dilute solution of nitrate of silver, and put into it a stick of metallic tin, warm it a little, and

the silver will be precipitated in the form of metallic leaves on the surface of the tin. Scrape it off, wash it in warm water, dry it, and grind it in a mortar.

No. 7. Take any quantity of nitrate of silver, and put into it a piece of copper plate; then proceed precisely as in No. 6.

The foregoing preparations of silver mixed with other ingredients, in the proportions about to be described, compose all the varieties of pigment which are requisite for staining glass.

Yellow.

Take silver, No. 2	..	..	1	} parts.
Yellow lake	..	..	1	

Mix the ingredients, and grind them well with oil of turpentine mixed with the thick oil of turpentine; lay it on thin.

Take silver, No. 1	..	..	..	1	} parts.
White clay, precipitated from a solution of alum by subcarbonate of soda	..	..	..	3	
Oxalate of iron, prepared by precipitating a clear solution of sulphate of iron by oxalate of potash	..	..	..	3	
Oxide of zinc	..	..	..	2	
	..	..	..	2	

Let the silver be ground first in water with the oxide of zinc, and then with the other ingredients. This is intended for floating on thick.

Take silver, No. 3	..	1	} parts.
Yellow lake	..	1	

Grind them in spirit of turpentine and oil, and lay the mixture on very thin.

Take silver, No. 4	..	1	} parts.
Yellow lake	..	1	
White clay	..	$\frac{1}{2}$	

Grind them in spirit of turpentine and oil, and lay the mixture on thin.

Orange.

Take silver, No. 6	..	..	..	1	} parts.
Venetian red and yellow ochre, equal parts,	..	..	..	2	
washed in water, and calcined red	..	..	..	2	

Grind the ingredients in spirit of turpentine, with thick oil of ditto, and lay the mixture on thin.

Take silver, No. 7	..	..	..	1	} parts.
Venetian red and yellow ochre	..	..	..	1	

Grind in turpentine and oil, &c. as the foregoing. If entire panes of glass are to be tinged orange, the proportion of ochre may be greatly increased. The depth of the tinge depends in some measure on the heat of the furnace, and on the time that the glass is exposed to it, which, though easily learned by experience, cannot be made the object of precise rules.

Take

Red.

Take silver, No. 5, 1
 Brown oxide of iron prepared by heating
 scales of iron, then quenching them in water,
 reducing them to a fine powder, and lastly
 calcining it in a muffle 1 } parts.

Grind the ingredients with turpentine and oil, and lay the mixture on thick.

Take of antimonial silver, prepared by melting
 together one part of silver, and two ditto of
 crude antimony, and pulverising the mass 1 } parts.
 Colcothar 1 }

Grind the ingredients in turpentine and oil, and lay the mixture on thick.

Take antimonial silver, prepared as above, .. 1 }
 Venetian red, and yellow ochre, of each .. 1 } parts.
 Grind, &c. as before mentioned.

When whole panes of glass are to be tinged, the proportions of ochre or of colcothar may be much increased, and the ingredients should be ground in water.

Of laying on the Colour.

The method practised by most stainers of glass is to draw the outline in Indian ink, or in a brown colour, ground with turpentine and oil, and then to float on the colour thick, having previously ground it with water. But in this way of proceeding it is very subject either to flow over or to come short of the outline, and thus render the skill of the draftsman of little effect.

My method is to draw the pattern in Indian ink, and having ground the colour as fine as possible in spirits of turpentine, brought to a proper consistence with thick oil of turpentine, to add a little oil of spike lavender, and to cover the outline entirely with this composition.

When it has become dry, I work out the colour with the point of a stick and a knife from those parts that are not intended to be stained, and am thus enabled to execute the most delicate ornaments and most intricate designs, with exactness and precision.

If the colour is required to be laid on so thick that the outline would not be visible through it, let the colour be first laid on as smoothly as possible, and when it has become dry draw the outline upon it with vermilion water-colour, and work out the design as before.

Besides the precision acquired by the above method, it enables the artist to apply different shades in the same design; whereas the old method of floating only communicates an uniform tint to the whole pattern.

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The artist should contrive to charge his furnace with pieces the colour of which is ground in the same vehicle, and not to mix in the same burning some colours ground in turpentine and others ground in water. The pieces must also be very carefully dried, and must be placed in the furnace when this latter is moderately warm.

To gild Glass.

Take of fine gold in grains 1 } parts.
 of pure mercury 8 }

Warm the mercury and then add the gold, previously making it red hot. When the gold is perfectly dissolved, pour the mixture into cold water and wash it well. Then press out the superfluous mercury through linen or soft leather, and the mercury which runs through (as it retains some gold) should be reserved for the next opportunity.

The amalgam which remains in the leather is to be digested in warm aquafortis, which will take up the mercury, but will leave the gold in the form of an extremely fine powder. This powder, when washed and dried, must be rubbed up with one-third of its weight of mercury; then mix one grain of this amalgam with three grains of gold flux (see the former part of this paper, p. 271), which is to be applied in the usual manner.

*. * In the foregoing communication borax is mentioned as an ingredient in the composition of the fluxes. It does give them very easy fusion, but we should fail in our duty did we neglect to caution artists against a profuse use of this flux. It can hardly be employed in any quantity whatever without danger to the durability of the work; having a great tendency to effloresce in the atmosphere. Indeed this can hardly, if at all, be prevented where borax enters into the composition of colours used for painting on glass.—EDIT.

XLVI. *On the Resilience of Materials; with Experiments.* By
 Mr. THOMAS TREDGOLD.

To Mr. Tilloch.

SIR,—PREVIOUS to making the experiments on the resilience of timber, the results of which are given in your Number for last month*, I had endeavoured to anticipate the results by the usual mode of calculation, and proceeded to make some rough essays, in order to try the apparatus and prepare for more correct experiments; as it was desirable to let the weight fall from a height that would only just produce fracture, without having to make successive trials, which always weaken the pieces considerably.

In these trials I soon discovered that the calculations I had made would be of no use to me whatever, although I had to-

* Phil. Mag. vol. li. p. 216.

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